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Written Section – 230 Questions

**Referenced Answers – 85 Pages**

***This examination is meant to be used as a study tool when preparing for the ACLAM or ECLAM Certifying Examinations. The material presented in this mock examination follows the ACLAM role delineation document, but is not necessarily reflective of the ACLAM or ECLAM Certifying Examinations.***

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**1.** Which two subfamilies of new world monkeys possess a prehensile tail with a tactile pad?

1. Cebinae and Pithecinae
2. Aotinae and Callicebinae
3. Alouattinae and Atelinae
4. Cercopithecine and Colobinae

**Answer: c. Alouattinae and Atelinae**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 4 – Functional Morphology, pp. 105-106.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 775, 777.

**Domain 1; Tertiary Species - Other Nonhuman Primates**

**2.** Which of the following is a drawback to the use of bispectral index (BIS) for anesthetic depth monitoring of laboratory animals?

1. Algorithms used to compare BIS are based on human data
2. It is an invasive procedure

 c. There is no data to support its use in common laboratory animals

 d. It can only be used for injectable anesthetic regimens

**Answer: a. Algorithms used to compare BIS are based on human data**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, pp. 1184-1185.
2. Jaber et al. 2015. Comparison of heart rate and blood pressure with toe pinch and bispectral index for monitoring the depth of anesthesia in piglets. JAALAS 54(5):536-544.

**Domain 2**

**3.** What stock of rats has been reported to have a high incidence of seizures and has been used in investigation of audiogenic seizures?

a. Albany

b. Wistar

c. Sprague-Dawley

d. Holtzman

e. Long-Evans

**Answer: b. Wistar**

**References:**

1)Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, pp. 152, 193-194.

2) Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 15 – Metabolic, Traumatic, and Miscellaneous Diseases, pp. 534-535.

**Domain 3; Primary Species – Rat (*Rattus norvegicus*)**

**4.** Which of the following statements best describes environmental enrichment strategies for adult zebrafish?

1. Environmental enrichment strategies in zebrafish should not include artificial material
2. Environmental enrichment strategies for zebrafish are well established in the literature
3. Environmental enrichment strategies should elicit species specific behavior
4. Environmental enrichment strategies should only be used for group housed zebrafish
5. Environmental enrichment strategies should only be used for juvenile zebrafish

**Answer: c. Environmental enrichment strategies should elicit species specific behavior**

**References:**

1. Collymore et al. 2015. The behavioral effects of single housing and environmental enrichment on adult zebrafish (*Danio rerio*). JAALAS 54(3):280-285.
2. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 3 – Environment, Housing, and Management, pp. 82-83.
3. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of the Zebrafish, p. 1023.

**Domain 4; Secondary Species – Zebrafish (*Danio rerio)***

**5.** Puppies under \_\_\_\_\_ months of age may not be housed in the same primary enclosure with adult dogs, other than the dam or foster dam, except when permanently maintained in breeding colonies?

* 1. 4
	2. 5
	3. 6
	4. 3

**Answer: a. 4**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.6 (b)(2) Primary enclosures (11-6-13 Edition, p. 65)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Primary Species – Dog (*Canis familiaris*)**

**6.** Which of the following organizations has recently used “The Identity Campaign” as a fund raiser which “adopts” animals to donors and provides information to the donor on how to obtain additional information on their “adopted” pet from the institution through an open records request?

a.   Beagle Freedom Project

b.   Beagle Rescue League

c. Humane Society of the United States

d.   National Biomedical Research Association

e. People for the Ethical Treatment of Animals

**Answer: a. Beagle Freedom Project**

**Reference:**  http://www.identitycampaign.org/

**Domain 6**

**7.** Guinea pigs are highly susceptible to an infection associated with high mortality, acute death, reproductive disorders, as well as lung and liver lesions with which of the following bacterial organisms?

1. *Brachyspira hyodysenteriae*
2. *Chlamydophilia caviae*
3. *Leptospira spp.*
4. *Listeria monocytogenes*

**Answer: d. *Listeria monocytogenes***

**References:**

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section III - Guinea Pigs, Chapter 23 – Infectious Diseases, pp. 652-653 656-657,
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 5 – Guinea Pig, p. 228.

**Domain 1; Secondary Species – Guinea Pig (*Cavia porcellus*)**

**8.** At what temperature will hibernation occur in *Cricetus cricetus*?

1. 3°C
2. 5°C
3. 8°C
4. 10°C

**Answer: b. 5°C**

**References:**

1. Fox JG LC, Anderson, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Disease of Hamsters, p. 215.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section IV - Hamsters, Chapter 36 – European Hamster, p. 931

**Domain 3; Tertiary Species – Other Rodents**

1. All other things being equal, which of the following caging conditions for mice would have the highest ammonia level?
	1. Static microisolator, 70% relative humidity, corncob bedding
	2. Static microisolator, 70% relative humidity, wood pulp bedding
	3. Static microisolator, 30% relative humidity, corncob bedding
	4. Individually ventilated microisolator, 70% relative humidity, wood pulp bedding
	5. Individually ventilated microisolator,30% relative humidity, corncob bedding

**Answer: b Static microisolator, 70% relative humidity, wood pulp bedding**

**References:**

1. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 3 – Environment, Housing, and Management, pp. 45, 71.
2. Silverman et al. 2008. Ammonia and carbon dioxide concentrations in disposable and reusable ventilated mouse cages. JAALAS 47(2):57-62.
3. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 9 – Design and Management of Research Facilities for Mice, p. 293.
4. Ferrecchia et al. 2014. Intracage ammonia levels in static and individually ventilated cages housing C57BL/6 mice on 4 bedding substrates. JAALAS 53(2):146-151

**Domain 4; Primary Species - Mouse (*Mus musculus*)**

**10.** Theft or “significant loss” of controlled substances requires immediate reporting to the DEA upon discovery of the loss or theft within how many hours?

a. 24 hours

b. 48 hours

c. 1 business day

d. 1 week

**Answer: c. 1 business day**

**References:**

1. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 25 – Regulatory Issues, p. 575.
2. Controlled Substances Act, USC Title 21, Section 831, Subchapter I – Control and Enforcement, Part C – Registration of Manufacturers, Distributors, and Dispensers of Controlled Substances. §813 Additional requirements relating to online pharmacies and telemedicine.
3. Title 21 Code of Federal Regulations, Part 1301 — Registration Of Manufacturers, Distributors, And Dispensers Of Controlled Substances; Security Requirements, §1301.76 (b) Other security controls for practitioners.

**Domain 5**

**11.** Your facility supports an antibody producing herd of goats. Every winter the care staff notice alopecia and flaking of the lower limbs and tails of several animals. They also show signs of pruritus. What is the most likely diagnosis?

a. *Demodex*

b. *Chorioptes*

c. *Sarcoptes*

d. *Psoroptes*

**Answer: b. *Chorioptes***

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 15 – Biology and Diseases of Ruminants, pp. 676-677

**Domain 1; Secondary Species – Goat (*Capra hircus*)**

**12.** Which of the following statements best describes porcine stress syndrome?

1. Only identified in miniature pig breeds
2. Triggered by dantrolene administration
3. Associated with a mutation in the calcium-release channel protein (ryanodine receptor)
4. Caused by excess dietary selenium

**Answer: c. Associated with a mutation in the calcium-release channel protein (ryanodine receptor)**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, pp. 752-753
2. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 15 – Amesthesia and Analgesia in Swine. p. 425

**Domain 2; Primary Species – Pig (*Sus scrofa domestica)***

**13.** Which of the following is another name for the Ommaya reservoir?

1. Cardiovascular reserve capacity
2. Cisternal pressure decompressor
3. Hepatocellular regeneration capacity
4. Lateral port model
5. Ventricular perfusion catheter

**Answer: d. Lateral port model**

**Reference:** McCully et al. 2015. Development of a cerebrospinal fluid lateral reservoir model in rhesus monkeys (*Macaca mulatta*). Comparative Medicine 65(1):77-82.

**Domain 3**

**14.** Which term best describes the measures taken to detect, prevent, contain, and eradicate adventitious infections?

1. Barrier
2. Biosecurity
3. Quarantine
4. Sentinel Program
5. Stabilization

**Answer: b. Biosecurity**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities, pp. 1543-1544.
2. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 4 – Veterinary Care, p. 109.

**Domain 4**

**15.** According to the Animal Welfare Act and its regulations, how often must dogs less than 16 weeks of age be offered potable water, starting from the time the dog was last offered potable water before transportation was begun?

1. At least once every 6 hours
2. At least once every 12 hours
3. At least once every 24 hours
4. Ad libitum

**Answer: b. At least once every** **12 hours**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.16 (a) Food and water requirements (11-6-13 Edition, p. 73)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Primary Species – Dog (*Canis familiaris*)**

**16.** Which of the following viruses has been shown to naturally infect African green monkeys but when transmitted to rhesus macaques can cause a fulminant and fatal infection?

1. African green monkey polyomavirus
2. Macacine herpesvirus 1
3. Simian hemorrhagic fever virus
4. Yaba monkey tumor virus

**Answer: c. Simian hemorrhagic fever virus**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 6-9, 33, 47-48
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 864-866, 869-875 and Chapter 26 – Selected Zoonoses, p. 1316.

**Domain 1; Primary Species – Macaques (*Macaca spp.*) and Tertiary Species – Other Nonhuman Primates**

**17.** In a recent study, chimpanzees were trained to urinate into a collection device. Trainers offered a food reward to chimpanzees that showed a fear response to the collection device. What of the following terms best describes this type of training?

a. Classical conditioning

b. Counter-conditioning

c. Negative-reinforcement training

d. Operant conditioning

e. Positive-reinforcement training

**Answer: b. Counter conditioning**

**References:**

1. Bloomsmith et al. 2015. Positive reinforcement methods to train chimpanzees to cooperate with urine collection. JAALAS 54(1):66-69.
2. McMillan et al. 2014. Refining the pole-and-collar method of restraint: emphasizing the use of positive training techniques with rhesus macaques (*Macaca mulatta*). JAALAS53(1):61-68.

**Domain 3; Tertiary Species – Other Nonhuman Primates**

**18.** Which of the following best describes peracetic acid?

a. High temperature sterilant

b. Created with a mechanical generator

c. Sporicidal in both liquid and vapor phase

d. Ineffective at killing organisms suspended in the air

**Answer: c. Sporicidal in both liquid and vapor phase**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1585

**Domain 4**

 **19.** According to the Animal Welfare Act and its regulations, which of the following statements best describes housing requirements for *Oryctolagus cuniculus*?

* 1. Primary enclosures for rabbits must be sanitized once every 14 days
	2. Litter pans or troughs underneath wire/mesh floored enclosures must be cleaned twice per week
	3. Minimum height of all enclosures is at least 16 inches
	4. Indoor housing facilities need not be heated
	5. Shelter be provided in outdoor housing facilities when ambient temperature is less than 45ºF

**Answer d. Indoor housing facilities need not be heated**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart C – Specifications for the Humane Handling, Care, Treatment, and Transportation of Rabbits, §3.51 (a) – Facilities, indoor (11-6-13 Edition, p. 85); §3.52 (c) - Facilities, outdoor (11-6-13 Edition, p. 86); §3.53 (c)(2) - Primary enclosures (11-6-13 Edition, p. 87); and §3.56 (a)(3)(b) Sanitation of enclosures (11-6-13 Edition, pp. 87-88)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Primary Species - Rabbit (*Oryctolagus cuniculus*)**

**20.** Which of the following statements best describes basophils in murine peripheral blood?

* 1. Most common leukocyte, contain lobulated nuclei and easily differentiated from mast cells
	2. Most common leukocyte, contain ovoid nuclei and are difficult to differentiate from mast cells
	3. Least common leukocyte, contain lobulated nuclei and are difficult to differentiate from mast cells
	4. Least common leukocyte, contain lobulated nuclei are easily differentiated from mast cells
	5. Least common leukocyte, contain ovoid nuclei and are difficult to differentiate from mast cells

**Answer: c. Least common leukocyte, contain lobulated nuclei and are difficult to differentiate from mast cells**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 5 – Hematology of the Laboratory Mouse, p. 150.
2. O’Connell et al. 2015. Practical murine hematopathology: a comparative review and implications for research. Comparative Medicine 65(2):96-113.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

1. Which of the following euthanasia agents is commonly used by neuroscientists to fix brain chemicals and metabolites *in vivo* while maintaining the brain’s anatomic integrity?

* 1. Argon
	2. CO2
	3. Decapitation
	4. Inhalant anesthesia
	5. Microwave irradiation

**Answer: e. Microwave irradiation**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 33 – Factors That Can Influence Animal Research, p. 1460
2. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 20-26, 38-39, 41

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

**Domain 2**

**22.** Which of the following sections is no longer required for the Vertebrate Animal Section of an NIH application?

a. Description of animals and how they will be used

b. Justifications for using animals

c. Veterinary care

d. Provisions to minimization of pain and distress

e. Euthanasia

**Answer: c. Veterinary care**

**Reference:**  http://grants.nih.gov/grants/olaw/vaschecklist.pdf

**Domain 3**

**23.** Which identification method has been associated with fibrosarcomas in various animal species?

1. Ear tagging
2. Ear punching
3. Fur coloring
4. Microchipping
5. Toe clipping

**Answer: d. Microchipping**

**Reference:**

1. Sura et al. 2011. Neoplasia and granulomas surrounding microchip transponders in Damaraland mole rats (*Cryptomys damarensis*). Vet Pathol 48:896-902.
2. Vascellari et al. 2006. Fibrosarcoma with typical features of postinjection sarcoma at site of microchip implant in a dog: histologic and immunohistochemical study. Vet Pathol 43:545-548.

**Domain 4**

**24.** All of the following applies to importation of nonhuman primates into the United States **EXCEPT**?

1. Importer must quarantine all NHPs for at least 31 days after arrival at a U.S. quarantine facility
2. Three tuberculin tests are required for all imported NHPs
3. Importers must notify CDC within 24 hours of any illness or death of NHPs in quarantine facilities
4. Importers must notify CDC at least 7 days before importing a shipment of NHPs
5. Importers must contact CDC within 72 hours to report any suspected zoonotic illness in an employee

**Answer: e. Importers must contact CDC within 72 hours to report any suspected zoonotic illness in an employee**

**References:**

1. Importations, CFR, Title 42, Chapter I, Subchapter F, Part 17 Subchapter F §71.53 Nonhuman primates.

http://www.cdc.gov/importation/laws-and-regulations/nonhuman-primates/nprm/qa-importers.html#table-quarantined

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations and Policies Relating to the Care and Use of Nonhuman Primates, pp. 50-51

**Domain 5; Primary Species - Macaques (*Macaca* *spp.*)**

**25.** For the “Experience Option” path to ACLAM board eligibility, a candidate may qualify to take the certifying examination after how many years of relevant, full-time experience in laboratory animal medicine following receipt of a veterinary medical degree?

* 1. 2
	2. 3
	3. 4
	4. 5
	5. 6

**Answer: e. 6**

**References:**

1. https://www.aclam.org/certification/requirements
2. https://www.aclam.org/certification/application-and-study-tools
3. ACLAM Examination Application Instructions and Forms (10/21/2015 version), p. 25

**Domain 6**

**26.** What is the primary target for K virus in affected tissue of mice?

a. Adipocyte

b. Alveolar epithelium

c. Mesenchymal cell

d. Smooth muscle cell

e. Vascular endothelium

**Answer: e. Vascular endothelium**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, p. 83.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 23-24.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**27.** Which of the following imaging modalities is the leading noninvasive technique for characterizing the structure and function of the irregularly shaped right ventricle in mice?

1. Magnetic resonance imaging
2. Micro-computed tomography
3. Positron emission tomography
4. Ultrasound

**Answer: a. Magnetic resonance imaging**

**References:**

1. Johnson. 2008. Introduction to rodent cardiac imaging. ILAR J 49 (1):27-34 (p. 33)
2. Amundsen et al. 2011. A comparison of retrospectively self-gated magnetic resonance imaging and high-frequency echocardiography for characterization of left ventricular function in mice. Laboratory Animals 45(1): 31–37.

**Domain 3; Primary Species – Mouse *(Mus musculus)***

**28.** All of the following are a commonly recommended identification methods for *Xenopus laevis* maintained in the laboratory **EXCEPT**?

1. Elastomere implants
2. Group identification by cage card
3. Photographs of skin patterns
4. Sterile transponder implants
5. Toe cutting

**Answer: e. Toe cutting**

**References:**

1. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 3 - Environment Housing and Management, p. 87.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 18 - Biology and Diseases of Amphibians, pp. 937-938.
3. Green SL. 2010. The Laboratory Xenopus, 1st ed. CRC Press: Boca Raton, FL. Chapter 2 - Husbandry, p. 56.

**Domain 4; Secondary Species – African Clawed Frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**29.** Tramadol is classified as which of the following controlled substance schedules?

1. I
2. II
3. III
4. IV

e. Non-controlled substance

**Answer: d. IV**

**References:**

1. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 25 – Regulatory Issues, p. 574 (Table 25-1)
2. http://www.deadiversion.usdoj.gov/schedules/index.html
3. https://www.nabp.net/news/dea-classifies-tramadol-a-controlled-substance
4. http://www.deadiversion.usdoj.gov/fed\_regs/rules/2014/fr0702.htm

**Domain 5**

**30.** In macaques, retroperitoneal fibromatosis is associated with infection with which virus?

a. Simian virus 40

b. Simian cytomegalovirus

c. Simian retrovirus type 2

d. Simian varicella virus

e. Simian immunodeficiency virus

**Answer: c. Simian retrovirus type 2**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 13 – Arthritis, Muscle, Adipose Tissue, and Bone Diseases of Nonhuman Primates, pp. 652-653.
2. Bailey and Mansfield. 2010. Emerging and reemerging infectious diseases of nonhuman primates in the laboratory setting. Vet Pathol 47:462-481.

**Domain 1; Primary Species – Macaques (*Macaca spp.*)**

**31.** Which of the following **IS NOT** considered a safe and effective anesthetic in the Syrian hamster (*Mesocricetus auratus*) due to its significant side effects and development of intra-abdominal adhesions?

1. Chloral hydrate
2. Ketamine
3. Xylazine
4. Telazol

**Answer: a. Chloral hydrate**

**Reference:** Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 10 – Anesthesia and Analgesia for Laboratory Rodents, pp. 280-281.

**Domain 2; Secondary Species – Syrian Hamster (*Mesocricetus auratus*)**

**32.** Euthanasia by rapid chilling (hypothermic shock) may be performed in all of the following adult species **EXCEPT**?

1. *Danio rerio*
2. *Oncorhynchus mykiss*
3. *Nematolosa erebi*
4. *Oryzias latipes*

**Answer: b. *Oncorhynchus mykiss***

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 73

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

1. Matthews and Varga, 2012.Anesthesia and euthanasia in zebrafish. ILAR J 53(2):192-204

**Domain 3; Tertiary Species – Other Fish**

**33.** Which of the following is most resistant to germicidal chemicals or disinfectants?

1. *Pseudomonas aeruginosa*
2. Herpes simplex virus
3. Enterococci
4. Poliovirus
5. *Bacillus subtillis* endospores

**Answer: e. *Bacillus subtillis* endospores**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Appendix B - Decontamination and Disinfection**,** pp. 326-335.

(http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5\_appendixB.pdf)

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 11 - Microbiological Quality Control for Laboratory Rodents and Lagomorphs, pp. 474-475.

**Domain 4**

**34.** Which institutions are required to appoint a biological safety officer?

1. Every institution that works with biological hazards requires a biological safety officer
2. Institutions that engage in large-scale research or production activities involving viable organisms containing recombinant DNA molecules
3. Institutions that engage in recombinant DNA research at BSL 2 or higher regardless of program scale
4. Any institution utilizing recombinant DNA molecules in research

**Answer: b. Institutions that engage in large-scale research or production activities involving viable organisms containing recombinant DNA molecules**

**Reference:** NIH Guidelines for Research Involving Recombinant of Synthetic Nucleic Acid Molecules, November 2013. National Institutes of Health. Section IV-B-3 – Biological Safety Officer, p. 28. (http://osp.od.nih.gov/sites/default/files/NIH\_Guidelines\_0.pdf)

**Domain 5**

**35.** Polycystic disease in aged Syrian hamsters most commonly presents in which organ?

1. Kidney
2. Liver
3. Lung
4. Spleen
5. Testes

**Answer: b. Liver**

**References:**

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section IV – Hamsters, Chapter 33 – Genetic, Traumatic, Environmental and Other Non-Infectious Diseases, p. 870.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 3 - Hamster, p. 203.

**Domain 1; Secondary Species – Syrian Hamster (*Mesocricetus auratus*)**

**36.** Imaging with PET and SPECT involves the use of which of the following?

a. Radioactive tracers such as F-2-deoxy-2-fluoro-D-glucose

b. Para magnetic agents such as gadolinium

c. High frequency ultrasonic vibrations

d. Bioluminescent proteins such as luciferase

**Answer: a. Radioactive tracers such as F-2-deoxy-2-fluoro-D-glucose**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 25 – Techniques in Experimentation, pp. 1244-1245.

2) Koba et al. 2013. MicroPET/SPECT/CE imaging of small animal models of disease. Am J Pathol 182(2):319-324.

**Domain 3**

**37.** Which of the following is a recommended characteristic of diets fed to ferrets in the laboratory?

1. High in complex carbohydrates
2. High in fiber and dietary fat
3. High in fish products
4. High in protein and dietary fat

**Answer: d. High in protein and dietary fat**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 14 - Biology and Diseases of Ferrets, pp. 583-584.
2. Quesenberry KE, Carpenter JW, Eds. 2012. Ferrets, Rabbits, and rodents: Clinical Medicine and Surgery. Elsevier: St. Louis, MO. Chapter 1 - Basic Anatomy, Physiology, and Husbandry, pp. 10-11.

**Domain 4; Secondary Species – Ferret (*Mustela putorious furo*)**

**38.** Which of the following amendments to the Animal Welfare Act mandated institutional environmental enhancement plans for nonhuman primates?

1. 1970: Expands the list of animals covered by the Act
2. 1985: Improved Standards for Laboratory Animals Act
3. 1976: Traveling, carrier and animal fighting amendments
4. 1990: Protection of Pets

**Answer: b. 1985: Improved Standards for Laboratory Animals Act**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 24-25.

**Domain 5**

**39.** Which of the following statements best describes hyperacute rejection in xenotransplantation from animal to human partially driven by natural antibodies that recognize the sugar moiety α-1,3 Gal?

1. α-1,3 Gal is present in pigs, humans and NHP only
2. α-1,3 Gal is present in most mammals but not in humans and old world monkeys
3. The development of the Gal-knockout pig has completely resolved rejection associated with pig to NHP xenografts
4. α-1,3 Gal is not associated with rejection in xenotransplantation
5. α-1,3 Gal is the major factor involved in chronic rejection of NHP to human xenografts

**Answer b: α-1,3 Gal is present in most mammals but not in humans and old world monkeys**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, p. 707

**Domain 1; Primary Species - Pig (*Sus scrofa*)**

**40.** What standard is recommended by ILAR to minimize animal distress in the production of monoclonal antibody when using the ascites method in mice?

a. Limit pristane priming to less than or equal to 0.2 ml IP

b. The animal must be observed twice daily

c. Anesthesia must be used during needle harvest of ascites fluid

d. Saline must be administered post-harvest of ascites fluid

e. The animal should be euthanized if hunched posture and roughened coat is observed

**Answer: e. The animal should be euthanized if hunched posture is observed**

**Reference:** ILAR Committee on Methods for Producing Monoclonal Antibodies.1999. Monoclonal Antibody Production. National Academy Press, Washington DC. p. 43.

**Domain 2; Primary Species – Mice (*Mus musculus*)**

**41.** Cerebrospinal fluid collection in rabbits is performed by which of the following approaches?

1. CSF obtained following surgical exposure of the atlanto-occipital region of the spine
2. Catheterization of the subdural space in the T1-T4 location
3. Needle inserted ~2 mm caudal to the external occipital protuberance
4. Catheters percutaneously inserted into the subdural space in the L7-S1 location
5. None of the above

**Answer: c. Needle inserted ~2 mm caudal to the external occipital protuberance**

**References**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 25 - Techniques of Experimentation, pp. 1240-1242.
2. Harkness JE, Turner PV, VandeWoude S, Wheler CL. 2010. Harkness and Wagner’s Biology and Medicine of Rabbits and Rodents, 5th ed. Wiley-Blackwell: Ames, IA. Chapter 3 – Clinical Procedures, p.116.

**Domain 3; Primary Species - Rabbits (*Oryctolagus cuniculus*)**

**42.** Which of the following species require a dietary source of vitamin D3 and ascorbic acid?

1. *Callithrix jacchus*
2. *Colobus angolensis*

c. *Hylobates lar*

d. *Macaca mulatta*

e. *Presbytis cristata*

**Answer: a. *Callithrix jacchus***

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 782.

2) Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 10 – Nutrient Requirements and Dietary Husbandry Principles for Captive Nonhuman Primates, pp. 278-279.

**Domain 4; Secondary Species – Marmoset/Tamarins (Callitrichidae)**

**43.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act and its regulations, the floor space requirement for guinea pigs in the United States is \_\_\_\_\_\_ in2 for animals weighing 350 g or less and \_\_\_\_\_\_ in2 for animals weighing more than 350 g?

1. 50 and 100
2. 75 and 151
3. 60 and 101
4. 71 and 111

**Answer: c. 60 and 101**

**References:**

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, p. 57.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart B – Specifications for the Humane Handling, Care, Treatment, and Transportation of Guinea Pigs and Hamsters, §3.28 Primary enclosures, (c)(1)(iii) (Edition, p. 77)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press/Elsevier: San Diego, CA. Section III – Guinea Pigs, Chapter 21 – Management, Husbandry, and Colony Health, p. 608.

**Domain 5; Secondary Species – Guinea pigs (*Cavia porcellus*)**

**44.** Which of the following viruses causes clinical disease in preweanling rats?

a. Pneumonia virus of mice

b. Rat parvovirus

c. Rat respiratory virus

d. Rat theilovirus

**Answer: b. Rat parvovirus**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, pp. 179-181.
2. Geletneky et al. 2015. Pathology, organ distribution, and immune response after single and repeated intravenous infection of rats with clinical-grade parvovirus H1. Comparative Medicine 65(1):23-35.
3. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 - Rat, pp. 127-129, 133-134,
4. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 12 – Viral Disease, pp. 426-434, 443-444.

**Domain 1; Primary Species – Rat (*Rattus norvegicus*)**

**45.** Which of the following mouse strains exhibit accumulation of *Coxiella burnetti* in the placenta, abortion, stillbirth, perinatal death, and endocarditis when infected with organism?

1. AKR/J
2. DBA/2J
3. BALB/c
4. SEC/ReJ
5. C3H/HeN

**Answer: c. BALB/c**

**Reference:** Bewley. 2014 Animal models of Q fever (*Coxiella burnetti*). Comparative Medicine. 63(6):469-476.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**46.** Which of the following best describes husbandry for the gerbil (*Meriones unguiculatus*)?

a. Gerbils produce large amounts of urine and feces and therefore need more frequent cleaning than other laboratory rodents

b. Gerbils thrive on commercial rodent diets but develop high blood cholesterol on diets containing more than 4% fat

c. Gerbils are desert dwelling rodents; therefore *The Guide* recommends housing them at a dry- bulb temperature of 79-85ºF

d. Gerbils develop nasal dermatitis if the relative humidity is maintained below 50%

**Answer: b. Gerbils thrive on commercial rodent diets but develop high blood cholesterol on diets containing more than 4% fat**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, pp. 317-318.

2) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing and Management, p. 44.

3) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section VI – Other Rodents, Chapter 52 – Gerbils, pp. 1138-1140

**Domain 4; Secondary Species – Gerbil (*Meriones spp.*)**

**47.** According tothe Public Health Service Policy on Humane Care and Use of Laboratory Animals, which of the following applies to an IACUC?

* 1. There can be no more than 3 members from the same administrative unit of the institution
	2. A suspension can only be approved by a majority vote of the quorum present at a convened meeting
	3. The CEO and IO cannot be the same individual
	4. Significant deficiencies remaining uncorrected beyond the scheduled correction date shall be reported in writing within 15 business days to OLAW

**Answer: b. A suspension can only be approved by a majority vote of the quorum present at a convened meeting.**

**References:**

1. Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals, p. 11 (http://grants.nih.gov/grants/OLAW/references/PHSPolicyLabAnimals.pdf)
2. Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. A.2. Authority, Composition and Functions, pp. 15-16.

(http://grants.nih.gov/grants/olaw/guidebook.pdf)

**Domain 5**

**48.** Which statement best describes differences between mouse and human hematological characteristics?

1. Mice have significantly larger neutrophils than humans
2. Mice have significantly larger erythrocytes than humans
3. Mice have physiologic splenic hematopoiesis and iron storage
4. Mice do not have physiologic splenic hematopoiesis and iron storage
5. Mice have the ability to perform renal erythropoiesis

**Answer: c. Mice have physiologic splenic hematopoiesis and iron storage**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 5 - Mouse Hematology, pp. 148-149, 161, 163.
2. O’Connell et al. 2015. Practical murine hematopathology: a comparative review and implications for research. Comparative Medicine 65(2):96-113.

**Domain 1; Primary Species - Mouse (*Mus musculus*)**

**49.** According to Good Laboratory Practice for conducting nonclinical laboratory studies, which of the following best describes what a sponsor is?

1. Any person or organizational element, except the study director, designated by testing facility management to perform the duties relating to quality assurance of nonclinical laboratory studies.
2. Individual responsible for the overall conduct of a nonclinical laboratory study
3. Person who submits a nonclinical study to the Food and Drug Administration in support of an application for a research or marketing permit
4. Test site manager who supports the study by provision of financial or other resources

**Answer: c. Person who submits a nonclinical study to the Food and Drug Administration in support of an application for a research or marketing permit**

**Reference:** 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A – General Provisions, § 58.3 Definitions

http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=58.3

**Domain 5**

**50.** IL-10-/- mice are a commonly used as a model for which of the following diseases?

1. Alzheimer’s
2. Arthritis
3. Autoimmune cardiomyopathy
4. Diabetes
5. Inflammatory bowel disease

**Answer: e. Inflammatory bowel disease**

1. Hsu et al. 2014. Infection with murine norovirus 4 does not alter Helicobacter-induced inflammatory bowel disease in IL10-/- mice. Comp Med 64(4):256-263.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 17 – Helicobacter Infections in Mice, p. 423.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**51.** Which of the following nonhuman primate species is monogamous?

1. *Aotus lemurinus*
2. *Callithrix jacchus*
3. *Pan paniscus*
4. *Papio anubis*
5. *Saimiri boliviensis*

**Answer: a. *Aotus lemurinus***

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 - Nonhuman Primates, pp. 683, 686, 694, 706, 713.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 8 – Reproduction and Breeding of Nonhuman Primates, pp. 215-218
3. Bardi et al. 2014. Parity modifies endocrine hormones in urine and problem-solving strategies of captive owl monkeys *(Aotus spp.)*. Comparative Medicine 64(6):486-495

**Domain 4; Tertiary Species - Other Nonhuman Primates**

**52.** All of the following practices are required when working with a laboratory adapted LCMV strain being used in a rodent model **EXCEPT**?

1. Availability of an autoclave
2. Biohazard warning signs posted
3. Decontamination of clothing before laundering
4. Decontamination of infected wastes before cage wash
5. Hand washing sink available in room

**Answer: c. Decontamination of clothing before laundering**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Section IV – Laboratory Biosafety Level Criteria, p. 59.

(http://www.cdc.gov/biosafety/publications/bmbl5/bmbl5\_sect\_iv.pdf).

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Working Safely with Experimental Animals Exposed to Biohazards, pp. 1301-1304.

**Domain 5**

**53.** Drugs metabolized by the kidney and liver should be injected into the epaxial muscles of the cranial half of the body in \_\_\_\_\_\_\_\_\_\_ or the muscles of the front legs in \_\_\_\_\_\_\_\_\_\_.

1. Chelonians; snakes
2. Crocodilians; lizards
3. Lizards; chelonians
4. Snakes; lizards

**Answer: d. Snakes; lizards**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Diseases of Reptiles, p. 983.
2. Miller RE, Fowler M. 2012. Fowler’s Zoo and Wild Animal Medicine, 7th edition. Elsevier: St. Louis, MO. Chapter 32 –Reptile and Amphibian Analgesia, p. 249.

**Domain 1; Tertiary Species – Reptiles**

**54.** The following are advantages of using isoflurane anesthesia in imaging pregnant mice **EXCEPT**?

1. Reduced risk of intrauterine trauma associated with injections
2. Readily adjustable dosage
3. Precise control of the duration of anesthesia
4. No effect on embryonic growth rate during first gestational week or following chronic exposure

**Answer: d. No effect on embryonic growth rate during first gestational week or following chronic exposure**

**References:**

1. Gargiulo et al. 2012. Mice anesthesia, analgesia and care, Part II: anesthetic considerations in preclinical imaging studies. ILAR J 53(1): E70-E81
2. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 10 – Anesthesia and Analgesia for Laboratory Rodents, pp. 252-253.

**Domain 3; Primary Species – Mouse *(Mus musculus)***

**55.** Which of the following meet general recommendations for lighting in zebrafish facilities?

1. Between 10 and 40 ft candles (107-430 lux) at tank level
2. Between 5 and 30 ft candles (54-354 lux) at tank level
3. Between 10 and 40 ft candles (107-430 lux) at ceiling level
4. Between 10 and 30 ft candles (107-354 lux) at ceiling level
5. Between 5 and 30 ft candles (54-354 lux) at ceiling level

**Answer: b. Between 5 and 30 ft candles (54-354 lux) at tank level**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of Zebrafish, p. 1027.
2. Koeber and Kalishman. 2009. Preparing for a semiannual IACUC inspection of a satellite zebrafish facility. JAALAS 48(1):65-75.

**Domain 4; Secondary Species – Zebrafish (*Danio rerio*)**

**56.** When breeding rabbits, which of the following behaviors should lead to separation of the animals?

* 1. Male tail-flagging
	2. Female tail-raising
	3. No interaction after 15 minutes
	4. First attempt at copulation

**Answer: c. No interaction after 15 minutes**

**References:**

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section II – Rabbits, Chapter 9 – Rabbit Colony Management and Related Health Concerns, pp. 230-231.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, p. 420.

**Domain 4; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**57.** What are the expected clinical signs from a young beagle with juvenile polyarteritis syndrome?

1. Exercise intolerance
2. Joint pain
3. Petechiae, purpura, or ecchymosis
4. Reluctance to move the head and neck

**Answer: d. Reluctance to move the head and neck**

1. Field G and Jackson TA. 2007. The Laboratory Canine (A Volume in the Laboratory Animal Pocket Reference Series). CRC Press: Boca Raton, FL. Chapter 4 – Veterinary Care, p. 78.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 12 – Biology and Diseases of Dogs, pp. 547-548.

**Domain 1; Primary Species - Dog (*Canis familiaris*)**

**58.** Which of the following is the reversal drug for pancuronium?

1. Atipamezole
2. Doxapram
3. Neostigmine
4. Yohimbine

**Answer: c. Neostigmine**

**References:**

1. Gargiulo et al. 2012. Mice Anesthesia, Analgesia, and Care, Part I: Anesthetic Considerations in Preclinical Research. ILAR J. 53(1): E55-E69.
2. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 10 – Anesthesia and Analgesia for Laboratory Rodents, p. 267.

**Domain 2**

**59.** The altered Shaedler flora consists of all of the following bacteria **EXCEPT**?

1. *Lactobacillus murinus*
2. *Clostridium spp.*
3. *Escherichia spp.*
4. *Eubacterium plexicaudatum*
5. *Lactobacillus intestinalis*

**Answer: c. *Escherichia spp.***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 – Gnotobiotics, p. 1284.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 229.
3. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 22 – Gnotobiotics, p. 699

**Domain 3**

**60.** Which one of the following methods would be most effective in eliminating all bacteria from rodent rack water lines and watering valves?

* 1. Rack-washer sanitation alone
	2. Flush lines and valves during sanitation through rack washer
	3. Removal of biofilm
	4. Rack washer-sanitation followed by autoclave sterilization
	5. Treatment of waterlines and valves with ultraviolet light

**Answer: d. Rack washer-sanitation followed by autoclave sterilization**

**References:**

1. [Meier](http://www.ncbi.nlm.nih.gov/pubmed/?term=Meier%20TR%5Bauth%5D) et al. 2008. Quantification, distribution, and possible source of bacterial biofilm in mouse automated watering systems. JAALAS47(2):63–70
2. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 32 - Plumbing: Special Considerations, pp. 437-439, 441-445
3. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 12 - Environmental and Equipment Monitoring, pp. 419-420

**Domain 4**

**61.** According to the Animal Welfare Act and its regulations, perimeter fencing around outdoor housing facilities for nonhuman primates must be constructed so that it protects nonhuman primates by restricting unauthorized humans, and animals the size of \_\_\_\_\_\_\_\_\_\_, from going through it or under it and having contact with the nonhuman primates?

a. Cats, dogs, skunks, and opossums

b. Dogs, cats, raccoons, and skunks

c. Raccoon, skunks, and dogs

d. Raptors, cats, and dogs

**Answer: c. Raccoon, skunks, and dogs**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart D – Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, §3.78 (d) Outdoor housing facilities (11-6-13 Edition, p. 96)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Primary Species – Dog (*Canis familiaris)* and Tertiary Species – Other Mammals**

1. Obesity in most mammalian species causes disruption of the hypothalamic-pituitary-gonadal axis predominantly via feedback from which hormone(s)?
2. Luteinizing hormone and estrogen
3. Follicle stimulating hormone and insulin
4. Grehlin and luteinizing hormone
5. Insulin and leptin
6. Gonadotropin releasing hormone

**Answer: d. Insulin and leptin**

**Reference:** Newell-Fugate et al. 2014. Effects of diet-induced obesity on metabolic parameters and reproductive function in female ossabaw minipigs. Comparative Medicine 64(1):44-49.

**Domain 1**

**63.** In sheep and goats, infection with *Dichelobacter nodosus* most commonly causes which of the following conditions?

1. Blue bag
2. Foot rot
3. Lumpy jaw
4. Sore mouth
5. Wooden tongue

**Answer: b. Foot rot**

**References:**

1) Hubrecht R, and Kirkwood J, eds. 2010. The Care and Management of Laboratory and Other Research Animals, 8th ed. Wiley-Blackwell: Ames, IA. Chapter 34 – Sheep and Goats, p. 522

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 14 - Biology and Diseases of Ruminants (Sheep, Goats, and Cattle), pp. 646-647.

**Domain 1; Secondary Species - Sheep (*Ovis aries*) and Goat (*Capra hircus*)**

**64.** When performing longitudinal cardiovascular phenotyping with conscious mice, electrocardiography **IS NOT** useful for detecting which of the following conditions?

* 1. Atrial fibrillation
	2. Cardiac hypertrophy
	3. Heart block
	4. Low ejection fraction

**Answer: d**. **Low ejection fraction**

**References:**

1. Sysa-Shah et al. 2015. Electrocardiographic characterization of cardiac hypertrophy in mice that overexpress the ErbB2*tg* receptor tyrosine kinase. Comparative Medicine 65(4):295-307.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 16 – Cardiovascular Disease: Mouse Models of Atherosclerosis, p. 555.

**Domain 3**; **Primary Species – Mouse (*Mus musculus*)**

1. Which of the following best describes the reproductive physiology of the female dog?
	1. Polyestrous, nonseasonal spontaneous ovulator
	2. Monoestrus, nonseasonal, spontaneous ovulator
	3. Polyestrous, seasonal, induced ovulator
	4. Monoestrous, non-seasonal, induced ovulator
	5. Monoestrous, seasonal, spontaneous ovulator

**Answer: b. Monoestrous, nonseasonal, spontaneous ovulator**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 12 – Biology and Diseases of Dogs, p. 517.

**Domain 4; Primary Species - Dog (*Canis familiaris*)**

**66.** What office within the NIH is responsible for overseeing the Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules, and how many voting members are required?

1. Office of Biotechnology Activities, 15 voting members
2. Office of Biosafety Activities, 5 voting members
3. Office of Biotechnology Activities, 5 voting members
4. Office of Biosafety Activities, 15 voting members
5. None of the above

**Answer: a. Office of Biotechnology Activities, 15 voting members**

**References:**

1) DHHS and NIH. 2013. NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines). Section IV-C-2. Recombinant DNA Advisory Committee (RAC), p. 33 (http://osp.od.nih.gov/sites/default/files/NIH\_Guidelines\_0.pdf)

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 41.

**Domain 5**

**67.** Alteration of the light cycle in a zebrafish facility has been documented to alter all of the following **EXCEPT**?

1. Fin length
2. Gene expression
3. Locomotion
4. Reproductive cycle

**Answer: a. Fin length**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 - The Biology and Management of the Zebrafish, p. 1027 and Chapter 33 - Factors That Can Influence Animal Research, p. 1450.
2. Harper C & Lawrence C. 2010. The Laboratory Zebrafish, 1st ed, CRC Press: Boca Raton, FL. Chapter 1 - Biology, p. 11; Chapter 5 - Veterinary Care, p. 134-135, 139; and Chapter 6 - Experimental Methodology, p. 176, 182.

**Domain 4; Secondary Species – Zebrafish (*Danio rerio*)**

**68.** All of the following drugs are partial mu agonists **EXCEPT**?

a. Buprenorphine

b. Butorphanol

c. Etorphine

d. Pentazocine

**Answer: c. Etorphine**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, Euthanasia, pp. 1146-1147.

2) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 4 – Pharmacology of Analgesics, pp. 111-112, 114-115

**Domain 2**

1. What is the preferred blood collection site in anesthetized *Xenopus tropicalis*?
	1. Heart
	2. Ventral abdominal vein
	3. Lingual venous plexus
	4. Ventral caudal vein
	5. Femoral vein

**Answer: a. Heart**

**References:**

1. Green SL. 2010. The Laboratory Xenopus sp. CRC Press: Boca Raton, FL. Chapter 5 – Experimental Methodology, pp. 128-129.
2. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and Diseases of Amphibians, p. 948.

**Domain 3; Secondary Species – African clawed frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**70.** What is the relationship between relative humidity and ammonia levels in an animal’s microenvironment?

1. As relative humidity increases, ammonia levels decrease
2. As relative humidity increases, ammonia levels increase
3. Ammonia levels are not influenced by relative humidity
4. Relative humidity is decreased by increasing ammonia levels

**Answer: b. As relative humidity increases, ammonia levels increase**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities. p. 1569.
2. Corning and Lipman. 1991. A comparison of rodent caging systems based on microenvironmental parameters. Lab Anim Sci 41:498–503.

**Domain 4**

**71.** According to the most recent version of the Guide for the Care and Use of Laboratory Animals, all of the following meet the criteria for public member(s) of an IACUC **EXCEPT**?

1. Must not receive any form of compensation to avoid compromising the member’s association with the community and public at large
2. Should not be laboratory animal users
3. Should not be affiliated in any way with the institution
4. Should not be affiliated with the immediate family of a person who is affiliated with the institution

**Answer: a. Must not receive any form of compensation to avoid compromising the member’s association with the community and public at large**

**Reference:** Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter2 – Animal Care and Use Program, pp. 24-25.

**Domain 5**

**72.** Which of the following statements best describes malignant hyperthermia in swine?

1. Condition is most commonly reported in miniature swine
2. No known genetic basis for the condition
3. Clinical signs include decreasing end-tidal CO2, bradycardia, and metabolic alkalosis
4. Pathophysiology involves elevated levels of intracellular calcium

**Answer: d. Pathophysiology involves elevated levels of intracellular calcium**

**References:**

1. Fish, RE, Brown, MJ, Danneman, PJ, Karas, AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd edition. Academic Press: San Diego, CA. Chapter 15 – Anesthesia and Analgesia in Swine, pp. 425-426.

2) Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, pp. 752-753

3) Swindle MM. 2007. Swine in the Laboratory, 2nd edition. CRC Press: Boca Raton FL. Chapter 2 – Anesthesia, analgesia, and Perioperative Care p. 47.

**Domain 1; Primary Species – Pig (*Sus scrofa*)**

**73.** Which of the following best describes whole body plethysmography?

a. Invasive, direct method of studying respiratory function in animals

b. Invasive, direct method for studying cardiac output in animals

c. Noninvasive, indirect method of studying respiratory function in animals

d. Noninvasive, indirect method of studying cardiac output in animals

**Answer: c. Noninvasive, indirect method of studying respiratory function in animals**

**References**

1. Raşid et al. 2012. Assessment of routine procedure effect on breathing parameters in mice by using whole-body plethysmography. JAALAS 51(4):469-474
2. Foster et al. 2008. Whole-body plethysmography in African green monkeys (*Chlorocebus aethiops*) with and without jackets.JAALAS 47(5):52-55

**Domain 3**

**74.** Which of the following is the single most expensive component of a modern vivarium, both in initial acquisition and life cycle costs?

1. Caging/housing system
2. Heating, ventilation, and air conditioning system
3. Humidifying, ventilation, and air conditioning system
4. Records management system

**Answer: b. Heating, ventilation, and air conditioning system**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities, pp. 1564-1565.
2. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 34 - Heating, Ventilation and Air Conditioning (HVAC): Special Considerations, pp. 461-462.

**Domain 4**

1. All of the following are classified by APHIS and the CDC as select agents **EXCEPT**?
2. *Bacillus anthracis*
3. *Burkholderia mallei*
4. Nipah virus
5. SARS
6. Venezuelan equine encephalitis virus

**Answer: d. SARS**

**References**:

1. http://www.selectagents.gov/SelectAgentsandToxinsExclusions.html
2. Kastenmayer et al. 2012. Select agent and toxin regulations: beyond the eighth edition of the Guide for the Care and Use of Laboratory Animals. JAALAS 51(3):333-338.
3. U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Appendix F – Select Agents and Toxins, p. 379.

(<http://www.cdc.gov/biosafety/publications/bmbl5/bmbl5_appendixf.pdf>)

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 18 – Biosafety in Laboratories using Nonhuman Primates, pp. 441-444

**Domain 5**

**76.** *Pasteurella multocida* infection in rabbits can be associated with a wide variety of symptoms including all of the following **EXCEPT**?

1. Abortion
2. Arthritis
3. Conjunctivitis
4. Otitis
5. Paracarditis

**Answer: b. Arthritis**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit, pp. 264-267.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, pp. 422-423.

**Domain 1; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**77.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, which of the following statements best describes euthanasia methods for small laboratory rodents?

1. Nitrogen and argon gas are acceptable with conditions
2. CO2, with or with­out premedication with inhaled anesthetics, is acceptable with conditions
3. Decapitation is an acceptable method for mice and rats
4. IP (intraperitoneal) injection of 70% ethanol is an unacceptable method
5. Focused beam microwave irradiation, using a machine profes­sionally designed for animal euthanasia, is acceptable for euthaniz­ing mice and rats

**Answer b. CO2,** **with or with­out premedication with inhaled anesthetics, is acceptable with conditions**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 26, 38-39, 41, 49, 99.

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

1. Allen-Worthington et al. 2015. Intraperitoneal injection of ethanol for the euthanasia of laboratory mice (*Mus musculus*) and rats (*Rattus norvegicus*). JAALAS 54(6):769-778.

**Domain 2**

**78.** Which of the following statements best describes what is involved with CRISPR/Cas9 technology for genome editing?

1. Synthetic proteins whose [DNA-binding domains](https://en.wikipedia.org/wiki/DNA-binding_domains) enable them to create double-stranded breaks in DNA at specific spots
2. Synthetic nucleases to target a double-strand break to a specific location on the DNA strand
3. Creation of a custom protein for each targeted DNA sequence
4. Simplistic design of a short RNA guide sequence that is paired to the targeted DNA sequence, using a modified bacterial immune system
5. Direct insertion of cloned genetic material into the pronucleus of a fertilized mouse egg

**Answer: d. Simplistic design of a short RNA sequence that is paired to the targeted DNA sequence, using a modified bacterial immune system**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of Zebrafish, pp. 1021-1022, Chapter 31 – Genetically Modified Animals, pp. 1427-1428, and Chapter 34 – Animal Models in Biomedical Research, pp. 1501-1502.

**Domain 3**

**79.** Which of the following statements best describes breeding of rhesus macaques in the U.S.A.?

1. Replacement breeders are readily available for import from India
2. There is no need for practical genetic management protocols for this species
3. Reduced genetic diversity can change the means and variability of biomedical traits
4. Accurate pedigree information can be obtained by observing breeding habits in a multi-male, multi-female colony

**Answer: c. Reduced genetic diversity can change the means and variability of biomedical traits**

**References:**

1. Vinson and Raboin. 2015. A practical approach for designing breeding groups to maximize genetic diversity in a large colony of captive rhesus macaques (*Macaca Mulatta*). JAALAS 54(6):700-707.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 11– Animal Identification and Record Keeping for Nonhuman Primates: Current Practice and Use, p. 288.

**Domain 4; Primary Species – Macaques (*Macaca spp.)***

**80.** Who bears ultimate responsibility for the Animal Care and Use Program of an institution and is responsible for resource planning and ensuring alignment of Program goals with the institution mission?

 a. Attending veterinarian

 b. Institutional Animal Care and Use Committee

 c. Institutional Official

 d. Biosafety officer

 e. Institutional Biosafety Committee

**Answer: c. Institutional Official**

**Reference:**  Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 2 – Animal Care and Use Program, p. 13

**Domain 5**

**81.** In order to maintain CMAR certification, one must do which of the following?

1. Successfully pass 4 exams and obtain 24 continuing education units every 2 years
2. Successfully pass 4 exams and obtain 24 continuing education units every 3 years
3. Successfully pass 4 exams and obtain 48 continuing education units every 2 years
4. Successfully pass 4 exams and obtain 48 continuing education units every 3 years

**Answer: a. Successfully pass 4 exams and obtain 24 continuing education units every 2 years**

**Reference:**

1. https://www.aalas.org/certification/management-certification/cmar-faq
2. https://www.aalas.org/certification/management-certification/eligibility-requirements

**Domain 6**

**82.** A rhesus macaque has severe anaplastic anemia following a recent organ transplantation. Bone marrow biopsy revealed numerous intranuclear inclusions in the erythroid precursor cells and marked erythroid hypoplasia. Which of the following viruses is the most likely etiologic agent?

a. Adenovirus

b. Arenavirus

c. Filovirus

d. Flavavirus

e. Parvovirus

**Answer: e. Parvovirus**

**References:**

1) Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 35-36

2) Simon. 2008. [Simian parvoviruses: biology and implications for research](http://www.ncbi.nlm.nih.gov/pubmed/19793456). Comparative Medicine 58(1):47-50.

3) [Bailey and](http://www.ncbi.nlm.nih.gov/pubmed/?term=Bailey%20C%5BAuthor%5D&cauthor=true&cauthor_uid=20472806) Mansfield. 2010. Emerging and reemerging infectious diseases of nonhuman primates in the laboratory setting. [Vet Pathol](http://www.ncbi.nlm.nih.gov/pubmed/?term=bailey+mansfiled++nonhuman+primates) 47(3):462-481.

**Domain 1; Primary Species - Macaques (*Macaca spp.*)**

1. All of the following are examples of a gnotobiote **EXCEPT**?

1. Associated animal
2. Defined microbiota
3. Monoxenic animal
4. Restricted flora
5. Specific pathogen free

**Answer: e. Specific pathogen free**

**References:**

1) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 218.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 26 - Gnotobiotics, p. 1264.

**Domain 3**

**84.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals, which of the following statements best describes relative humidity in animal rooms?

1. Is maintained by humidification of the air via condensers that fluctuate the temperature of the air
2. Is maintained by humidification of air entering the animal spaces utilizing steam injectors or atomizing water into the air stream
3. Utilizes dehumidification mechanisms via increasing the air temperature until the moisture is removed and then decreasing the temperature to that appropriate for each room
4. Should be maintained between 50 and 70 % according to The Guide for the Care and Use of Laboratory Animals, 8th edition

**Answer: b. Is maintained by humidification of air entering the animal spaces utilizing steam injectors or atomizing water into the air stream**

**References:**

1. Institute of Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press: Washington, D.C. Chapter 5 – Physical Plant, p. 139.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities, p. 1566.

**Domain 4**

**85.** Acute allograft rejection is mediated by cells expressing which of the following?

a. CD20 and CD79a

b. CD68 and CD20

c. CD4 and CD8

d. CD79a and CD68

**Answer: c. CD4 and CD8**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 34 – Animal Models in Biomedical Research, p. 1511.

**Domain 3**

**86.** What diagnostic parameters can best be used to differentiate microsporidiosis in zebrafish caused by *Pseudoloma neurophila* or *Pleistophora hypessobryconis*?

1. Wet mount of *P.* *neurophila* spores can be made from opaque lesions in skeletal muscle
2. Microsporidian spores from *P. neurophilia* are gram negative
3. *P. hyphessobryconis* spores are pyriform-shaped and measure 2.7 x 5.4 microns
4. Spores from *P. hyphessobryconis* have a more prominent posterior vacuole
5. Real time and conventional PCR techniques are used to detect *P. hyphessobryconis* infection

**Answer: d. Spores from *P. hyphessobryconis* have a more prominent posterior vacuole**

**References:**

1. Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of the Zebrafish, p. 1047.
2. Sanders et al. 2012. Microsporidiosis in zebrafish research facilities. ILAR J 53(2):106-113.

**Domain 1; Secondary Species – Zebrafish (*Danio rerio*)**

**87.** Which of the following are classified by APHIS and CDC as select agents category A, B, C respectively?

a. *Francisella tularensis*, *Burkholderia pseudomallei*, Hantavirus

b. Hantavirus, *Burkholderia pseudomallei*, *Francisella tularensis*

c. Machupo, Lassa, *Francisella tularensis*

d. Ricin toxin, *Burkholderia pseudomallei*, *Francisella tularensis*

e. *Yersinia pestis*, *Burkholderia pseudomallei*, *Clostridium perfringens* (epsilon toxin).

**Answer: a. *Francisella tularensis*, *Burkholderia pseudomallei*, Hantavirus**

**Reference:** Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 18 – Biosafety in Laboratories using Nonhuman Primates, pp. 441-444

**Domain 5**

**88.** According to the Guide for the Care and Use of Laboratory Animals, most HVAC systems are designed for average high and low temperatures and humidities experienced in a geographical area within what percentage variation?

1. +/- 3%
2. +/- 5%
3. +/- 7%
4. +/- 10%

**Answer: b. +/- 5%**

**Reference:** Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter5 – Physical Plant, p. 140.

**Domain 4**

**89.** According to the Animal Welfare Act and its regulations, the ambient temperature shall not be allowed to fall below 60°F, nor to exceed 85°F for indoor facilities housing what species?

1. Cats
2. Dogs
3. Guinea pigs
4. Rabbits
5. Rhesus macaques

**Answer: c. Guinea pigs**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.2 (a) Indoor housing facilities (11-6-13 Edition, p. 61); Subpart B – Specifications for the Humane Handling, Care, Treatment, and Transportation of Guinea Pigs and Hamsters, §3.26 (a) Facilities, indoor (11-6-13 Edition, p. 76); Subpart C – Specifications for the Human Handling, Care, Treatment and Transportation of Rabbits, §3.51 (a)(b) Facilities, indoor (11-6-13 Edition, p. 85); and Subpart D – Specifications for the Human Handling, Care, Treatment and Transportation of Nonhuman Primates, §3.76 (a) Indoor housing facilities (11-6-13 Edition, pp. 94-95)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Secondary Species – Guinea pig (*Cavia porcellus*)**

**90.** Coated (red-tint) glass is commonly used on animal holding room doors in rodent vivaria, since it is assumed that mice and rats cannot see light at what part of the visible spectrum?

1. 450 nm
2. 650 nm
3. 750 nm
4. 950 nm

**Answer: b. 650 nm**

**References:**

1. Fox JG LC, Anderson, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, pp. 1566-1567.
2. Dauchy et al. 2015. The influence of red light exposure at night on circadian metabolism and physiology in Sprague-dawley rats. JAALAS 54(1):40-50.

**Domain 4; Primary – Mouse (*Mus musculus*) and Rat (*Rattus norvegicus*)**

**91.** Which of the following best describes the research complications caused by murine parvovirus?

1. It causes extensive mortality in weanlings from infected dam
2. It causes chronic diarrhea and retarded growth in affected mice
3. It causes colonic hyperplasia and increases the sensitivity of colonic mucosa to chemical carcinogens
4. It affects the immune function and causes augmentation or suppression of humoral and cellular immune responses
5. Infected animals have an increased sensitivity to irradiation

**Answer: d. It affects the immune function and causes either augmentation or suppression of humoral and cellular immune responses**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp, 79-81.
2. Macy et al. 2013. Effect of immunodeficiency on MPV shedding and transmission. Journal JAALAS 52(4):467-464.
3. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 4 – Parvoviruses, p. 101.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

1. Which of the following instruments is most commonly used to test a gnotobiotic isolator for leakage prior to use?
	1. Balometer
	2. Gas detector
	3. Geiger counter
	4. Hygrometer
	5. Particle detector

**Answer: b. Gas detector**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 223.
2. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 – Gnotobiotics, p. 1277.

**Domain 3**

**93.** Which of the following cleaning agents **IS NOT** safe to use on cages housing *Dendrobates spp.*?

a. 1% Virkon

b. Iodine-based cleanser

c. 2% bleach

d. 70% ethanol

**Answer: b. Iodine-based cleanser**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and Diseases of Amphibians, p. 937

**Domain 4; Tertiary Species – Other Amphibians**

**94.** According to the Animal Welfare Act and its regulations, **f**or how long must records of IACUC-approved activities be kept?

1. As long as the protocol is active
2. For the duration of the activity and for 3 years following
3. For 3 years, or for as long as the activity is ongoing
4. For 7 years
5. There is no requirement for the number of years records must be maintained

**Answer: b. For the duration of the activity and for 3 years following**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 28.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.35 (f) Recordkeeping Requirement (11-06-13 Edition, p. 38)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5**

**95.** Atrophic rhinitis is a multifactorial disease in pigs which can be caused by all of the following toxigenic bacterial strains EXCEPT?

1. *Bordetella bronchiseptica*
2. *Hemophilus parasuis*
3. *Pasteurella multocida*
4. *Streptococcus suis*

**Answer: d. *Streptococcus suis***

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition Academic Press: San Diego, CA. Chapter 16 - Biology and Diseases of Swine, pp. 717-718, 720-722.

**Domain 1; Primary Species – Pig (*Sus scrofa*)**

**96.** How often does Public Health Service Policy on Humane Care and Use of Laboratory Animals require an IACUC to conduct a complete review of ongoing activities?

1. At least once every 3 years
2. At least once every year
3. At least once every 5 years
4. At least once every 6 months

**Answer: a. At least once every 3 years**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 31.
2. Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals, p. 15 (http://grants.nih.gov/grants/OLAW/references/PHSPolicyLabAnimals.pdf)

**Domain 5**

**97.** Cynomolgus macaques **DO NOT** have which of the following antigens?

 a. Anti-A and Anti-B agglutinin in their sera

 b. AB cell surface antigens on the surface of erythrocytes

 c. ABO antigens in the epithelium of the gastrointestinal tract

 d. ABO antigens in the saliva

**Answer: b. AB cell surface antigens on the surface of erythrocytes**

**Reference:** Kim et al. 2015. Comparison of methods for determining ABO blood type in cynomolgus macaques (*Macaca fascicularis*). JAALAS 54(3):255-260.

**Domain 3; Primary Species – Macaques (*Macaca spp.*)**

**98.** Which of the following best describes appropriate housing conditions for a research colony of *Heterocephalus glaber*?

1. Climbing enrichment should be provided
2. Animals should be singly housed due to their solitary lifestyle in the wild
3. Water should be provided through a continual supply of vegetables
4. Compared to mice relatively cool temperatures and low humidity are recommended

e. A low fat diet should be provided to minimize adenocarcinoma risk

**Answer: c. Water should be provided through a continual supply of vegetables**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7- Biology and Diseases of Other Rodents, p. 330.

2) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section IV – Other Rodents, Chapter 45- Naked Mole Rat, pp. 1066-1067.

**Domain 4; Tertiary Species - Other Rodents**

**99.** OSHA recently standardized the content and formatting of the Material Safety Data Sheets. What is the title of the new revised replacement document?

a. Material Safety Information Sheet

b. Material Information Form

c. Chemical Substance Information Sheet

d. Safety Data Sheet

e. Substance Data Form

**Answer: d. Safety Data Sheet**

**References:**

1) 29 CFR Part 1910, Occupational Safety and Health Standards, subpart Z, Toxic and Hazardous Substances, Standard Number 1910.1200. 2012. Title: Hazard Communication. Paragraph (g).

2) U.S. Department of Labor, Occupational Safety & Health Administration, OSHA 3493-12R 2013

https://www.osha.gov/Publications/HazComm\_QuickCard\_SafetyData.html

**Domain 5**

**100.** Which of the following **IS NOT** recommended as a flooring substrate for swine?

a. Fiberglass slatted flooring

b. Plastic coated metal grids

c. Rubber mats

d. Seamless epoxy

e. Straw bedding

**Answer: d. Seamless epoxy**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, p. 697.
2. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 5 – Animal Handling and Transport, p. 49.

 (http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf)

**Domain 4; Primary Species – Pig (Sus scrofa)**

**101.** What is the mode of transmission of Theiler’s mouse encephalitis virus and where does the virus replicate after infection?

1. Horizontal transmission through mouse-to-mouse contact; brain
2. Oronasal transmission; lungs
3. Fecal-oral transmission; gastrointestinal tract
4. Vector-borne transmission; spleen
5. Vertical transmission via an infected dam; brain

**Answer: c. Fecal-oral transmission; gastrointestinal tract**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 95-97.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 12 – Cardioviruses: Encephalomyocarditis Virus and Theiler's Murine Encephalomyelitis Virus, p. 316.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**102.** All of thefollowing statement are applicable to the dried blood spot technique in mice **EXCEPT**?

a. It is used as an alternative to serum for serology

b. Requires approximately 100 to 200 μL blood

c. It enhances the ability to identify and streamline better drug candidates during drug discovery.

d. It is consistent with 3Rs principles by achieving reductions in the number of animals used

**Answer: b. Requires approximately 100 to 200 μL blood**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 11 – Microbiological Quality Control for Laboratory Rodents and Lagomorphs, p. 484.

2) Wickremsinhe and Perkins. 2015. Using dried blood spot sampling to improve data quality and reduce animal use in mouse pharmacokinetic studies. JAALAS 54(2):139-144

**Domain 3; Primary Species - Mouse (*Mus musculus*)**

**103.** What minimal contact time is considered adequate for sanitation using mechanical washers and water at a temperature of 61.7oC (143oF)?

a. 15 seconds

b. 30 seconds

c. 5 minutes

d. 15 minutes

e. 30 minutes

**Answer: e. 30 minutes**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1559
2. Compton and Macy. 2015. Effect of cage-wash temperature on the removal of infectious agents from caging and the detection of infectious agents on the filters of animal bedding-disposal cabinets by PCR analysis. JAALAS 54(6):745-755.

**Domain 4**

**104.** Which of the following pathogens in zebrafish would be analogous to *Encephalitozoon cuniculi* in rabbits?

1. *Mycobacterium marinum*
2. *Myxidium spp.*
3. *Pseudocapillaria tomentosa*

 d. *Pseudoloma neurophila*

**Answer: d. *Pseudoloma neurophila***

**References:**

1. Kent et al. 2012. Documented and potential research impacts of subclinical diseases in zebrafish. ILAR J53(2):126-134.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of the Zebrafish, p. 1045-1047.

**Domain 1; Primary Species – Rabbit (*Oryctolagus cuniculus*) and Secondary Species – Zebrafish (*Danio rerio*)**

**105.** Which of the following is the most appropriate combination of floor space and environmental temperature to house Japanese quail?

1. 1 ft2/animal; 29°C
2. 0.75 ft2/animal; 27°C
3. 0.5 ft2/animal; 20°C
4. 0.25 ft2/animal; 23°C

**Answer: d. 0.25 ft2/animal; 23°C**

**References:**

1. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter3 – Environment, Housing, and Management, p. 60.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 22 – Japanese Quail as a Laboratory Animal Model, pp. 1094-1095.

**Domain 4; Tertiary Species – Other Birds**

**106.** Both injectable and transdermal preparations of which of the following sustained-released drugs have been associated with self-limiting skin reactions?

1. Bupivacaine
2. Buprenorphine
3. Carprofen
4. Fentanyl
5. Lidocaine

**Answer: b.** **Buprenorphine**

**References:**

1) Thiede et al. 2014. Pharmacokinetics of sustained-release and transdermal buprenorphine in Göttingen minipigs (Sus scrofa domestica). JAALAS 53(6):692–699.

2) Foley et al. 2011. Evaluation of sustained-release formulation of buprenorphine for analgesia in rats. JAALAS 50(2):198-204.

**Domain 2**

**107.** Up to how many mice are required to map a single gene with recessive inheritance and full penetrance, and have adequate numbers of progeny for developmental studies, phenotyping and linkage analysis?

a. 80-100

b. 750

c. 1100

d. 1200

**Answer: d. 1200**

**References:**

1. Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. C.3. Other Protocol Review Considerations, p. 132 (http://grants.nih.gov/grants/olaw/guidebook.pdf)
2. Committee on Guidelines for the Use of Animals in Neuroscience and Behavioral Research, Institute for Laboratory Animal Research, Division on Earth and Life Studies. 2003. Guidelines for the Care and Use of Mammals in Neuroscience and Behavioral Research. National Academies Press: Washington, D.C. Appendix B – Estimating Animal Numbers, p.186.

(http://grants.nih.gov/grants/olaw/National\_Academies\_Guidelines\_for\_Use\_and\_Care.pdf)

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**108.** How does housing density affect the frequency and intensity of territorial behaviors in zebrafish?

1. No correlation
2. Directly proportional (aggression increases as density increases)
3. Directly proportional, but only in female zebrafish
4. They are inversely proportional (aggression decreases as density increases)

**Answer: d. Inversely proportional (aggression decreases as density increases)**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of Zebrafish, p. 1023.
2. Harper C, Lawrence C. 2011. The Laboratory Zebrafish. CRC Press: Boca Raton, FL. Chapter 2 – Husbandry, p. 62.

**Domain 4; Secondary Species – Zebrafish (Danio rerio)**

**109.** Allof the following are requirements of the Animal Welfare Act for transportation and handling of warm-blooded animals other than dogs, cats, rabbits, hamsters, guinea pigs, nonhuman primates, and marine mammals **EXCEPT**?

1. Cages must have either wire floors or adequate bedding to keep the animals clean from waste
2. Animals must be offered water at least every 12 hours and food at least every 24 hours during transport
3. Animals must be observed at least every 6 hours during surface transportation
4. Temperature should not be allowed to be colder than 45**°**F or to exceed 75**°**F

**Answer: c. Animals must be observed at least every 6 hours during surface transportation**

**References:**

1. Smith and Swindle. 2006. Preparation of swine for the laboratory. ILAR J 47(4): 358-363.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart F – Specifications for the Humane Handling, Care, Treatment, and Transportation of Warm-blooded Animals Other Than Dogs, Cats, Rabbits, Hamsters, Guinea Pigs, Nonhuman Primates, and Marine Mammals, §3.140 (a) Care in transit and § 3.141 - Terminal facilities (11-6-13 Edition, p. 141)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5**

**110.** Which of the following laboratory animal species is the reservoir for the Powassan virus, a flavivirus which can cause a fatal encephalitis in humans?

1. *Cynomys ludovicianus*
2. *Marmota monax*
3. *Mus musculus*
4. *Rattus norvegicus*
5. *Sigmodon hispidus*

**Answer**: **b. *Marmota monax***

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 8 – The Laboratory Woodchuck, p. 367.

**Domain 1; Tertiary Species – Other Rodents**

1. Which of the following in rabbits is a model of colibacillosis?
	1. Ileal loop ligation
	2. Injection of either *E. coli* organisms or LPS into the marginal ear vein
	3. Removable intestinal tie-adult rabbit diarrhea
	4. Thiry fistula
	5. Thiry-Vella loop fistula

**Answer: c. Removable intestinal tie-adult rabbit diarrhea**

**References:**

1) Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 25 – Techniques of Experimentation, p. 1221.

2) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section II – Rabbits, Chapter 18 – The Rabbit as an Experimental Model, pp. 546-548

**Domain 3; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**112.** Which of the following water quality parameters would pose the greatest health risk to a zebrafish colony?

1. pH of 7.5
2. Nitrite level of 4 mg/L
3. Temperature of 80°F (27°C)
4. Nitrate level of 110 mg/dl

**Answer: b. Nitrite level of 4 mg/L**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of Zebrafish, pp. 1024-1026, 1055
2. Lawrence and Mason. 2012. Zebrafish housing systems: a review of basic operating principles and considerations for design and functionality. ILAR J53:179-191 (p. 180).

**Domain 4; Secondary Species – Zebrafish (*Danio rerio*)**

**113.** All of the following are responsibilities of the Quality Assurance Unit under GLP Regulations **EXCEPT**?

a. Maintain a copy of the master schedule sheet of all nonclinical laboratory studies conducted at the testing facility

b. Maintain copies of all protocols pertaining to all nonclinical laboratory studies for which the unit is responsible

c. Periodically submit to management and the study director written status reports on each study

d. Maintain a current summary of training and experience and job description for each individual engaged in or supervising the conduct of a nonclinical laboratory study

**Answer: d. Maintain a current summary of training and experience and job description for each individual engaged in or supervising the conduct of a nonclinical laboratory study**

**Reference:** 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A - General Provisions, § 58.35 Quality Assurance Unit (4–1–15 Edition, pp. 308-309) (http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=58)

**Domain 5**

**114.** Which of the following is an enveloped DNA virus that has been detected in nonhuman primates?

1. Poliovirus
2. Simian Retrovirus type 1
3. Measles virus
4. Cytomegalovirus
5. Dengue virus

**Answer: d. Cytomegalovirus**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 863-871.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Vial Diseases, pp. 12-13, 19-20, 43-46, 57-60.

**Domain 1**

**115.** Which of the following drugs may be ineffective in rabbits?

1. Atropine
2. Dexmedetomidine
3. Diazepam
4. Glycopyrrolate
5. Pentobarbital

**Answer: a. Atropine**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 - Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 1150.

2) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section I – General, Chapter 2 - Anesthesia and Analgesia, p. 35.

**Domain 2; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

1. Which of the following animals is least likely to develop clinical hypercholesterolemia over time?
2. Beagle dog
3. Brattleboro rat
4. Kurosowa and Kusanagi rabbit
5. Rapacz FH swine
6. WHHL rabbit

**Answer: b. Brattleboro rat**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 152; Chapter 10 – Biology and Diseases of Rabbits, p. 414, 448; Chapter 12 – Biology and Diseases of Dogs, p. 530; and Chapter 16 – Biology and Diseases of Swine, p. 699.

**Domain 3;** **Primary Species – Rat (*Rattus norvegicus*)**

**117.** Which of the following is attributed to the high resistance of parvoviruses to disinfection with UV and gamma irradiation?

1. Highly efficient DNA repair capabilities and small genome volume
2. Small size of the organism
3. Solubility and structure
4. Association with dirt and organic matter
5. Lack of an envelope

**Answer: a. Highly efficient DNA repair capabilities and small genome volume**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition Academic Press: San Diego, CA. Chapter 11 – Microbiological Quality Control For Laboratory Rodents And Lagomorphs, p. 473

**Domain 4**

**118.** According to the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act and its Recommendations, all of the following are regulatory requirements for cats **EXCEPT**?

* 1. Cats up to and including 4 kg must be provided with at least 3.0 ft²
	2. Cats over 4 kg must be provided with at least 4.0 ft²
	3. Vertical space with perches is required and may require additional cage height
	4. Primary enclosures housing cats must be at least 24 inches high

**Answer: c. Vertical space with perches is required and may require additional cage height**

**References:**

1. Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals The National Academies Press: Washington, D.C. Chapter Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals The National Academies Press: Washington, D.C. Chapter 3 – Environment, Housing, and Management, p. 59.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.6 Primary enclosures, (b) Additional requirements for cats. (11-6-13 Edition, p. 64)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Secondary Species - Cat (Felis domestica)**

**119.** Which of the following organizations has a mission “to educate people about the essential role humans and responsible animal research plays in the quest for medical advancements, treatments and cures for both people and animals?”

1. Americans for Medical Progress
2. Foundation for Biomedical Research

c. National Association for Biomedical Research

d. Speaking of Research

**Answer: b. Foundation for Biomedical Research**

**Reference:** <http://fbresearch.org/about-fbr/>

**Domain 6**

**120.** What etiologic agents are most commonly implicated in feline upper respiratory infections?

1. *Chlamydophila felis* and *Mycoplasma felis*
2. Feline calicivirus (FCV) and feline herpesvirus-1 (FHV-1)
3. FCV and *Mycoplasma felis*
4. FHV-1 and *Mycoplasma felis*
5. FCV and *Chlamydophila felis*

**Answer: b. Feline calicivirus (FCV) and feline herpesvirus-1 (FHV-1)**

**Reference:** Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 13 - Biology and Diseases of Cats, pp. 569-570.

**Domain 1; Secondary Species – Cat (*Felis domestica*)**

**121.** What is the recommended maximal amount of total blood volume that can be safely collected weekly in healthy adult male and female cynomolgus macaques for 4 consecutive weeks with minimal effect on animal wellbeing?

* 1. 7.5 %
	2. 10%
	3. 12.5%
	4. 15%
	5. 17.5%

**Answer: d. 15% total blood volume weekly**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 13 - Clinical Techniques Used for Nonhuman Primates, p. 331.
2. Adams et al. 2014. Effects of weekly blood collection in male and female cynomolgus macaques (*Macaca fascicularis*). JAALAS 53(1):81-88.

**Domain 3; Primary Species – Macaques (*Macaca* *spp*.)**

**122.** Which of the following species is used as a model for the evaluation of human oral cancer development because of its “immunologically privileged” cheek pouches?

1. *Cavia porcellus*
2. *Heterocephalus glaber*
3. *Marmota monax*
4. *Meriones unguiculatus*
5. *Mesocricetus auratus*

**Answer: e.*****Mesocricetus auratus***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, p. 212.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section IV – Hamsters, 27 – Anatomy, Physiology, and Behavior, p. 755.

**Domain 3; Secondary Species – Syrian Hamster (*Mesocricetus auratus*)**

**123.** According to the Animal Welfare Act and its regulations, what five considerations must be a part of an environment enhancement plan for a nonhuman primate?

1. Restraint devices, exemptions, social grouping, special considerations, and environmental enrichment
2. Behavior management, social grouping, food enrichment, psychological well-being, and health management
3. Behavior management, restraint devices, exemptions, social grouping, and special considerations
4. Exemptions, behavior management, social grouping, environmental enrichment, and special considerations

**Answer: a. Restraint devices, exemptions, social grouping, special considerations, and environmental enrichment**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart D – Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, §3.81 (a-e) Environment enhancement to promote psychological well-being (11-6-13 Edition, pp. 100-101)

 (http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5**

**124.** Which of the following mouse strains has a lymphoproliferation mutation and is used as an animal model for rheumatoid arthritis and system lupus erythematosus?

* 1. BALB/c
	2. C57BL/6
	3. FVB
	4. MRL/MpJ
	5. SJL/J

**Answer: d. MRL/MpJ**

**References:**

1. Currer JM et al. 2009. Handbook on Genetically Standardized Mice, 6th Edition. The Jackson Laboratory: Bar Harbor, Maine. Chapter 4 – Characteristics of Popular Strains of JAX® Mice, Including Reproductive Performance, pp. 8996, 112, 118, 133
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume IV – Immunology. Academic Press: San Diego, CA. Chapter 11 – The Genetics of Mouse Models of Systemic Lupus, pp. 244-246.
3. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 134-135
4. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 4-6

**Domain 1; Primary Species - Mouse (Mus musculus)**

**125.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, all of the following statements describe euthanasia methods in zebra finches and other avian species **EXCEPT**?

a. Intracoelomic barbiturates and their congeners are acceptable

b. Inhaled anesthetics and carbon dioxide asphyxiation are acceptable

c. Unwanted embryos that have undergone over 50% of incubation can be euthanized by decapitation

d. Thoracic compression used solely is an unacceptable method

**Answer: b. Inhaled anesthetics and carbon dioxide asphyxiation are acceptable**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 23 – Zebra Finches in Biomedical Research, p. 1120

2) American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 34, 41, 65-67, 99, 102

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

**Domain 2; Tertiary Species - Other Birds**

**126.** The B6.129P2-*Apoetm1Unc*/J mouse is which of the following?

1. A congenic strain, where the locus of interest (*Apoetm1Unc*) of the 129P2 donor strain has been backcrossed to recipient strain C57BL/6J at least 5 times.
2. A congenic strain, where the locus of interest (*Apoetm1Unc*) of the 129P2 donor strain has been backcrossed to recipient strain C57BL/6J less than 5 times.
3. A congenic strain, where the locus of interest (*Apoetm1Unc*) of the C57BL/6J donor strain has been backcrossed to recipient strain 129P2 at least 5 times.
4. A congenic strain, where the locus of interest (*Apoetm1Unc*) of the C57BL/6J donor strain has been backcrossed to recipient strain 129P2 less than 5 times.

**Answer: a. A congenic strain, where the locus of interest (*Apoetm1Unc*) of the 129P2 donor strain has been backcrossed to recipient strain C57BL/6J at least 5 times.**

**References:**

1. Hsu et al. 2015. Murine norovirus infection variably alters atherosclerosis in mice lacking apolipoprotein E. Comparative Medicine 65(5) 369-381.
2. Currer J, Ed. Handbook on Genetically Standardised Mice. 6th Ed The Jackson Laboratory, Bar Harbor, Maine, 2009. Section II: Using Mice in Research, p.86.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**127.** Which of the following statements best describes allergies to laboratory animals as an important occupational disease?

a. Reducing allergens is the primary method for reducing the incidence and relieving symptoms of animal allergies; the type of rodent caging used has no impact on mouse allergens

b. Reducing allergens is the primary method for reducing the incidence and relieving symptoms of animal allergies; allergens can be removed by switching from open cages to filter-top cages and further reduced with IVC systems

c. Increasing allergens is the primary method for reducing the incidence and relieving symptoms of animal allergies; allergens can be increased by switching from open cages to filter-top cages and further reduced with IVC systems

d. Reducing allergens is the primary method for reducing the incidence and relieving symptoms of animal allergies; allergens can be removed by switching from IVC systems to filter-top cages

**Answer: b. Reducing allergens is the primary method for reducing the incidence and relieving symptoms of animal allergies; allergens can be removed by switching from open cages to filter-top cages and further reduced with IVC systems**

**Reference:** Lindsell and Geertsema. 2015. Effects of room ventilation rates in rodent rooms with direct-exhaust IVC systems. JAALAS 54(5):521-526.

**Domain 4**

**128.** Work with which of the following requires Animal Biosafety Level 3 containment?

1. Animal models of swine influenza
2. Bats infected with Hendra virus
3. Dogs known to be infected with rabies
4. LCMV-infected hamsters

**Answer: d. LCMV-infected hamsters**

**Reference:** U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Section VIII-E: Viral Agents, pp. 202, 212, 216, 221

(http://www.cdc.gov/biosafety/publications/bmbl5/bmbl5\_sect\_viii\_e.pdf)

**Domain 5; Secondary Species – Syrian Hamster (Mesocricetus auratus) and Tertiary – Other Rodents**

**129.** What are the main concerns in terms of viral disease transmission between species when mixing African nonhuman primate species with Asian or new world nonhuman primate species?

1. Dengue Fever and Tanapox
2. SIV and SHFV
3. SRV/D and Hepatitis A
4. Yellow Fever and Monkey Pox

**Answer: b. SIV and SHFV**

**References:**

1. Gardner and Luciw. 2008. Macaque models of human infectious disease. ILAR J 49(2):220-255.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 871-875, 878-879
3. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 47-49, 62-70

**Domain 1**

**130.** Gamma-irradiated diets for gnotobiotic mouse colonies are subjected to what irradiation dose to reduce the number of total viable count to 1 organism per 10*25* g.

a. 10 kGy

b. 20 kGy

c. 25 kGy

d. 40 kGy

**Answer: d. 40 kGy**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 10 – Nutrition, pp. 364-365.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, pp. 1578-1579.

**Domain 3; Primary Species – Mouse (*Mus musuculus*)**

**131.** Which of the following types of enrichment is the least effective in macaques?

1. Forage boards
2. Olfactory stimulation
3. Play cages
4. Tactile enrichment

|  |  |
| --- | --- |
| **Answer: b. Olfactory stimulation** |  |

**References:**

1. Bayne K, Turner PV, eds. 2014. Laboratory Animal Welfare. Academic Press: San Diego, CA. Chapter 13 – Nonhuman Primate Welfare in the Research Environment, p. 204
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 6 – Behavioral Management, Enrichment, and Psychological Well-being of Laboratory Nonhuman Primates, p. 161.

**Domain 4; Primary Species – Macaque (*Macaca mulatta*)**

**132.** Which of the following statements applies to the Health Research Extension Act of 1985?

1. Governs the use of all animals (invertebrate and vertebrate) in research, research training, or testing that is funded by the Public Health Service
2. Governs the use of all vertebrate animals in research, research training, or testing that is funded by the Public Health Service
3. Governs the use of all animals (invertebrate and vertebrate) in research, research training, or testing regardless of funding source
4. Governs the use of all vertebrate animals in research, research training, or testing regardless of funding source

**Answer: b. Governs the use of all vertebrate animals in research, research training, or testing that is funded by the Public Health Service**

**References:**

1. Silverman et al. 2015. Decision making and the IACUC: part 1 – protocol information discussed at full-committee reviews. JAALAS 54(4):745-755.
2. Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals. National Institutes of Health, Bethesda, MD, pp. 1-3.

(http://grants.nih.gov/grants/olaw/references/PHSPolicyLabAnimals.pdf)

1. Fox JG LC, Anderson, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 30.

**Domain 5**

**133.** Which of the following mouse strains is hepatitis-resistant when infected with *Helicobacter hepaticus*?

1. A/JCr
2. BALB/cANCr
3. C3H/HeNCr
4. C57BL/6

e. SJL/NCr

**Answer: d. C57BL/6**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 59.

2) Garrett et al. 2014. Effects of medicated diet to eradicate *Helicobacter spp.* on growth, pathology, and infection status in Rag1–/– and nude mice. JAALAS 53(3):238-245.

**Domain 1; Primary Species – Mouse (Mus musculus)**

**134.** Which of the following is considered a minimum necessary standard for extra-label drug use?

1. Valid veterinary, client, patient relationship
2. Only FDA-approved drugs for the species in question may be utilized
3. Any extra-label drug usage is permissible as long as it is prescribed by a licensed veterinarian
4. The route and dose of the drug must be consistent with the product label

**Answer: a. Valid relationship between patient, client, and veterinarian**

**References:**

1. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 3 - Husbandry, Housing, and Biosecurity, p. 13

 (http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf)

1. U.S. Food and Drug Administration. Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA).

[http://www.fda.gov/RegulatoryInformation/Legislation/SignificantAmendmentstotheFDCAct/AnimalMedicinalDrugUseClarificationActAMDUCAof1994/default.htm. Accessed 21 Dec 2015](http://www.fda.gov/RegulatoryInformation/Legislation/SignificantAmendmentstotheFDCAct/AnimalMedicinalDrugUseClarificationActAMDUCAof1994/default.htm.%20Accessed%2021%20Dec%202015).

**Domain 5**

**135.** When designing housing for *poikilothermic* animals, which of the following considerations is of **LEAST** concern for animal health?

1. Ambient lighting conditions
2. Conditioned fresh air
3. Habitat water temperature / quality
4. Humidity
5. Noise and vibration

**Answer: b. Conditioned fresh air**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities, pp. 1556-1557.
2. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing and Management, pp. 82-83.

**Domain 4**

**136.** Xenopus laevis adults may be housed at how many liters of water per frog?

1. 0.5
2. 1
3. 2
4. 3
5. 5

**Answer: c. 2**

**References:**

1. Green SL. 2010. The Laboratory Xenopus, 1st ed. CRC Press: Boca Raton, FL Chapter 2 – Husbandry, p. 47.
2. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, p. 83.

**Domain 4; Secondary Species – African Clawed Frog (*Xenopus laevies* and *Xenopus tropicalis*)**

**137.** When giving gentamicin as a post-operative antibiotic in mice, why is it recommended to wait until the animal fully recovers from anesthesia?

1. Calcium blocking action of gentamicin could cause hypotension and prolonged anesthesia
2. Gentamicin is only effective in fully awake mice
3. Gentamicin can potentially induce hypothermia in anesthetized mice
4. Gentamicin is less nephrotoxic in awake mice

**Answer: a. Calcium blocking action of gentamicin could cause hypotension and prolonged anesthesia**

**Reference:** Gargiulo et al. 2012. Mice anesthesia, analgesia, and care, Part I: Anesthetic considerations in preclinical research. ILAR J 53(1): E55-E69.

**Domain 2; Primary Species – Mouse *(Mus musculus)***

**138.** Which of the following laboratory animal organizations has representation within the AVMA’s House of Delegates?

1. AAALAC
2. AALAS
3. ACLAM
4. ASLAP
5. FBR

**Answer: d.** **ASLAP**

**References:**

1. http://www.aslap.org/about
2. https://www.avma.org/About/Governance/Pages/AVMA-Governance-Organizations-Represented-in-AVMA-House-of-Delegates.aspx

**Domain 6**

**139.** Which of the following malarial parasites is indigenous to new world monkeys?

a. *P. knowlesi*

b. *P. pitheci*

c. *P. reichenowi*

d. *P. schwetzi*

e. *P. simium*

**Answer: e. *P. simium***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 882.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 5 – Nonhuman Primate Models for Human Malaria Research, pp. 310-311.

**Domain 1; Secondary Species – Squirrel Monkey (*Saimiri sciureus*) and Marmoset/Tamarins (Callitrichidae)**

**140.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition,, if euthanizing zebrafish by rapid chilling, adult zebrafish must be exposed to 2-4° C ice-chilled water for at least \_\_\_ minutes, and fry 4 to 7 days post-fertilization must be exposed for at least \_\_\_ minutes.

1. 5; 7
2. 5; 10
3. 7; 5
4. 10; 20

**Answer: d. 10; 20**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 51

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf )

1. Strykowski and Schech. 2015. Effectiveness of recommended euthanasia methods in larval zebrafish (*Danio rerio*). JAALAS 54(1):81-84.

**Domain 5; Secondary Species – Zebrafish (*Danio rerio*)**

1. Which of the following drugs has been associated with dose-dependent pulmonary edema and hypoxemia in sheep?
2. Acepromazine
3. Midazolam
4. Morphine
5. Telazol
6. Xylazine

**Answer: e. Xylazine**

**References:**

1. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 14 – Anesthesia and Analgesia of Ruminants, pp. 390-395.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, pp. 1173-1174

**Domain 3; Secondary Species – Sheep (*Ovis aries*)**

**142.** An investigator is proposing a project that involves experimental infections of *Coxiella burnetii* in sheep. All of the following are recommendations you would make based on current accepted safety practices **EXCEPT**?

1. BSL-3 facilities are required for handling of infected tissues
2. Animals that die as part of the experimental design may be necropsied in BSL-2 facilities
3. Animals should be housed in BSL-3 facilities for the project
4. Respiratory PPE is necessary due to the low inhaled infective dose of this agent
5. The lab should register with the CDC prior to experimental protocols, as *C. burnetii* is a select agent

**Answer: b. Animals that die as part of the experimental design may be necropsied in BSL-2 facilities**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health. 2007. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Section VIII-D: Rickettsial Agents, pp. 195-196.

(http://www.cdc.gov/biosafety/publications/bmbl5/bmbl5\_sect\_viii\_d.pdf)

1. Whitney et al. 2013. Survey of laboratory animal technicians in the United States for *Coxiella burnetii* antibodies and exploration of risk factors for exposure. JAALAS52(6):725-731.

**Domain 4; Secondary Species – Sheep (*Ovis aries*)**

**143.** According to the Animal Welfare Act and its regulation, which of the following statements best describe the requirement for transporting a rabbit by surface vehicle?

1. Rabbits being transported more than 6 hours should have access to food and water and they are required to be observed no less than once every 4 hours
2. Rabbits being transported more than 8 hours should have access to food and water and they are required to be visually observed no less than once every 4 hours
3. Rabbits being transported more than 6 hours should have access to food and water and they are required to be observed no less than once every 8 hours
4. Rabbits being transported more than 8 hours should have access to food and water and they are required to be observed no less than once every 6 hours

**Answer: a. Rabbits being transported more than 6 hours should have access to food and water and they are required to be observed no less than once every 4 hours**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart C – Specifications for the Humane Handling, Care, Treatment, and Transportation of Rabbits, §3.63 (a) Food and water requirements and §3.64 (a) Care in transit (11-6-13 Edition, p. 91)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf**)**

**Domain 5; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**144.** All of the following statements describe pancreatic islet cell tumors in ferrets **EXCEPT**?

* 1. If the patient is stable, surgical debulking is the treatment of choice
	2. Clinical signs are intermittent and may include ptyalism
	3. Metastasis rates are high, usually greater than 50%.
	4. Disease is usually later onset, with most cases occurring in 4-5 year old animals

**Answer: c. Metastasis rates are high, usually greater than 50%**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 14 – Biology and Diseases of Ferrets, pp. 607-608.
2. Quesenberry KE, Carpenter JW, Eds. 2012. Ferrets, Rabbits, and rodents: Clinical Medicine and Surgery. Elsevier: St. Louis, MO. Chapter 7 - Endocrine Diseases, pp. 92-99.

**Domain 1; Secondary Species - Ferret (*Mustela putorius furo*)**

**145.** Which animal model is prone to developing immune complex glomerulonephritis as an autoimmune disease resembling human lupus erythematosus?

1. CX8B/EiJ
2. CX8D/EiJ
3. B6DBF1
4. NZB x NZW F1
5. C57BL/6

**Answer: d. NZB x NZW F1**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Disease of Mice, p.133.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 2 – Mouse Physiology, p. 74.

**Domain 3; Primary Species – Mouse (*Mus musculus)***

**146.** Which of the following species **WILL NOT** eat in low light or darkness, thus requiring a restriction on these time periods due to welfare concerns?

* 1. *Chinchilla lanigera*
	2. *Gallus domesticus*
	3. *Meriones unguiculatus*
	4. *Mesocricetus auratus*
	5. *Taeniopygia guttata*

**Answer: b. *Gallus domesticus***

**Reference:** Institute of Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press: Washington, D.C. Chapter 3 – Environment, Housing, and Management, p. 48.

**Domain 4; Tertiary Species - Chicken (*Gallus domesticus*)**

**147.** An investigator with NIH funding has an IACUC protocol that is about to expire in the next 3 days. He will need his IACUC approved period extended so that he can complete a very important experiment planned in a pig model of cardiac insufficiency that includes a surgeon flying in from out of state 5 days from now. After the procedure, he plans to submit his 3-year renewal. Which of the following statements best describes what action the IACUC can take in this situation?

1. The IACUC is able to administratively extend the approved protocol by only 30 days
2. The IACUC is able to administratively extend the approved protocol by only 14 days
3. The IACUC is able to extend the approved protocol if the attending veterinarian approves
4. The IACUC is able to extend the approved protocol if the attending veterinarian and IACUC chair approve
5. The IACUC does not have the authority to administratively extend the approved protocol period beyond 3 years

**Answer:** **e.** **The IACUC does not have the authority to administratively extend the approved protocol period beyond 3 years**

**Reference:** OLAW. "Frequently Asked Questions - PHS Policy on Humane Care and Use of Laboratory Animals - Office of Laboratory Animal Welfare." Section D, #2, OLAW, 11 June 2015. Web. 1 Nov. 2015 (http://grants.nih.gov/grants/OLAW/faqs.htm)

**Domain 5; Primary Species - Pig (*Sus scrofa)***

**148.** All of the following has been shown to be advantageous to have in quail habitats **EXCEPT**?

1. Elevated perches
2. Material such as sand or cat litter for dust baths
3. Nest boxes
4. Solid flooring with seed scattered in bedding

**Answer: a. Elevated perches**

**Reference:** Fox JG LC, Anderson, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 22 – Japanese Quail as a Laboratory Animal Model, pp. 1091-1092.

**Domain 4; Tertiary Species – Other Birds**

**149.** Which of the following statements best describes the physiological and behavioral changes caused by the immobility response of rabbits?

1. Analgesia, increased depth of respiration, miosis, reduced respiratory rate, reduced heart rate, reduced blood pressure
2. Analgesia, increased depth of respiration, mydriasis, reduced respiratory rate, reduced heart rate, reduced blood pressure
3. Anesthesia, increased depth of respiration, mydriasis, reduced respiratory rate, reduced heart rate, reduced blood pressure
4. Increased depth of respiration, mydriasis, reduced respiratory rate, reduced heart rate, reduced blood pressure
5. Decreased depth of respiration, miosis, reduced respiratory rate, reduced heart rate, reduced blood pressure

**Answer: a. Analgesia, increased depth of respiration, miosis, reduced respiratory rate, reduced heart rate, reduced blood pressure**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 1155.

2) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 11 – Anesthesia and Analgesia in Rabbits: Special Anesthetic Considerations, p. 320.

**Domain 2; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**150.** A strain of transgenic mice was originally created in FVB stem cells and then back crossing was performed for 10 generations to get the Myh6-cre transgene onto a C57B/6 background. Which of the following names best describes this mouse strain?

1. FVB.B6-Tg(Myh6-cre)
2. B6.FVB-Tg(Myh6-cre)
3. B6:FVB-Tg(Myh6-cre)
4. FVB:B6-Tg(Myh6-cre)

**Answer: b. B6.FVB-Tg(Myh6-cre)**

**References:**

1. The Jackson Laboratory, Mouse Strain Datasheet – 018972 (https://www.jax.org/strain/018972)
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 32 – Genetically Modified Animals, pp. 1434-1436.

**Domain 3; Primary Species – Mouse (Mus musculus)**

**151.** Which of the following is the most important physical enrichment for laying hens?

1. Overhead cover
2. Nestbox
3. Foraging materials
4. Hanging strings
5. Dustbaths

**Answer: b. Nestbox**

**References:**

1. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 4 - Environmental Enrichment. pp. 33-34. (http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf)
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 38 – Laboratory Animal Behavior, pp. 1638-1639.

**Domain 4; Tertiary Species – Chicken (*Gallus domesticus)***

**152.** Which of the following rat urine proteins is responsible for the allergic reactions of many research and animal care personnel?

1. Alpha 2u-globulin, Rat n 1
2. Alpha 2u-globulin, Rat m 1
3. P53 protein, Rat r 1
4. P53 protein, Rat m 3
5. P53 protein, Rat n 1

**Answer: a. Alpha 2u-globulin, Rat n1**

**References:**

1. Committee on Occupational Safety and Health in Research Animal Facilities, Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council. 1997. Occupational Health and Safety in the Care and Use of Research Animals. National Academy Press, DC. Chapter 4 – Allergens, pp. 53-56.
2. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 17 - Occupational Health and Safety in the Laboratory rat, p. 567.

**Domain 5; Primary Species - Rat (*Ratttus norvegicus*)**

**153.** All of the following strains of mice are susceptible to Helicobacter-associated gastrointestinal disease and may develop chronic enterohepatic disease **EXCEPT**?

a. A/JCr

b. B6C3F1

c. BALB/cAnNCr

d. C3H/HeNCr

e. SJL/NCr

**Answer: b. B6C3F1**

**References:**

1) Garrett et al. 2014. Effects of medicated diet to eradicate *Helicobacter* *spp*. on growth, pathology, and infection status in Rag1-/- and nude mice. JAALAS 53(3):238-245

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 - Mice, p. 59.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**154.** Colony managers must consider which of the following when determining how to decontaminate diets fed to SPF or gnotobiotic rodents?

1. Autoclavable diets must be fortified as autoclaving reduces the nutritional value of diets
2. Gamma or UV irradiation are both equally effective in eliminating pathogens from food
3. Pelleted feed is exposed to sufficient heat as part of the pelleting process to eliminate all important rodent pathogens.
4. Gamma irradiation is effective in eliminating pathogens from food via denaturing of proteins found in contaminating microorganisms

**Answer: a. Autoclavable diets must be fortified as autoclaving reduces the nutritional value of diets**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 11 - Microbiological Quality Control for Laboratory Rodents and Lagomorphs, p. 473.
2. Taciak et al. 2015. Effects of autoclaving soy-free and soy-containing diets for laboratory rats on protein and energy values determined in vitro and in vivo. JALAAS 54(5):507-515.

**Domain 3**

**155.** Unless the primary enclosure used to transport dogs is permanently affixed to the conveyance, the total combined surface area of the ventilation openings must be at least what percent of the total combined surface area of all the walls of the primary enclosure?

* 1. 8
	2. 14
	3. 16
	4. 50

**Answer b. 14**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.14 (c)(1)(i-iv) Primary enclosures (11-6-13 Edition, p. 71)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 4; Primary Species - Dog *(Canis familiaris)***

**156.** According to NIH Guidelines for Research Involving Recombinant DNA Molecules, membership of the Institutional Biosafety Committee must include a minimum of:

a. 3 individuals, with no requirement for unaffiliated members

b. 3 individuals, including 1 unaffiliated community member

c. 5 individuals, with no requirement for unaffiliated members

d. 5 individuals, including 1 unaffiliated community member

e. 5 individuals, including 2 unaffiliated community members

**Answer: e. 5 individuals, including 2 unaffiliated community members**

**Reference:**

1. NIH Guidelines For Research Involving Recombinant DNA Molecules. 2013. Section IV-B-2-a. Membership and Procedures, p. 26

(http://oba.od.nih.gov/oba/rac/Guidelines/NIH\_Guidelines.pdf)

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 40 and Chapter 27 – Working Safely with Experimental Animals Exposed to Biohazards, pp. 1308

**Domain 5**

**157.** Which of the following best describes simian hemorrhagic fever in nonhuman primates?

1. Highly contagious, fatal viral disease of macaques caused by a flavivirus
2. Causes fatal hemorrhagic fever in a number of African primates, principally the Patas monkey
3. Causes hemorrhage and necrosis of the proximal duodenum in macaques
4. Lesions differ from those seen in Ebola due to the involvement of the spleen and kidney

**Answer: c. Causes hemorrhage and necrosis of the proximal duodenum**

**References:**

1)Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 47-49.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 871-875.

**Domain 1; Primary Species - Macaque (*Macacca* *spp.***)

**158.** Which of the following agents **IS NOT** suitable as a sole anesthetic agent for surgical procedures in zebrafish (*Danio rerio*)?

1. Eugenol
2. Gradual cooling
3. Isoflurane
4. Metomidate hydrochloride
5. Tricaine methanesulfonate

**Answer: c. Isoflurane**

**References:**

1. Collymore et al. 2014. Efficacy and safety of 5 anesthetics in adult zebrafish (*Danio rerio*). JAALAS 55(2):198-203.
2. Mathews and Varga. 2012. Anesthesia and euthanasia in zebrafish. ILAR J 53(2):192-204.
3. Neiffer and Stamper. 2009. Fish sedation, anesthesia, analgesia, and euthanasia: considerations, methods, and types of drugs. ILAR J 50(4):343-360.

**Domain 2**

**159.** An investigator would like to use sustained release buprenorphine (Bup-SR) in his C57BL/6J mice to decrease the number of times they need to be handled post operatively. As the overseeing veterinarian, what recommendations should you provide?

1. Bup-SR has the potential to cause skin lesions
2. Bup-SR provides extended analgesia for 5 days, and this method would be sufficient for his model
3. Using Bup-SR would be considered part of the Three R’s as a reduction due to the reduced stress in the animals from handling
4. Bup-SR has been shown to cause significant respiratory depression; therefore, it should not be used.

**Answer: a. Bup-SR has the potential to cause skin lesions**

**References:**

1. Carbone et al. 2012. Duration of action of sustained-release buprenorphine in 2 strains of mice. JAALAS51(6):815-819.
2. Foley et al. 2011. Evaluation of a sustained-release formulation of buprenorphine for analgesia in rats. JAALAS 50(2):198-204.

**Domain 2; Primary Species - Mouse (*Mus musculus)***

**160.** Which of the following must be considered during the design of animal room ventilation systems?

1. Room air change rates of 4 to 6 air changes per hour are recommended in the Guide for the Care and Use of Laboratory Animals
2. Room air change rates vary depending on numerous factors including the heat load of the room
3. Positive pressure differentials as low as 0.02 inches of water column may be associated with difficulties in opening doors.
4. Positive pressure differentials from rooms to corridors are required for spaces housing volatile chemicals or biohazards

**Answer. b. Room air change rates vary depending on numerous factors including the heat load of the room**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities, pp. 1564-1566.
2. Geertsema and Lindsell. 2015. Effect of room ventilation rates in rodent rooms with direct-exhaust IVC systems. JALAAS 54(5):521-526.

**Domain 4**

**161.** Which of the following statements best describes regulations regarding hazardous substances?

a. The National Institute for Occupational Safety and Health regulates the Occupational Safety and Health Administration

b. The Occupational Safety and Health Administration regulates the protection of workers against illness or injury resulting from unsafe working conditions

c. The United States Department of Agriculture plans, directs and coordinates national programs to develop occupational safety and health standards.

d. The Center for Disease Control and Prevention provides recommendations to the National Institute for Occupational Safety and Health regarding safe work practices

**Answer: b. The Occupational Safety and Health Administration regulates the protection of workers against illness or injury resulting from unsafe working conditions**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 - Laws, Regulations and Policies Affecting the Use of Laboratory Animals, p. 40 and Chapter 27 – Working Safely With Experimental Animals Exposed To Biohazards, pp. 1308-1309

2) Committee on Occupational Safety and Health in Research Animal Facilities, Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council. 1997. Occupational Health and Safety in the Care and Use of Research Animals. National Academy Press, DC. Chapter 2 – Program Design and Management, p. 25.

**Domain 5**

**162.** Which antibiotic has been reported to eradicate *Pasteurella pneumotropica* in mice?

1. Ampicillin
2. Enrofloxacin
3. Tetracycline
4. Tylosin tartarate

**Answer: b. Enrofloxacin**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 19 – Pasteurellaceae, pp. 497-498.
2. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, p. 106.
3. Towne et al. 2014. Elimination of Pasteurella pneumotropica from a mouse barrier facility by using a modified enrofloxacin treatment regimen. JAALAS 53(5):517-522.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

1. All of the following statements apply to ulcerative dermatitis (UD) in mice **EXCEPT**?
	1. High-fat, western-style diet may potentiate UD
	2. UD is more prevalent in females
	3. Supplementing a high-fat, western-style diet with mineralized red-algae may ameliorate UD
	4. Increasing dietary fat content decreases incidence of UD
	5. Deficient or excess dietary vitamins A or E might predispose mice to UD

**Answer: d. Increasing dietary fat decreases the incidence of UD**

**References:**

1. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, p. 130.
2. Hampton et al. 2015. Ulcerative dermatitis in C57BL/6NCrl mice on a low-fat or high-fat diet with or without a mineralized red-algae supplement. JAALAS 54(5):487-496.

**Domain 1; Primary Species - Mouse (*Mus musculus*)**

**164.** Which of the following is an example of a recombinant inbred strain?

1. DBA/2J
2. BXD-1/Ty
3. CcS1
4. B6C3F1
5. Hsd:ICR

**Answer. b BXD-1/Ty**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Disease of Mice, p. 52.
2. The Jackson Laboratory. 2009. The Jackson Laboratory Handbook on Genetically Standardized Mice. 6th edition. The Jackson Laboratory. Bar Harbor, ME. Chapter 3 D.2.c.

**Domain 3; Primary Species – Mice (*Mus musculus*)**

**165.** All of the following statements applies to the use of autoclaves in animal facilities **EXCEPT**?

1. Autoclaving of food can significantly affect concentrations of essential nutrients such as thiamine, vitamin A, and vitamin K
2. Gravity displacement cycles are preferred for feed and bedding
3. Water sterilization can be effectively monitored using *Geobacillus stearothermophilus* biological indicators
4. Autoclaving is not recommended for polystyrene materials

**Answer: b. Gravity displacement cycles are preferred for feed and bedding**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 - Gnotobiotics, pp. 1273-74.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 225.

**Domain 4**

**166.** According to Good Laboratory Practice for conducting nonclinical laboratory studies, which of the following best describes the *in vivo* and *in vitro* experiments(s) which are part of a nonclinical laboratory study?

1. Utilize human subjects
2. Include field trials conducted in animals
3. Include a basic exploratory study carried out to determine whether a test article has any potential utility
4. Study test articles prospectively in test systems under laboratory conditions to determine safety
5. Determine physical or chemical characteristics of a test article

**Answer: d. Study test articles prospectively in test systems under laboratory conditions to determine safety**

**Reference:** 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A – General Provisions, § 58.3 Definitions

 http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=58.3

**Domain 5**

1. Which of the following best describes a male *Coturnix japonica*?
2. Are slightly larger than females
3. Have black speckling on the chest and are slightly larger than females
4. Has ZW sex chromosomes
5. Secretes a white foamy material from the cloacal gland that prolongs sperm motility

**Answer: d. Secretes a white foamy material from the cloacal gland that prolongs sperm motility**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 22 – Japanese Quail as a Laboratory Animal Model, pp. 1087, 1089, 1093.

**Domain 1; Tertiary Species – Birds**

**168.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, intraperitoneal injection of ethanol in mice as a primary method of euthanasia is considered which of the following?

a. Acceptable with conditions

b. Acceptable

c. Unacceptable

d. None of the above

**Answer: a. Acceptable with conditions**

**References:**

1) Allen-Worthington et al. 2015. Intraperitoneal injection of ethanol for the euthanasia of laboratory mice (Mus Musculus) and Rats (Rattus norvegicus). JAALAS 54(6):769-778.

2) American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 31-32, 99

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

**Domain 2; Primary Species - Mouse (*Mus musculus*)**

**169.** Which of the following would be a mid-diaphyseal tibial critical size defect in aged ewes?

1. 1 cm
2. 2 cm
3. 3 cm
4. 4 cm
5. 5 cm

**Answer: e. 5 cm**

**Reference:** Christou et al. 2015. Ovine model for critical-size tibial segmental defects. Comparative Medicine 64(5):377-385.

**Domain 3; Secondary Species – Sheep (*Ovis aries*)**

**170.** Which of the following may give rise to a false-negative reaction to an intradermal tuberculin test in nonhuman primates?

1. Animals exposed to Freund’s Complete Adjuvant
2. Concomitant measles infection or a recent history of measles vaccination
3. Infection with atypical mycobacterium
4. Nonspecific reactivity to the vehicle
5. Trauma due to improper administration of the test

**Answer: b. Concomitant measles infection or a recent history of measles vaccination**

**References:**

1. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 - Nonhuman Primates, p. 857.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 2 - Bacterial and Mycotic Diseases of Nonhuman Primates, pp. 114-115

**Domain 4**

**171.** According tothe Public Health Service Policy on Humane Care and Use of Laboratory Animals, funding from a PHS awarding unit can only be provided once which of the following has occurred?

1. Assurance is approved by USDA for the awardee institution
2. Assurance is approved for the awardee institution and the IACUC has approved for the animal activities
3. Only after IACUC approval for animal activities
4. Institution has obtained AAALAC accreditation
5. Institution has obtained AAALAC accreditation and IACUC approval for animal activities

**Answer: b. Assurance is approved for the awardee institution and the IACUC has approved for the animal activities**

**Reference:** Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals, pp. 9-15

 (http://grants.nih.gov/grants/OLAW/references/PHSPolicyLabAnimals.pdf)

**Domain 5**

**172.** Of the following treatment options for ectoparasitism by gyrodactylids in fish, which is most likely to result in resistant organisms when used for an extended period of time?

1. Freshwater baths for marine fish
2. Saltwater baths for freshwater fish
3. Formalin (prolonged immersion)
4. Organophosphates (prolonged immersion)
5. Praziquantel (prolonged immersion or PO)

**Answer: d. Organophosphates (prolonged immersion)**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 21 – Biology and Management of Laboratory Fishes, pp. 1081-1082.
2. Garcia et al. 2014. Gyrodactylid ectoparasites in a population of rainbow trout (*Oncorhynchus mykiss*). JAALAS 53(1):92-97.

**Domain 1; Secondary Species – Zebrafish (*Danio rerio*) and Tertiary Species – Other Fish**

**173.** Which of the following is the most frequently used song bird in the laboratory?

 a. *Columba livia domestica*

 b. *Gallus gallus domestica*

c. *Serinus canaries*

 d. *Sturnus vulgaris*

 e. *Taenopygia guttata*

**Answer: e. *Taenopygia guttata***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 23 – Zebra Finches in Biomedical Research, pp. 1110-1111.
2. Snyder et al. 2013. Increased mortality in a colony of zebra finches exposed to continuous light. JAALAS 52(3):301-307.

**Domain 3; Tertiary Species – Other Birds**

**174.** When breeding mice, using what in combination with plug checks can reduce the false positive rate for pregnancy detection significantly versus relying on plug checks alone?

 a. Body temperature

 b. Body weight

 c. Cortisol levels

 d. Corticosterone levels

 e. Progesterone levels

**Answer: b. Body weight**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 65-67.
2. Heyne et al. 2015. A simple and reliable method for early pregnancy detection in inbred mice. JAALAS 54(4):368-371.

**Domain 4; Primary Species – Mouse (*Mus musculus*)**

**175.** According to the most recent edition of the Guide for the Care and Use of Laboratory Animals, which of the following applies to physical restraint?

* 1. Restraint devices should be used simply as a convenience in handling or managing animals
	2. Animals that fail to adapt to necessary restraint systems should be removed from the study
	3. Alternatives to physical restraint do not need to be considered
	4. Provision should be made for observation of the animal at appropriate intervals, as determined by the PI

**Answer: b. Animals that fail to adapt should be removed from the study**

**Reference:** Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals The National Academies Press: Washington, D.C. Chapter 2 – Animal Care and Use Program, pp. 29-30.

**Domain 5**

**176.** Which of the following is the typical presentation of *Streptococcus azizii* infection in mice?

1. Morbidity and mortality among neonatal mice P1-3
2. Morbidity and mortality among weanlings
3. Subclinical infection in immunocompetent mice of all ages
4. General ill thrift in adult mice

**Answer: b. Morbidity and mortality among weanlings**

**Reference:** Braden et al. 2015. A novel α-hemolytic *Streptococcus* species (*Streptococcus azizii* sp. nov.) associated with meningoencephalitis in naïve weanling C57BL/6 mice. Comparative Medicine 65(3):186-195.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**177.** Bispectral index scores of what value indicate a surgical plane of anesthesia?

1. 15-20
2. 20-25
3. 25-35
4. 30-40
5. 40-60

**Answer: e. 40-60**

**References:**

1) Romanov et al. 2014. Paradoxical increase in the bispectral index during deep anesthesia in New Zealand white rabbits. JAALAS53(1):74-80.

2) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 6 – Monitoring of Anesthesia, pp. 179-180.

**Domain 2**

**178.** All of the following statements describeswine models of hematopoietic cell transplantation (HCT) **EXCEPT**?

* 1. Control for acute GVHD is important within the first 100 days after bone marrow suppression and HCT
	2. The potential of adverse reactions from cytokine-mediated donor cell mobilization has no bearing on the post-transplantation outcomes in the recipient
	3. Animals undergoing myeloablative doses of radiation as a conditioning regiment prior to HCT have a higher risk of GVHD
	4. A scoring system for GVHD in swine involves the presence or absence of skin rashes, gastrointestinal signs and elevated liver enzymes

**Answer: b. The potential of adverse reactions from cytokine-mediated donor cell mobilization has no bearing on the post-transplantation outcomes in the recipient.**

**References:**

1. Duran-Struuck et al. 2015. Miniature swine as a clinically relevant model of graft-versus-host disease. Comparative Medicine 65(5):429-443.
2. Matar et al. 2012. Effects of mobilization regimens in donors on outcomes of hematopoietic cell transplantation in miniature swine. Comparative Medicine 62(6):487-494.

**Domain 3; Primary Species – Pig (*Sus scrofa domesticus*)**

**179.** Which of the following types of valves, when placed within an automatic watering system for rodents, provides a means of computer controlled, higher-pressure water flushing to reduce microbial biofilm production?

1. Flutter
2. Lixit
3. Schrader
4. Solenoid
5. Venturi

**Answer: d. Solenoid**

**References:**

1) Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 32 – Plumbing: Special Considerations, pp. 434, 438, 444-445.

2) Molk et al. 2013. Sanitization of an automatic reverse-osmosis watering system: removal of a clinically significant biofilm. JAALAS 52(2):197-205.

3) Hau J and Schapiro SJ, eds. 2010. Handbook of Laboratory Animal Science, Volume I, 3rd Edition. CRC Press: Boca Raton, FL. Chapter 8 – Laboratory Animal Facilities and Equipment, p. 192.

**Domain 4**

**180.** A DEA Form 222 is used to order which schedules of controlled substances?

1. I
2. II
3. III through V
4. I and II

**Answer: d. I and II**

**References:**

1) Drug Enforcement Agency Controlled Substances Act and Scheduling Actions, 2013. http://www.deadiversion.usdoj.gov/schedules/orangebook/a\_sched\_alpha.pdf

1. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 25 – Regulatory Issues, p. 574 (Table 25-1).
2. http://www.deadiversion.usdoj.gov/schedules/index.html

**Domain 5**

**181.** Which of the following species produces abundant cervical mucus that is visible on ultrasound?

1. *Macaca arctoides*
2. *Macaca fascicularis*
3. *Macaca mulatta*
4. *Macaca nemestrina*
5. *Macaca radiata*

**Answer: e*. Macaca radiata***

**Reference:** Chaudhari et al. 2014. Echography of the cervix and uterus during the proliferative and secretory phases of the menstrual cycle in bonnet monkeys (*Macaca radiata*). JAALAS53(1):18-23.

**Domain 1; Primary Species – Macaques (*Macaca spp.*)**

**182.** Which of the following terms best describes injection of glioma cells of human origin intracranially in a nude mouse?

1. Allograft
2. Autograft
3. Heterotopic
4. Orthotopic

**Answer: d. Orthotopic**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 25 – Techniques of Experimentation, p. 1242.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 4 – Immunology. Academic Press: San Diego, CA. Chapter 13 – Mouse Models of Immunodeficiency, p. 283.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**183.**  According to the Guide for the Care and Use of Laboratory Animals, all of the following are components of the contingency plan that should/must be addressed **EXCEPT**?

a. Criminal activities (trespassing, arson, vandalism)

b. Preservation of animals

c. Communication of disaster to appropriate regulatory agencies

d. Training of personnel in advance of a catastrophe

e. Actions necessary to prevent animal pain, distress, and deaths due to loss of systems

**Answer: c. Communication of disaster to appropriate regulatory agencies**

**Reference:** National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 2 – Animal Care and Use Program, pp. 23, 35.

**Domain 4**

**184.** According to the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act and its Recommendations, what is the minimum cage height for a 4.5 kg cat?

1. 18 inches
2. 20 inches
3. 24 inches
4. 32 inches
5. 40 inches

**Answer: c. 24 inches**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.6 (b)(1)(ii)(A) Primary enclosures (11-6-13 Edition, p. 64)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Fox JG LC, Anderson, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 13 – Biology and Disease of Cats, p. 560.
2. Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals Academies Press: Washington, D.C. Chapter 3 – Environment, Housing, and Management, p. 59.

**Domain 5; Secondary Species – Cat (*Felis domestica*)**

**185.** Which of the following statements best describes ulcerative dermatitis in mice?

1. An idiopathic disease of C3H/HeJ mice associated with a variety of environmental factors
2. Occurs at a greater incidence in C57BL/6 mice fed a high fat diet
3. Characterized by intense pruritis and lesion formation concentrated on the rear limbs and tail
4. Occurs most common in outbred rats and responds to dietary vitamin E supplementation

**Answer**: **b. Occurs at a greater incidence in C57BL/6 mice fed a high fat diet**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, p. 130.
2. Hampton et al. 2015. Ulcerative dermatitis in C57BL/6NCrl mice on a low-fat or high-fat diet with or without a mineralized red-algae supplement. JALAAS 54(5):487-496.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**186.** Pica in rats has been reported in association with administration of which drug?

1. Aspirin
2. Buprenorphine
3. Carprofen
4. Gabapentin
5. Lidocaine

**Answer: b. Buprenorphine**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia. pp. 1146-1147.
2. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 19 – Anesthesia and Analgesia, p. 650.

**Domain 2; Primary Species – Rat (*Rattus norvegicus)***

**187.** Which of the following statements best describes findings from a recent study evaluating the pharmacokinetics of several formulations of meloxicam in cynomolgus macaques?

a. Sustained released formulations generated the lowest plasma concentrations for the shortest period of time

b. Oral formulation had low circulating levels of the drug

c. Intramuscular formulation, both over 3 d and as a single dose, provided higher plasma levels and a shorter duration than did a sustained-release subcutaneous formulation

d. All of the above are correct

**Answer: b. Oral formulation had low circulating levels of the drug**

**Reference:** Bauer et al. 2015. Pharmacokinetics of 3 formulations of meloxicam in cynomolgus macaques (Macaca fascicularis). JAALAS 53(5):502-511.

**Domain 3; Primary Species - Macaque (*Macaca spp.*)**

**188. Which of the following statements best describes the development of asthma and related respiratory disease in laboratory animal workers?**

1. **Was reported by NIOSH to be as high as 50% of the workforce**
2. **Is associated with things other than allergens such as airborne endotoxin and dust**
3. **Is only associated with lab animal exposure and not other more traditional risk factors such as smoking, age and atopy**
4. **Has no genetic component**

**Answer: b. Is associated with things other than allergens such as airborne endotoxin and dust**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 30 - Occupational Health of Laboratory Animal Workers, pp. 1382-1383.

**Domain 4**

**189.** Which of the following best describes parasitic infections in rats?

1. *Rodentolepis nana* always has an indirect life cycle
2. *Trichosomoides crassicauda* infestation is diagnosed in live rats by fecal flotation for eggs
3. *Hymenolepis diminuta* always has an indirect life-cycle
4. *Entamoeba muris* is a highly pathogenic amoeba of rats
5. *Syphacia muris* are readily recognized by the four alae present at the anterior end of the body

**Answer: c. *Hymenolepis diminuta* always has an indirect life-cycle.**

**References:**

1. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 - Biology and Diseases of Rats, pp. 181-185.
2. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 13 – Parasitic Diseases, pp. 467-471.

**Domain 1; Primary Species – Rats (*Rattus norvegicus)***

**190.** Which region of the rhesus macaque genome has been associated with phenotypic protection from simian AIDS following SIV infection?

* 1. ABO region
	2. Major histocompatibility region
	3. MAM-domain containing region
	4. Toll-like receptor region

**Answer: b. Major histocompatibility region**

**References:**

1. Wiseman et al. 2013. Haplessly hoping: macaque major histocompatibility complex made easy. ILAR J 54(2):196-210.
2. Vallender and Miller. 2013. Nonhuman primate models in the genomic era: a paradigm shift. ILAR J 54(2):154-165.

**Domain 1; Primary Species – Macaques (*Macaca* *spp.*)**

**191.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, cooling or freezing is an appropriate method for euthanasia of bird embryos that have attained what percentage incubation?

1. < 25% incubation
2. < 50% incubation
3. < 75% incubation
4. < 100% incubation

**Answer: b. < 50% incubation**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 23 – Zebra Finches in Biomedical Research, p. 1120.
2. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, Part III – Methods of Euthanasia by Species and Environment, S5.3 Eggs, Embryos, and Neonates, p. 67.

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf).

**Domain 2; Tertiary Species – Other Birds**

**192.** Which of the following chemicals can be safely used to effectively decontaminate electronic and electrical devices in mouse housing rooms not currently housing animals?

1. Chlorine dioxide
2. Ethanol
3. Quaternary ammonium compounds
4. Phenols
5. Vaporized hydrogen peroxide

**Answer: e. Vaporized hydrogen peroxide**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 9 – Design and Management of Research Facilities of Mice, p. 310.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, pp. 1584-1585.

**Domain 4; Primary Species - Mouse (*Mus musculus*)**

**193.** Which of the following statements best describes cat allergens?

1. *Fel d 1-* the major cat allergen –is produced in sebaceous glands, urine and saliva
2. *Fel d 1* is the major cat allergen, produced in sebaceous glands and saliva, and is found in all cats
3. *Fel b 1* is the major cat allergen, produced in sebaceous glands, urine and saliva
4. *Fel b 1* is the major cat allergen, produced in sebaceous glands and saliva, and is found in all cats

**Answer: b. *Fel d 1* is the major cat allergen, produced in sebaceous glands and saliva, and is found in all cats**

**Reference:** Committee on Occupational Safety and Health in Research Animal Facilities, Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council. 1997. Occupational Health and Safety in the Care and Use of Research Animals. National Academy Press, DC. Chapter 4 – Allergens, pp. 57-58.

**Domain 5; Secondary Species – Cat (*Felis domestica*)**

**194.** A diagnosis of *Gyrodactylus* infestation has been made in a colony of commercially purchased rainbow trout. In a closed colony, how many treatments with praziquantel would be required to clear the infestation?

1. 1
2. 2
3. 3
4. 4
5. 5

**Answer: a. 1**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 21 - Biology and Management of Laboratory Fishes, pp.1081-1082.
2. Garcia et al. 2014. Gyrodactylid ectoparasites in a population of rainbow trout (Oncorhynchus mykiss). JAALAS *53*(1):92-97

**Domain 1; Tertiary Species – Other Fish**

**195.** Which of the following **IS NOT** anacceptable method for semen collection in the respective laboratory animal species?

1. Artificial vagina in trained bovid, canine, lagomorphs, and feline
2. Rectal probe ejaculation (RPE) in bovid, ovine, canine, equine, non-human primates
3. Electrical stimulation of the penis in bovid, ovine, equine, non-human primates
4. Post coital uterine flush in an anesthetized mouse
5. Collection of rete testis fluid in non-human primates

**Answer: a. Artificial vagina in trained bovid, canine, lagomorphs, and feline**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 25 - Techniques of Experimentation, pp. 1228-1229.
2. Hedrich, Hans J. 2012. The Laboratory Mouse. Elsevier: San Diego, CA. Chapter 4, pp. 675-682.

**Domain 3; Primary Species – Dog (*Canis familiaris*), Rabbit (*Orytolagus cuniculus*); Secondary Species – Cat (*Felis domesticus*); and Tertiary Species – Other Livestock**

1. Because of their cheek pouches, hamsters can be a good model to study which of the following?
2. Primary lung tumors
3. Pancreatic adenocarcinoma
4. SV 40 tumor induction
5. Oral carcinogenesis

**Answer: d. Oral carcinogenesis**

**References:**

1) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section II – Rabbits, Chapter 34 - The Experimental Use of Syrian Hamsters, pp. 877-878.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 5 - Biology and Diseases of Hamsters, p. 212.

**Domain 3; Secondary Species – Syrian Hamster (*Mesocricetus auratus*)**

**197.** All of the following activities are regulated by the United States Department of Agriculture **EXCEPT**?

1. A rhesus macaque that is part of a breeding colony at a large research institution
2. A euthanized dog used in an anatomy lab
3. A horse on a study investigating MRI as an equine diagnostic modality to improve racing performance
4. Wild-caught ducks used as part of a waterfowl handling lab for a biology class

**Answer: c. A horse on a study investigating MRI as an equine diagnostic modality to improve racing performance**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 25.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 1 – Definition of Terms, §1.1 Definitions (11-06-13 Edition, p. 17) (http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)
3. Animal Care. January 2002. APHIS Fact Sheet: The Animal Welfare Act. (http://www.ca-biomed.org/pdf/media-kit/oversight/USDAAWA.pdf)

**Domain 5; Tertiary Species – Other Livestock**

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| --- | --- |
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**198.** Which statement best describes the effects of murine norovirus in Ldlr-/- mice?

1. Tropism of MNV for macrophages results in deceased atherosclerotic lesion size in Ldlr-/- mice
2. Tropism of MNV for macrophages results in increased atherosclerotic lesion size in Ldlr-/- mice
3. MNV infection does not change the disease phenotype of Ldlr-/- mice
4. MNV infection causes significant mortality via respiratory infection in Ldlr-/- mice
5. MNV infection causes significant mortality via immunosuppression in Ldlr-/- mice

**Answer: b. Tropism of MNV for macrophages results in increased atherosclerotic lesion size in Ldlr-/- mice**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 97.
2. Paik et al. 2015. Effects of murine norovirus on atherosclerosis in *Ldlr–/–* mice depends on the timing of infection. Comparative Medicine 65(2):114-129

**Domain 1; Primary Species - Mouse (*Mus musculus*)**

**199.** Which of the following statements best describes irradiation of mice for bone marrow ablation?

1. X-ray irradiators utilize radioisotopes such as Cs-137
2. A lower dose of radiation should be used for X-ray irradiation
3. A lower dose of radiation should be used for gamma-ray irradiation
4. Two common types of irradiators are cesium-irradiators and gamma-ray irradiators
5. BALB/c mice are highly resistant to irradiation

**Answer: b. A lower dose of radiation should be used for X-ray irradiation**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 13 – Biomethodology and Surgical Techniques, pp. 453-454.

2) Gibson et al. 2015. Comparison of cesium-137 and x-ray irradiators by using bone marrow transplant reconstitution in C57BL/6J mice. Comparative Medicine 65(3):165-172.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**200.** Which of the following types of wood bedding can emit aromatic hydrocarbons that induce hepatic microsomal enzymes and cytotoxicity and have been reported to increase the incidence of cancer in rodents?

1. Aspen
2. Birch
3. Cedar
4. Maple

**Answer: c. Cedar**

**References:**

1. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter3 – Environment, Housing, and Management, p. 69.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1579.

**Domain 4; Primary – Mouse (*Mus musculus*) and Rat (*Rattus norvegicus*)**

**201.** According to the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act and its regulations, nonhuman primate food receptacles must be sanitized at least how often?

1. Once daily
2. Once a week
3. Once every 2 weeks
4. Once a month

**Answer: c. Once every 2 weeks**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart D – Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, §3.82 (d) Feeding (11-6-13 Edition, p. 102)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter3 - Environment, Housing and Management, pp. 70-72.

**Domain 5**

**202.** A young female rabbit presented with torticollis, paresis, uveitis and kidney failure from a breeding colony. Which of the following statements **DOES NOT** apply to the disease most consistent with these clinical signs?

1. Transmission is primarily via ingestion and transplacental
2. Caesarean hysterectomy rederivation can be used to eliminate the pathogen from a rabbit colony
3. Can infect immunocompromised human patients
4. Histologic diagnosis is possible through examination of brain and kidney samples stained with Giemsa stain

**Answer: b. Caesarean hysterectomy rederivation can be used to eliminate the pathogen from a rabbit colony**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit, pp. 290-294.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, pp. 439-440.
3. Harkness JE, Turner PV, VandeWoude S, Wheler CL. 2010. Harkness and Wagner’s Biology and Medicine of Rabbits and Rodents, 5th ed. Wiley-Blackwell: Ames, IA. Chapter 5 – Specific Diseases and Conditions, pp. 289-291.

**Domain 1; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**203.** Rapid freezing may be used as a method of euthanasia for amphibians such as Xenopus if they weigh less than \_\_\_\_\_\_\_\_\_\_?

a. 4 g

b. 5 g

c. 6 g

d. 7 g

e. 8 g

**Answer: a. 4 g**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 78

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

**Domain 2; Secondary Species – African Clawed Frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**204.** Which of the following statements applies to both natural ingredient and purified diets?

1. Although nutrient ingredients are fixed bioavailability may be altered due to oxidation and nutrient interactions
2. Bioavailability of nutrients is limited in both diets due to the presence of tannins, lignins and phytates
3. Both are inexpensive to manufacture
4. Potential for contamination with pesticides is higher in natural ingredient diets compared to purified diets
5. Purified diets are prepared using elemental compounds

**Answer: d. Potential for contamination with pesticides is higher in natural ingredient diets compared to purified diets**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 12 – Biology and Diseases of Dogs, pp. 515-516.
2. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, pp. 65-67

**Domain 4**

**205.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals, techniques for non-survival surgery should include, at a minimum, which of the following?

a. Surgical site should be clipped and prepped with disinfectant; the surgeon should wear a cap, mask, disposable gown or clean lab coat and sterile gloves; surgery should be performed in a sterile field with sterile instruments

b. Surgical site should be clipped and prepped with disinfectant; the surgeon should wear a cap, mask and gloves; surgery should be performed in a clean area with sterile instruments

c. Surgical site should be clipped; the surgeon should wear gloves; surgery should be performed in a clean area with sterile instruments

d. Surgical site should be clipped; the surgeon should wear gloves; surgery should be performed in a clean area with clean instruments

e. Surgical site should be clipped; the surgeon’s hands should be washed and disinfected; surgery should be performed with clean instruments

**Answer: d. Surgical site should be clipped; the surgeon should wear gloves; surgery should be performed in a clean area with clean instruments**

**References:**

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 4 – Veterinary Care, p. 118.
2. Silverman J, Suckow MA, Murthy S, eds. 2014. The IACUC Handbook, 3rd edition. CRC Press: Boca Raton, FL. Chapter 18 – Surgery, p. 432.

**Domain 5**

**206.** Which of the following naturally occurring conditions is an important cause of morbidity and mortality in owl monkeys?

1. Cardiomyopathy
2. Metabolic syndrome
3. Neoplasia
4. *Plasmodium spp*.
5. Renal disease

**Answer: a. Cardiomyopathy**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 7 - Hematopoietic, Cardiovascular, Lymphoid, and Mononuclear Phagocyte Systems of Nonhuman Primates, p. 372.
2. Knowlen et al. 2013. Hypertrophic cardiomyopathy in owl monkeys (*Aotus spp.*). Comparative Medicine 63(3):279-287

**Domain 1; Secondary Species – Squirrel Monkey (*Saimiri sciureus*) and Tertiary Species - Other Nonhuman Primates**

**207.** Which of the following euthanasia methods can cause acidosis and decrease the cerebral concentrations of sodium and potassium in zebrafish?

1. Carbon dioxide inhalation
2. Ethyl 3-aminobenzoate methanesulfonic acid
3. Eugenol or clove oil
4. Quinaldine
5. Thermal shock (cooling the water)

**Answer: b. Ethyl 3-aminobenzoate methanesulfonic acid**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 21 – Biology and Management of Laboratory Fishes, pp. 1075-1076.
2. Matthews and Varga. 2012. Anesthesia and euthanasia in zebrafish. ILAR J 53(2):192-204.

**Domain 2; Secondary Species – Zebrafish (*Danio rerio*)**

**208.** In collagen-induced arthritis rat models, susceptibility to disease, similar to that found in humans, is associated with which of the following factors?

1. Coat color patterns
2. Major histocompatibility complex class II subtypes
3. Neutrophilic infiltration
4. Tolerance to peripheral nervous system antigens

**Answer: b. Major histocompatibility complex class II**

**References:**

1. Hau J, Van Hoosier GL, eds. Handbook of Laboratory Animal Science, 2nd ed. CRC press, Chapter 10 - Animal Models of Skeletal Disease, p. 205.
2. Brand. 2005. Rodent models of rheumatoid arthritis. Comparative Medicine 55(2):114-122.

**Domain 3; Primary Species - Rat (*Rattus norvegicus)***

**209. Which of the following lists the hierarchy of controls from the most effective to the least effective in controlling biological hazards?**

1. **Elimination of hazard, substitution, engineering controls, administrative controls, PPE**
2. **Elimination of the hazard, PPE, engineering controls, administrative controls, substitution**
3. **Elimination of the hazard, substitution, PPE, engineering controls, administrative controls.**
4. **Elimination of the hazard, engineering controls, PPE, administrative controls, substitution**

**Answer: a. Elimination of hazard, substitution, engineering controls, administrative controls, PPE**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 30 - Occupational Health of Laboratory Animal Workers, p. 1389.
2. Centers for Disease Control and Prevention (CDC). National Institute for Occupational Safety and Health (NIOSH). Workplace Safety and Health Topics. Hierarchy of Controls. http://www.cdc.gov/niosh/topics/hierarchy/

**Domain 4**

**210.** Which of the following studies would be performed using Good Laboratory Practices for Nonclinical Laboratory Studies?

1. Bench tests, such as chemical or physical testing
2. Studies utilizing human subjects, human specimens, clinical studies
3. Field trials in animals (e.g., wildlife studies)
4. *In vivo* or *in vitro* experiment in which a test article is studied prospectively in a test system under laboratory conditions to determine its safety

**Answer: d. *In vivo* or *in vitro* experiment in which a test article is studied prospectively in a test system under laboratory conditions to determine its safety**

**Reference:** 21 CFR, Chapter 1 – Food and Drug Administration, Department of Health and Human Services, Subchapter A – General, Part 58 Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart E--Testing Facilities Operation, §58.1 – Scope and §58.3 Definitions (http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=58&showFR=1)

**Domain 5**

**211.** Which of the following swine breeds are susceptible to malignant hyperthermia?

1. Berkshire and Ossabaw
2. Landrace and Pietrain
3. Hanford and Yucatan
4. Sinclair and Göttingen

**Answer: b. Landrace and Pietrain**

**References:**

1. Smith and Swindle. 2006. Preparation of swine for the laboratory. ILAR J 47(4): 358-363.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 - Biology and Diseases of Swine, p. 752.

**Domain 1; Primary Species – Pig (*Sus scrofa*)**

**212.** Due to alterations in circadian rhythm, 24 hour light in a rodent room can alter physiologic function resulting in \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Stimulation of plasma lactic acid concentration
2. Suppression of corticosterone levels
3. Stimulation of melatonin production
4. Suppression of plasma glucose levels
5. Stimulation of proliferation of tumor xenografts

**Answer: e. Stimulation of proliferation of tumor xenografts**

**References:**

1. Dauchy et al. 2011. Eliminating animal facility light-at-night contamination and its effect on circadian regulation of rodent physiology, tumor growth, and metabolism: a challenge in the relocation of a cancer research laboratory. JAALAS 50(3):326-336.
2. Dauchy et al. 2010. Dark-phase light contamination disrupts circadian rhythms in plasma measures of endocrine physiology and metabolism in rats. Comparative Medicine60(5):348-356.

**Domain 4**

**213.** Which of the following entities is in charge of the international registry of laboratory registration codes on behalf of the International Committee on Standardized Genetic Nomenclature for Mice?

1. AALAS
2. APA
3. ASLAP

d. ILAR

e. NABR

**Answer: d. ILAR**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 34-35.

2) http://dels.nas.edu/global/ilar/Lab-Codes

**Domain 5; Primary Species – Mouse (*Mus musculus*)**

**214.** Which of the following **IS NOT** a characteristic of myoepitheliomas in mice?

1. Common in BALB/c and BALB/cBy mice
2. Arises exclusively from liver
3. Microscopically, tumors are composed of large, pleomorphic spindle cells with epithelial and mesenchymal features
4. Rare metastasis to lung and bone marrow

**Answer: b. Arises exclusively from liver**

**Reference:** Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 120-121.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**215.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, manual cervical dislocation is acceptable with conditions for euthanasia of rats weighing how much when performed by individuals with a demonstrated degree of technical proficiency?

1. < 200 g
2. < 200 g
3. < 250 g
4. < 250 g
5. < 300 g

**Answer: a. < 200 g**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia and Euthanasia, p. 1149.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section I – General, Chapter 4 – Euthanasia and Necropsy, p. 123.
3. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 38
4. (https://www.avma.org/KB/Policies/Documents/euthanasia.pdf).

**Domain 2; Primary Species – Rat (*Rattus norvegicus*)**

1. When must antibody testing be done for any Old World primate that exhibit signs consistent with a filovirus infection during quarantine?
2. As soon as clinical signs appear
3. As soon as clinical signs resolve
4. At the end of the quarantine period
5. Two weeks after the animal is released into the colony

**Answer: c. At the end of the quarantine period**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 - Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 38
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations and Policies Relating to the Care and Use of Nonhuman Primates, p. 50.
3. 42 CFR, Part 71 – Foreign Quarantine, Subpart F – Importations, §71.53 Requirements for importers of nonhuman primates (http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&r=PART&n=42y1.0.1.6.59#se42.1.71\_153)
4. http://www.cdc.gov/animalimportation/lawsregulations/nonhuman-primates/nprm/questions-answers-importers.html

**Domain 4**

**217.** *Corynebactium bovis* is associated with all of the following **EXCEPT**?

1. Aerosolization within a class II biosafety hood spreads bacterium during cage-change procedures
2. Being carried in the nasal pharynx of humans
3. Mild non-suppurative inflammation
4. Successful treatment with topical antibiotics

**Answer: d. Successful treatment with topical antibiotics**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 112-113.

2) Burr et al. 2011. Strategies to prevent, treat, and provoke Corynebacterium-associated hyperkeratosis in athymic nude mice. JAALAS 50(3):378-388.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**218.** Inoculation of mice with mouse parvovirus produces the least serological response in which of the following strains?

a. C3H

b. C57BL/6

c. BALB/c

d. DBA/2

**Answer: b. C57BL/6**

**References:**

1) Henderson et.al. 2015. A comparison of mouse parvovirus 1 infection in BALB/c and C57BL/6 mice: susceptibility, replication, shedding, and seroconversion. Comparative Medicine 65(1):5-14.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 80.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

1. Which of the following best describes the primary purpose of barrier facilities?
2. Prevent transmission of pathogenic agents from animals contained within the barrier to other animals in a facility
3. Exclude the introduction of infectious agents to animals with a defined health status
4. Exclude intrusion of specific personnel from working with rodents
5. Isolate zoonotic agents within a barrier from research personnel
6. Prevent the escape of barrier animals from a facility

**Answer b. Exclude the introduction of adventitious infectious agents to animals with a defined health status**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, pp. 1547-1548.
2. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 5 – Physical Plant, pp. 145-146.

**Domain 4**

**220.** What is the short-term exposure limit for carbon dioxide for employees exposed in a 15-min time interval?

a. 500 ppm

b. 5,000 ppm

c. 30,000 ppm

d. 40,000 ppm

**Answer: c. 30,000 ppm**

**References:**

1) Amparan et al. 2014. Exposure of research personnel to carbon dioxide during euthanasia procedures. JAALAS 53(4):376-380.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 33 - Factors That Can Influence Animal Research, pp. 1447-1448.

3) https://www.osha.gov/dts/sltc/methods/inorganic/id172/id172.html

**Domain 5**

**221.** Which of the following clinical pathology analytes has been found to be significantly lower in aged versus young adult Xenopus laevis?

1. Amylase
2. BUN
3. Calcium
4. PCV
5. Total Protein

**Answer: b. BUN**

**References:**

1. Chang et al. 2015. Biochemical and hematologic reference intervals for aged *Xenopus laevis* in a research colony. JAALAS54(5): 465-470.
2. Wilson et al. 2011. Serum clinical biochemical and hematologic reference ranges of laboratory reared and wild caught *Xenopus laevis*. JAALAS 50(5): 635-640.

**Domain 1; Secondary Species – African Clawed Frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**222.** To minimize potential adverse effects such as renal toxicity and gastric hemorrhage in cattle, \_\_\_\_\_\_\_\_\_\_ should be given as needed every 12-24 hours not to exceed 4 doses?

a. Carprofen

b. Flunixin meglumine

c. Ketoprofen

d. Meloxicam

e. Phenylbutazone

**Answer: b. Flunixin meglumine**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 1179.
2. Jasmin et al. 2011. Perioperative ruminal pH changes in domestic sheep (*Ovis aries*) housed in a biomedical research setting. JAALAS 50(1):27-32.

**Domain 2; Tertiary Species – Other Livestock**

**223.** According to The Guide for the Care and Use of Laboratory Animals, enrichment for aquatic species should be evaluated for which of the following?

a. Bioload

b. Cost

c. Pathogens

d. Taste

e. Utility

**Answer: e. Utility**

**Reference:** National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, pp. 82-83

**Domain 4**

**224.** What is the optimum concentration (in ppm) of chlorine needed to be added in drinking water provided water bottles changed weekly to eliminate *Pseudomonas aeruginosa* and reduce carriage of the organism in infected mice?

a. 0.5 - 1

b. 2.5 - 3

c. 6 - 8

d. 12 - 18

e. 20 – 25

**Answer: c. 6 – 8**

**Reference:**

1)Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1581.

2) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 9 – Design and Management of Research Facilities for Mice, p. 308.

**Domain 4; Primary Species – Mice (*Mus musculus*)**

**225.** Which of the following etiological agents found in nonhuman primates requires a rodent vector, has been reported in *Macaca mulatta, Callithrix jacchus,* and *Saimiri sciureus* among others, and is known to interfere with cardiac studies?

1. *Babesia pitheci*
2. Encephalomyocarditis virus
3. Monkeypox virus
4. *Strongyloides fulleborni*
5. *Trypanosoma cruzi*

**Answer: b. Encephalomyocarditis virus**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 868-869, 880-884.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 3-4, 73 and Chapter 4 – Parasitic Diseases of Nonhuman Primates, pp. 204-206, 220, 222-231

**Domain 1; Primary Species – Macaques (*Macaca spp.*) and Secondary Species – Squirrel Monkey (*Saimiri sciureus*) and Marmoset/Tamarins (Callitrichidae)**

**226.** According to the Animal Welfare Act and its regulations, a licensed veterinarian must inspect a nonhuman primate on a specified date not more than how many days prior to the delivery of the nonhuman primate for transportation?

1. 3
2. 7
3. 10
4. 15
5. 31

**Answer: c. 10**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart G – Records, §2.78 (a)(1) Health certification and identification. Health certification and identification (11-06-13 Edition, p. 48)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 4**

**227.** What is the definition of sanitation?

1. Use an appropriate disinfectant for cleaning of the equipment and environment
2. Maintenance of environmental conditions conducive to the health and well-being of the animal, which involves bedding changes, cleaning, and disinfection
3. Process of inactivating harmful pathogens using various agents, such as chemicals, heat, ultraviolet light, or radiation
4. Procedures intended to protect humans or animals against disease or harmful biological agents

**Answer: b. Maintenance of environmental conditions conducive to the health and well-being of the animal, and involves bedding changes, cleaning, and disinfection**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 27 – Working Safely with Experimental Animals Exposed to Biohazards, p. 1305.
2. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter3 – Environment, Housing and Management, p. 69.

**Domain 4**

1. Which of the following agents is considered a noncore vaccine in cats?
2. Calicivirus
3. *Chlamydophila*
4. Herpesvirus
5. Parvovirus
6. Rabies

**Answer: b. *Chlamydophila***

**References:**

1. 2013 AAFP Feline Vaccination Advisory Panel Report. *Journal of Feline Medicine and Surgery* (2013) 15, p. 785–808, <http://jfm.sagepub.com/content/15/9/785.full.pdf>
2. Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 13 - Biology and Diseases of Cats, pp. 567- 570.

**Domain 1; Secondary Species – Cat (*Felis domestica*)**

**229.** Pesticides should only be used in animal areas following approval by or consultation with the \_\_\_\_\_?

1. Attending Veterinarian
2. IACUC
3. Institutional Official
4. Investigator
5. Safety Officer

**Answer: d. Investigator**

**References:**

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, p. 74
2. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 3 – Husbandry, Housing, and Biosecurity, p. 24.

(http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf**)**

**Domain 3**

**230.** Which of the following **WOULD NOT** lead to gas supersaturation of tank/system water and consequent gas bubble disease in zebrafish?

1. Pumping water from deep wells for use in recirculating systems
2. A leaky pipe supplying water for use in recirculating systems
3. Rapidly cooling hot water and then utilizing in recirculating systems
4. Injection of air from filters upon water changes in recirculating systems

**Answer: c. Rapidly cooling hot water and then utilizing in recirculating systems**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – Biology and Management of the Zebrafish, pp. 1053-1054.
2. Noga, EJ. 2010. Fish Disease: Diagnosis and Treatment, 2nd edition. Wiley-Blackwell: Ames, IA. Chapter 8 – Diagnoses Made by Either Gross External Examination of Fish, Wet Mounts of Skin/Gills, or Histopathology of Skin/Gills, p. 107.

**Domain 1; Secondary Species – Zebrafish (*Danio rerio*)**

END OF EXAM