2015 International Mock Board Exam Coalition

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| Europe | Trinity College Dublin  Dublin, Ireland (mock ECLAM exam) | 10/30/15 |

Practical Section – 120 Questions

**Referenced Answers – 46 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. Identify species of this reptile which is commonly used to teach physiology and anatomy, and is also used as a research model for respiratory physiology because of their apparent resistance to anoxia.

1. Chrysemys picta
2. Terrapene carolina
3. Gopherus polyphemus
4. Trachemys scripta elegans
5. Aspidoscelis sexlineata

**Answer: a. Chrysemys picta**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and Diseases of Reptiles, p. 829.
2. Alworth, L.C., Hernandez, S.M., Divers, S.J. Laboratory Reptile Surgery: Principles and Techniques. *JAALAS*, 50(1): 11-26.
3. <http://blogs.discovermagazine.com/d-brief/files/2013/05/painted-turtle.jpg>

**Domain 3; Tertiary Species – (Chrysemys picta)**

2. What grade of tuberculin skin test score is this most likely to be?

1. Grade 0
2. Grade 1
3. Grade 2 or 3
4. Grade 4 or 5

**Answer: c. Grade 2 or 3**

**References:**

1) JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 724.

2) Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research (Volume 1): Biology and Management, 2nd Edition. Academic Press: San Diego, CA. Chapter 12 – Preventative Medicine in Nonhuman Primates, p. 308.

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

3. In *Oryctolagus cuniculus*, what concurrent pathology has been reported to accompany this lesion?

1. Mammary dysplasia
2. Adrenal gland enlargement
3. Buphthalmia
4. Renal cortical cysts
5. Ovarian cysts

**Answer: a. Mammary dysplasia**

**References:**

1) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press:San Diego, CA. Chapter 16 – Rabbit Neoplasia, pp. 474-475.

2) Sikoski P, Trybus J, Cline JM, Muhammad FS, Eckhoff A, et al. 2008. *Cystic mammary adenocarcinoma associated with a prolactin-secreting pituitary adenoma in a New Zealand White rabbit (Oryctolagus cuniculus)*. Comp Med 58(3):297-300.

**Domain 1; Primary species – *Oryctolagus cuniculus***

4. This is an example of what type of breeding scheme:

1. Recombinant inbred
2. Recombinant congenic
3. Congenic inbred
4. Segregating inbred

**Answer: a. Recombinant inbred**

**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. 36-7.
2. Fox JG, Davisson MT, Quimby FW, Barthold SW, Newcomer CE, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition. Burlington, MA: Elsevier. Chapter 4–Breeding Systems, p. 70.

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

5. What is an indication for use of this equipment in the rodent housing facility?

1. Measuring ATP
2. Measuring ultrasound
3. Measuring ammonia
4. Measuring hydration

**Answer: b. Measuring ultrasound**

**References**:

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. Laboratory Animal Medicine, 2nd edition. American College of Laboratory Animal Medicine, Quimby. Academic Press, 2002. Chapter 29 p. 1150.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition. Chapter 3, p.106.

**Domain 4**

6. The tool depicted in the image is used for:

1. Collecting sperm samples in mice
2. Cerebrospinal fluid collection in mice
3. Embryo transfer in mice
4. Cryopreservation of sperm

**Answer: c. Embryo transfer in mice**

**References**:

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 28 – Transgenic and Knockout Mice, p.1139.

2) Takahashi, H and Liu C. 2010. Archiving and Distributing Mouse Lines by Sperm Cryopreservation, IVF, and Embryo Transfer. *Methods in Enzymology,* 476. p.53-69.

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

7. A group of rhesus involved in an organ transplantation study has severe aplastic anemia. The following sample was obtained from one of the affected individuals. Please select the most likely etiological agent.

a. Adenovirus

b. Filovirus

c. Arenavirus

d. Flavavirus

e. Parvovirus

**Answer: e. parvovirus.**

**References:**

1) Christian Abee, Keith Mansfield, Suzette Tardiff, and Timothy Morris. 2012. Nonhuman Primates in Biomedical Research, two-volume set, 2nd edition. Elsevier. pg. 36

2)Simon MA. [Simian parvoviruses: biology and implications for research.](http://www.ncbi.nlm.nih.gov/pubmed/19793456) *Comp Med*. 2008 Feb;58(1):47-50.

3)[Bailey C](http://www.ncbi.nlm.nih.gov/pubmed/?term=Bailey%20C%5BAuthor%5D&cauthor=true&cauthor_uid=20472806)1, [Mansfield K](http://www.ncbi.nlm.nih.gov/pubmed/?term=Mansfield%20K%5BAuthor%5D&cauthor=true&cauthor_uid=20472806). 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) 2010 May;47(3):462-81.

**Domain 1. Primary species, Rhesus macaque (*Macaca mulatta*).**

8. Proper husbandry and care of which of the following species requires providing this material as it plays a key role in the digestive process?

a. *Ictidomys tridecemlineatus*

b. *Oncorhynchus mykiss*

c. *Columba livia*

d. *Xenopus tropicalis*

e. *Carrasius auratus*

**Answer: c. *Columba livia* (Pigeon)**

**References:**

1) Hubrecht, R and Kirkwood JK, eds. 2010. The UFAW Handbook on the Care and Management of Laboratory and Other Research Animals, 8th edition. Blackwell Publishing: Ames, Iowa. Chapter 44 - Pigeons and Doves, pp. 688-689.

2) Canadian Council on Animal Care – Pigeons and Doves <http://www.ccac.ca/Documents/Standards/Guidelines/Vol2/pigeons_doves.pdf>

**Domain 4; Tertiary Species – Pigeon (Columba livia)**

9. This egg was found during a fecal exam in a 6 month old pig.  What clinical sign is typically seen in pigs infected with this parasite?

a.   No clinical signs

b.   Coughing

c.   Stranguria

d.   Pruritis

e.   Hemorrhagic diarrhea

**Answer: e.   Hemorrhagic diarrhea** (*Trichuris suis-*swine whipworm)

**References:**

1)  Fox JG, Anderson LC, Loew FM, Quimby FW, eds.  2002.  Laboratory Animal Medicine, 2nd edition.  Academic Press: San Diego, CA.  Chapter 15 – Biology and Disease of Swine, p. 652-653.

2)   Baker, DG.  2007.  Flynn’s Parasites of Laboratory Animals, 2nd edition.  Academic Press: Blackwell Publishing: Ames, IA.  Chapter 19- Parasites of Swine, p. 628.

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

10. The items shown are most commonly used for laboratory rabbits for what purpose?

* 1. Enrichment
  2. Weight-training
  3. Optical-testing
  4. Color differentiation testing

**Answer: a. Enrichment**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 32 – Laboratory Animal Behavior, p. 1245.
2. Harriss LD, Custer LB, Soranaka ET, Burge JR & Ruble GR. 2001. “Evaluation of Objects and Food for Environmental Enrichment of NZW Rabbits” *JAALAS,* **40**(1):27-30.

3) [**http://www.bio-serv.com/product/Bunny\_Blocks.html**](http://www.bio-serv.com/product/Bunny_Blocks.html)

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

11. It has recently been recommended that this genotyping/identification technique be performed on mice up to what post-natal day (PND) of age?

1. PND 2
2. PND 7
3. PND 14
4. PND 17
5. PND 21

**Answer: b. PND 7**

**References:**

1. Institute for Laboratory Animal Research. 2011. Guide for the Care

and Use of Laboratory Animals, 8th ed. Washington (DC): National Academies Press, pg. 75

1. Dahlborn K, Bugnon P, Nevalainen T, Raspa M, Verbost P,

Spangenberg E. 2013. *Report of the Federation of European Laboratory*

*Animal Science Associations Working Group on Animal*

*Identification*. Lab Anim 47:2–11

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

12. The following species is categorized by CITES on which appendix?

1. Not listed
2. Appendix I
3. Appendix II
4. Appendix III

**Answer: c. Appendix II**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press, San Diego, CA. Chapter 16 – Biology of Nonhuman Primates
2. <http://www.cites.org/eng/app/2013/E-Appendices-2013-06-12.pdf>

**Domain 5; Secondary Species**

13. Identify the following instrument and its most likely use:

1. Stylet; to aide in intubation of the neonatal trachea
2. Acupuncture needle; to enhance analgesia by stimulating the release of endogenous opioids
3. Trochar; to implant small pellets subcutaneously
4. Peripheral nerve stimulator; to measure the degree of neuromuscular blockade

**Answer: b. Acupuncture needle; to enhance analgesia by stimulating the release of endogenous opioids**

**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 10 – Anesthesia and Analgesia for Laboratory Rodents, p. 275; Chapter 29- Nonpharmacologic Pain Control, p. 626

2) Magden ER, Haller RL, Thiele EJ, Buchl SJ, Lambeth SP, Schapiro SJ. *Acupuncture as an adjunct therapy for osteoarthritis in chimpanzees (Pan troglodytes).* J Am Assoc Lab Anim Sci. 2013 Jul;52(4):475-80.

**Domain 2**

14. A colony of breeding rabbits at your facility began to develop ulcerations with exudation and crusting on the nares and prepuce, as seen in the picture below. You suspect that the lesions are caused by the spirochete, *Treponema paraluioscuniculi.* Which of the following diagnostic tools is recommended for confirming this diagnosis?

* 1. Bacterial culture of lesions
  2. Polymerase chain reaction from oral swabs
  3. Visualization of organisms using electron microscopy
  4. Wet mounts examined by dark-field microscopy

**Answer: d.** Wet mounts examined by dark-field microscopy

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6– Rabbit, p.282
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 9 – Biology and Diseases of Rabbits. P. 343

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

15. What is the following imaging modality and what is it measuring?

* 1. In vivo bioluminescent imaging; measuring luciferase-expressing cells by a specialised CCD camera
  2. In vivo bioluminescent imaging; light source is used to excite the fluorescence and captured by a specialised CCD camera
  3. In vivo fluorescence imaging; measuring luciferase-expressing cells by a specialised CCD camera
  4. In vivo fluorescence imaging; light source is used to excite luciferase-expressing cells and captured by a specialised camera

**Answer: a. In vivo bioluminescent imaging; measuring luciferase-expressing cells by a specialised CCD camera**

**References:**

1. Fox JG, Davisson MT, Quimby FW, Barthold SW, Newcomer CE, Smith AL, eds. 2007. *The Mouse in Biomedical Research, 2nd Ed. : Normative Biology, Husbandry, and Models.* Academic Press: San Diego, CA. Chapter 14 – In-Vivo Whole-Body Imaging of the Laboratory Mouse, p. 506.
2. Walton KD, Lord A, Kendall LV, Dow SW. 2014. Comparison of 3 Real-Time, Quantitative Murine Models of Staphylococcal Biofilm Infection by Using In Vivo Bioluminescent Imaging. Comparative Medicine. 64(1) 25 – 33.

**Domain 3;**

16. How often should the species below be fed to promote growth during the juvenile phase?

1. Daily
2. 2-3 times a week
3. Once a week
4. Every other two weeks

**Answer: a. Daily**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 17 – Biology and Diseases of Amphibians, p. 800-806.
2. Gouchie GM1, Roberts LF, Wassersug RJ. 2008. Effects of available cover and feeding schedule on the behavior and growth of the juvenile African clawed frog (Xenopus laevis). *Lab Animal*, 37(4): 165-9.

**Domain 4; Secondary Species – African clawed frog (Xenopus spp)**

17. The following organisms were found in Boa constrictor used in a research study. What represents the correct categorization of the organism pictured below:

a. Nematode

b. Cestode

c. Arthropod

d. Trematode

e. Filarid

**Answer: c. Arthropod** *Armillifer spp*.

**References:**

1) Baker DG. 2007. Flynn’s Parasites of Laboratory Animals. Second edition. Blackwell. Page 199.

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. p. 225, 852, 470

3) Christian Abee, Keith Mansfield, Suzette Tardiff, and Timothy Morris. 2012. Nonhuman Primates in Biomedical Research, two-volume set, 2nd edition. Elsevier. pg. 271-272

**Domain 1- Tertiary species-Boa constrictor**

18. Your institution has an investigator that does research on the animals shown above. Your rabbit cages are square, 2.5 ft x 2.5 ft and 18 inches tall. They each have a sliding panel so that animals may be housed in pairs. An IACUC member is concerned as one of the grey rabbit’s ears are bent over when they sit up in these cages, although the white rabbits sit up without touching the top. You must do which of the following?

* 1. Provide cages of greater height for the larger rabbit to sit up unobstructed.
  2. The height of your cages is 2 inches greater than described in The Guide, so the cages are fine.
  3. The height is fine for the majority of the rabbits, so the investigator needs an IACUC variance for the one larger rabbit.
  4. The cages are shorter than that described in The Guide, and thus new cages are needed for all the rabbits.

**Answer. a. Provide cages of greater height for the larger rabbit to sit up unobstructed.**

**References:**

1. National Research Council, 2011. The Guide for the Care and Use of Laboratory Animals, Eighth edition. National Academy Press, Washington, DC. P. 59.
2. http://grants.nih.gov/grants/OLAW/faqs.htm#f16

**Domain 5; Primary species – Rabbit (*Oryctolagus cuniculi*)**

19. In the image below, what is the likely cause for the white tail discoloration?

1. low humidity
2. fight wounds
3. ethylene chloride application
4. latent infection with Myocoptes musculinus

**Answer: c. ethylene chloride application**

**References:**

1. Matthias N, Robinson MA, Crook R, Lockworth CR, Goodwin BS. 2013. Local cryoanalgesia is effective for tail-tip biopsy in mice. *J Am Assoc Lab Anim Sci* 52(2):171-175.

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

20. The pictured animal weighing 90g requires what minimum floor area?

1. 76in2
2. 13in2
3. 16in2
4. 17in2

**Answer: c. 16in2**

**Reference:**

1. Institute for Laboratory Animal Research**.** 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. Washington (DC): National Academies Press. Chapter 3 – Environment, Housing, and Management, p. 57.

**Domain 5; Secondary Species – (Mesocricetus auratus)**

21. Which of the species shown above is covered by the Animal Welfare Act?

1. A
2. B
3. C
4. D

**Answer. C. Chinese Hamster (*Cricetulus griseus*).**

**References:**

1. Animal Welfare Act, 1.1 Definitions: Animal.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. p.21.

**Domain 5; Tertiary species – Chinese Hamster (*Cricetulus griseus*)**

22. According to the 2013 AVMA Guidelines on Euthanasia, which method is preferred for euthanizing the pictured species:

a. penetrating captive bolt

b. immersion in buffered tricaine methansulfonate

c. CO2 inhalation

d. immersion in an isoflurane water bath

e. decapitation

**Answer: b) buffered tricaine methansulfonate**

**References:**

1) 2013 AVMA Guidelines on Euthanasia. AVMA. Pg: 77-78.

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd ed. Academic Press: San Diego, CA. Chapter 17 – Biology and Diseases of Amphibians, p. 815.

**Domain 2 – secondary species, Xenopus laevis**

23. Which of the following is true about this assay?

1. Measures mechanical hypersensitivity (grams force)
2. Repeat testing affects the latency for paw withdrawal
3. A cut-off point to prevent tissue damage is not needed
4. Allows for independent testing of both sides of the body
5. Increases the number of animals required for a given experiment

**Answer: d. Allows for independent testing of both sides of the body**

**References:**

1) Chum HH, Jampachairsri K, McKeon GP, Yeomans DC, Pacharinsak C, Felt SA. *Antinociceptive effects of sustained-release buprenorphine in a model of incisional pain in rats (Rattus norvegicus)*. J Am Assoc Lab Anim Sci. 2014 Mar;53(2):193-7.

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 23- Pain Testing in the Laboratory Mouse, p. 552

**Domain 2; Primary Species- Rat *(Rattus norvegicus)***

24. This disinfectant would provide effective sanitization after contamination with which hamster pathogen?

1. *Clostridium difficile*
2. *Mycobacterium avium*
3. Hamster parvovirus
4. LCMV

**Answer: d. LCMV**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 10 – Microbiological Quality Control for Laboratory Rodents and Lagomorphs, pp 370-371.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2006. The Mouse in Biomedical Research, Vol. 3 - Normative Biology, Husbandry, and Models, 2nd edition. Academic Press: San Diego, CA. Chapter 12 – Environmental and Equipment Monitoring, p. 424.

**Domain 4; Secondary Species – Syrian Hamster (*Mesocricetus auratus*)**

25. What is the mode of action and scheduling with respect to the Controlled Substance Act of the following?

a. Non-narcotic analgesic and thus is not scheduled

b. Centrally acting opioid agent that binds to μ-opioid receptor; not a scheduled drug

c. Centrally acting opioid agent that binds to κ opioid receptor; Schedule IV, Controlled Substance Act

d. Centrally acting opioid agent that binds to μ-opioid receptor; Schedule IV, Controlled Substance Act

* 1. Centrally acting opioid agent that binds to κ opioid receptor; not a scheduled drug

**Answer: d. Centrally acting opioid agent that binds to μ-opioid receptor; Schedule IV, Controlled Substance Act**

**References:**

1. Federal Registry, Vol 79(127). <http://www.gpo.gov/fdsys/pkg/FR-2014-07-02/pdf/2014-15548.pdf>
2. Rätsep MT, Barrette VF, Winterborn A, Adams MA, Croy AB. 2013. Hemodynamic and Behavioral Differences after Administration of Meloxicam, Buprenorphine, or Tramadolas Analgesics for Telemeter Implantation in Mice. Journal of the American Association of Laboratory Animal Science. 52(5) 560 – 566.

**Domain 2;**

26. The figure below represents a metabolic cage to house cats. According to the Animal Welfare Act Regulations, how is the minimum space requirement calculated?

1. C x D
2. (C x D) + (A x B)
3. (C x D) – (E x F)
4. (C x D) + (A x B) + (E x F)
5. (C x D) + (A x B) – (E x F)

**Answers: a. C x D. The minimum floor space does not include the elevated surface, and the litter box may be considered part of the floor space.**

**References:**

1. Animal Welfare Act Regulations, November 2013. Part 3-Standards. Section 3.6.b.1.iv

**Domain 4; Secondary species – Cat (Felis domestica)**

27. The instrument shown in this picture was used to assess which stage in a rat?

a. Ovulation

b. Copulation

c. Estrous

d. Pregnancy

**Answer: b. Copulation**

**Reference:**

1) Borjeson TM, et. Al. “Administration of leuteinizing hormone hormone releasing hormone agonist for synchronization of estrus and generation of pseudopregnancy for embryo transfer in rats”. 2014. *JAALAS*. 53(3):232-237

**Domain 3- Primary species – Rat (*Rattus norvegicus*)**

28. A rhesus macaque is observed with the following posture is observed by remote camera. Which of the following is most likely to be true?

* 1. The animal will drink water when you enter the room.
  2. The animal will lie down when you enter the room.
  3. The animal will press its hand to its head when you enter the room.
  4. The animal will sit up straight or stand when you enter the room.
  5. The animal will self-groom when you enter the room.

**Answer: d. The animal will sit up straight or stand when you enter the room.**

**References:**

1. Gaither AM et al. 2014. Videotaped behavior as a predictor of clinical outcome in rhesus macaques (*Macaca mulatta*). *Comp. Med. 64*:193-199
2. Institute for Laboratory Animal Research. 2009. Recognition and alleviation of pain in laboratory animals. Washington (DC): National Academies Press. Chapter 3 – Recognition and assessment of pain, p.48-50

**Domain 2; Primary Species – Macaques (*Macaca species*)**

29. The photograph below is taken from a section of ileum obtained from a hamster with diarrhea. The section is stained with Warthin-Starry strain. What is the most likely etiology?

a. *Citrobacter rodentium*

b. *Salmonella enterica* Typhimurium

c. *Brachyspira hyodysenteriae*

d. *Lawsonia intracellularis*

e. Circovirus

**Answer: d. *Lawsonia intracellularis***

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Management of the Hamsters, p. 180.
2. Vannucci FA and Gebhart CJ. 2014. Recent advances in understanding the pathogenesis of *Lawsonia intracellularis* infections. *Vet Pathol* 51(2):465-477.

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

30. The following non-human primate has an interbirth interval of what length?

* 1. 375 days
  2. 197 days
  3. 1691 days
  4. 127 days

**Answer: a. 375 days.**

**Reference:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research: Diseases, 2nd edition. Academic Press: San Diego, CA. Chapter 8– Reproduction and breeding of Nonhuman Primates, p. 201.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman primates, p. 704.

**Domain 4; Primary Species – (Macaca fascicularis)**

31. Which of the following is true regarding the pictured piece of equipment?

* 1. It is a flexible film isolator used to house gnotobiotic animals under positive pressure ventilation.
  2. It is more expensive and more difficult to modify than stainless steel isolators but more commonly used in gnotobiotic research as they aren’t as heavy
  3. Cannot be damaged by organic chemical or sharp objects.
  4. It is commonly used for biohazardous materials rather than rigid stainless steel isolators as they can operate under negative pressure

**Answer: a. Is a flexible film isolator used to house gnotobiotic animals under positive pressure ventilation.**

**References**

1. Rahija, R. *Gnotobiotics*, Ch. 7 in The Mouse in Biomedical Research: Normative Biology, Husbandry, and Models, 2nd edition, Fox J, Barthold S, Davisson M, Newcomer C, Quimby F, and Smith A. (eds.), p. 218. Elsevier.
2. http://germfreeisolators.com/

**Domain 3**

32. The figure below is a thermograph. The mouse on the left is housed in an individually ventilated cage. The mouse on the right was housed in an individually ventilated cage with a fixed shelter. Which of the following most correctly describes these images?

1. The animal on the left is housed in a colder environment than the one on the right.
2. The animal on the left is under greater cold-stress than the animal on the right.
3. The animal on the left is housed in a warmer environment than the one on the right.
4. The animal on the left has reduced ability to hear and smell compared to the animal on the right.
5. There is no different between the two animals.

**Answer: b. The animal on the left is under greater cold-stress than the animal on the right.** The arrow points to the region of interscapular brown adipose tissue, which is radiating heat due to cold-induced non-shivering thermogenesis.

**References:**

1. David JM, Knowles S, Lamkin D, Stout DB. 2013. Individually Ventilated Cage Impose Cold-stress on Laboratory Mice: a source of experimental variability. *J Am Assoc Lab Anim Sci* 52(6): 738-44.
2. David JM**,** Chatziioannou A, Taschereau R, Wang H, Stout DB. 2013. Quantifying chronic cold-stress of laboratory rodents with non-invasive imaging. *Comp Med* 63(5): 386-91.

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

33. What does the equipment depicted below measure?

a. Depression

b. Memory

c. Avoidance

d. Mechanical allodynia

e. Rotational behavior

**Answer: e. Rotational behavior**

**References:**

1) <http://www.harvardapparatus.com/hapdfs/HAI_DOCCAT_3/BH1_18.pdf>

2) <http://www.panlab.com/panlabWeb/Hardware/ROTAMETER/ROTAMETER.pdf>

**Domain 3**

34. Which of the following is **FALSE** regarding the following condition in a female guinea pig?

1. Clinical signs include alopecia and abdominal distention
2. The condition is usually unilateral
3. Testosterone administration is reported as an experimental cause
4. Incidence of this condition is >75% in older guinea pigs

**Answer: b. The condition is usually unilateral**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, p. 239.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The laboratory rabbit, guinea pig, hamsters, and other rodents. Academic press: Waltham, MA. Chapter 24 – Non-infectious diseases, p. 694.

**Domain 1; Secondary Species**

35. This organism causes icterus, gallbladder distension, splenomegaly, and watery blood in pigs. What is the organism pictured below?

1. Babesia suis
2. Hemobartonella suis
3. Eperythrozoon suis
4. Eimeria suis

**Answer: C Eperythrozoon suis**

**References:**

1. Fox J, Anderson L, Lowe F, Quimby F. Laboratory Animal Medicine, 2nd edition. American College of Laboratory Animal Medicine. Academic Press, 2002. Pg 654.
2. Cynthia M. Kahn and Scott Line 2010. The Merck Veterinary Manual, 10th edition

**Domain 1; Primary Species - Swine**

36. The following photo demonstrates:

1. Mouse cages need to be cleaned on Day 7 if low bedding conditions are present
2. Mouse cages with high bedding conditions do not need to be changed for at least 17 days
3. Mouse bedding levels impact stress levels of mice
4. The level of bedding provided for mice impacts the appearance of caging, with less bedding condition appearing dirtier earlier than medium or high bedding
5. None of the above

**Answer: d.** **The level of bedding provided for mice impacts the appearance of caging, with less bedding condition appearing dirtier earlier than medium or high bedding**

**References:**

1. Rosenbaum MD, VandeWoude S, Johnson TE. 2009. Effects of Cage-Change Frequency and Bedding Volume on Mice and Their Microenvironment. *JAALAS*, 48(6): 763-773.
2. 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, p. 40-41.

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

37. Which of the following images of Syphacia spp. shows a nonviable egg?

**Answer: a. Nonviable egg**

**Reference:**

1) Czarra JA, et. Al. “Exposure to chlorine dioxide gas for 4 hours renders *Syphacia* ova nonviable”. 2014. *JAALAS*. 53(4):364-367.

2) Dix J, et. Al. “Assessment of methods of destruction of *Syphacia muris* eggs”. 2004. *Lab Animal* 38:11-16.

**Domain 4-Animal Care**

38. What is the gestation period of the species pictured?

1. 11-13 days
2. 15-18 days
3. 20-23 days
4. 25-27 days
5. 30-33 days

**Answer: b. 15-18 days (*Mesocricetus auratus*)**

**References:**

1. Suckow MA, Stevens KA, Wilson RP, eds.  2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents.  Academic Press: San Diego, CA.  Chapter 56 – Normative Values, p. 1234.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds.  2002.  Laboratory Animal Medicine, 2nd edition.  Academic Press: San Diego, CA.  Chapter 5 – Biology and Diseases of Hamsters, p. 175.

**Domain 4; Secondary Species – Syrian Hamster (Mesocricetus auratus)**

39. Which of the following statements best characterizes the biosafety cabinet depicted in the image?

* 1. Product protection; a minimum of 75 linear feet per minute face velocity; suitable for work with radionuclides
  2. Product protection; a minimum of 100 linear feet per minute face velocity; not suitable for work with volatile toxic chemicals
  3. Product and operator protection; a minimum of 75 linear feet per minute face velocity; suitable for work with radionuclides
  4. Operator protection; a minimum of 75 linear feet per minute face velocity; suitable for work with radionuclides
  5. Product and operator protection; a minimum of 100 linear feet per minute face velocity; suitable for work with volatile toxic chemicals

**Answer: d. Operator protection; a minimum of 75 linear feet per minute face velocity; suitable for work with radionuclides**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press, San Diego, CA. Chapter 24 – Control of Biohazards, p. 1050

2) Centers for Disease Control and Prevention and National Institutes of Health. 2007. Biosafety in Microbiological and Biomedical Laboratories, 5th edition. U. S. Government Printing Office: Washington, D.C. Appendix A, Section III Biological Safety Cabinets.

**Domain 5**

40. The following contrast agent can be used for the pictured imaging modality:

* 1. Technetium-99 (Tc-99)
  2. Fludeoxyglucose (FDG)
  3. Isovue-370 (Iopamidol)
  4. Luciferase

**Answer: c. Isovue-370 (Iopamidol)**

**Reference:**

1. Fox JG, et al. 2006. The Laboratory Mouse in Biomedical Research (vol 3). Academic Press: San Diego, CA. Chapter 14 –ln-Vivo Whole-Body Imaging of the Laboratory Mouse, p.493.
2. Lalwani K, et al. 2013. Contrast agents for quantitative microCT of lung tumors in mice. *CompMed*, 63(6)482-490.
3. Christou C, et al. 2014. Ovine Model for Critical-size tibial segmental defects. *CompMed*’ 64(5):377-385.

**Domain 3.Primary species.**

41. A 3-year-old male pigtailed macaque (*Macaca nemestrina*) housed in an outdoor compound in Arizona presented with respiratory distress and was euthanized. Histology of the lung is shown above. What is the name of the organism seen in this slide?

1. *Candida albicans*
2. *Mycoplasma pneumonia*
3. *Coccidioides immitis*
4. *Histoplasma capsulatum*
5. *Cryptococcus neoformans*

**Answer: c. *Coccidioides immitis***

**References:**

1. Abee CR, et al. 2012. Nonhuman Primates in Biomedical Research: Diseases, 2nd edition, Elsevier. Chapter 2 – Bacterial and Mycotic Diseases of Nonhuman Primates, p.151-152 and Chapter 9 – Respiratory System Diseases of Nonhuman Primates, p. 458-459.
2. Sherman A and Ham K. 2014. What is your Diagnosis? *JAVMA 245*:1331-1333

**Domain 1; Primary Species – Macaques (*Macaca species*)**

42. What is depicted in the following image and for what types of studies is it useful?

1. the avian chorioallantoic membrane; implantation studies.
2. the avian chorioallantoic membrane; toxicity studies
3. the avian inner intraembryonic membrane; implantation studies
4. the avian inner intraembryonic membrane; toxicity studies

**Answer: a. the avian chorioallantoic membrane; implantation studies**

**References:**

1. Uematsu E et al. 2014. Use of in ovo chorioallantoic membrane engraftment to culture testes from neonatal mice. *Comp Med* 64(4): 264-269.
2. Ribatti D. 2012. Chicken chorioallantoic membrane angiogenesis model. *Methods Mol Biol* 843:47-57.

**Domain 3;** **Tertiary Species – Chickens (Gallus domestica)**

43. What husbandry and management recommendations would you make for the 3 week old, Suffolk lamb pictured?

1. Remove the lamb from the dam; this is likely a bacterial infection that may cause mastitis.
2. No additional precautions are necessary.
3. Gloves and dedicated clothing should be worn when handling the animal or any feed, bedding, or waste that has been in contact with this animal.
4. These lesions are most likely papillomatosis, a zoonotic disease, and a warning sign should be posted on the animal housing room.

**Answer: c. Gloves and dedicated clothing should be worn when handling the animal or any feed, bedding, or waste that has been in contact with this animal.**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 14 – Biology and Diseases of Ruminants: Sheep, Goats, and Cattle p. 573-573.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 25 – Selected Zoonoses p. 1061-1062.
3. Federation of Animal Science Societies. 2010. Guide for the care and use of agricultural animals in research and teaching. FASS. Appendix 2, p. 158-159

**Domain 1; Secondary Species – Sheep (*Ovis aries*)**

44. Identify the piece of equipment below:

1. Transfer port connection
2. Transfer sleeve
3. High-efficiency particulate air filter for supply and exhaust air
4. Supply sterilizing cylinder

**Answer: d. Supply sterilizing cylinder**

**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, p. 222
2. Suckow, MA, Weisbroth SH, Franklin, CL, eds. 2005. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 1 – Historical Foundations, p. 36.
3. <http://www.cbclean.com/sterlizing_cylinders_compare.html> (Vendor product description)

**Domain 3; Primary Species**

45. What is the species and structure indicated by the white arrows:

1. *Mesocricetus auratus* and cecum
2. *Cavia porcellus* and ileum
3. *Oryctolagus cuniculus* and sacculus rotundus
4. *Mustela putorius furo* and cecum
5. *Felis cattus* and ileocecal junction

**Answer: c.  *Oryctolagus cuniculus* and sacculus rotundus**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 9 – Biology and Diseases of Rabbits, p. 331.
2. Suckow MA and Schroeder V. 2010. The Laboratory Rabbit, 2nd edition. CRC Press: Boca Raton, FL. Chapter 1 – Important Biological Features, p. 3.

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

46. Which of the following methods is an unacceptable method of euthanasia for the species depicted below?

1. Inhaled CO2 overdose followed by cervical dislocation
2. Decapitation using a guillotine
3. IP injection of Ethanol
4. Focused beam microwave irradiation
5. Injectable barbiturates and neuromuscular blocking agents

**Answer: e. Injectable barbiturates and neuromuscular blocking agents**

**References:**

1. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition. Part III – Methods of Euthanasia by Species and Environment, S2. Laboratory Animals, S2.2.3 - Unacceptable Methods, p. 49. <https://www.avma.org/kb/policies/documents/euthanasia.pdf>
2. Ingvast-Larsson JC, Axén VC, Kiessling AK. 2003. Effects of isoeugenol on in vitro neuromuscular blockade of rat phrenic nerve-diaphragm preparations. *American Journal of Veterinary Research,* 64(6): 690–693.

**Domain 5; Secondary species – Gerbil (Meriones spp.)**

47. What is this device?

1. Sociability apparatus
2. Shock threshold sensitivity apparatus
3. Step-down passive avoidance apparatus
4. Tail flick assay device
5. Hot plate apparatus

**Answer: e. Hot plate apparatus**

**References:**

1. Carbone ET, Lindstrom KE, Diep S, Carbone L. 2012. Duration of action of sustained-release buprenorphine in 2 strains of mice. JAALAS 51(6): 815-9.
2. Mulder GB, Pritchett K. 2004. Rodent analgesiometry: the hot plate, tail flick, and Von Frey hairs. *Contemp Top Lab Anim Sci*. 43(3):54-5

2) Wilson SG, Mogil JS. 2001. Measuring pain in the (knockout) mouse: big challenges in a small mammal. Behav Brain Res 125:65–73.

**Domain 3; Primary species-mouse**

48. For which one of the nonhuman primate species listed below must the seasonal cycle be considered when managing a breeding colony?

**Answer: a. Rhesus macaque (*Macaca mulatta*)**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research Volume 1: Biology and Management, 2nd edition. Academic Press: San Diego, CA. Chapter 8 – Reproduction and Breeding of Nonhuman Primates, p. 201.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds.  2002.  Laboratory Animal Medicine, 2nd edition.  Academic Press: San Diego, CA.  Chapter 16 – Nonhuman Primates, p. 699.

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

49. The piece of equipment pictured below can be used for all of the following procedures EXCEPT:

1. Changing cages
2. Conducting minor animal procedure
3. Conducting procedure associated with injectable anesthesia
4. Conducting procedure associated with gaseous anesthesia
5. None of the above

**Answer: d. Conducting procedure associated with gaseous anesthesia**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA, p 941-942

2) BMBC (CDC) appendix A (4th ED)

**Domain 4; primary species (Mus and Rattus)**

50. What is an effective treatment for nonhuman primates infected with this parasite?

a. Ketoconazole

b. Nifurtimax

c. Benznidazole

d. No reported effective treatment

**Answer: d. No reported effective treatment**

**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 4 –Parasitic Diseases of Nonhuman Primates. p. 205.
2. [Fong](http://www.ncbi.nlm.nih.gov/pubmed/?term=Fong%20DL%5Bauth%5D), et al 2014.Transmission of Chagas Disease via Blood Transfusions in 2 Immunosuppressed Pigtailed Macaques (*Macaca nemestrina*). *CompMed*, 64(1): 63–67.

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

51. The pathology seen in the lungs would be consistent with what disease of rats.

1. *Mycoplasma pulmonis*
2. Rat Cornoavirus
3. Rat Cardiovirus
4. *Pneumocystis spp*.

**Answer: a. *Mycoplasma pulmonis***

**References:**

* 1. Percy, DH and SW Barthold. Pathology of Laboratory Rodents and Rabbits, 3rd edition. 2007. Blackwell Publishing. Oxford. P144. (and P. 130,135, 157)
  2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. P,142-143.

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

52. What statistical test is most likely the most appropriate for the data set presented below?

1. F tests
2. One-way analysis of variance (ANOVA)
3. Two-way ANOVA
4. Kruskal-Wallis test
5. Student T-test

**Answer: d. Kruskal-Wallis test.** The Kruskal-Wallis test is a nonparametric test that compares three or more unmatched groups. All other options are parametric tests and generally are not appropriate for data sets with non-Gaussian distributions (though additional data processing, such as transformations, can be done to utilize parametric tests). Both references listed below provides an excellent, brief overviews of basic statistical tests for animal experimental design.

**References:**

1. Festing MF and Altman DG. 2002. Guidelines for the design and statistical analysis of experiments using laboratory animals. *ILAR*, 43(3):244-258.
2. GraphPad. <http://www.graphpad.com/guides/prism/6/statistics/index.htm?choosing_parametric_vs__nonpar.htm>

**Domain 3**

53. The infectious agent shown in this image (A. Giemsa stain; B. Wet mount with Nomarski's phase interference) from the brain of *Danio rerio* is most likely:

1. *Pseudocapillaria tomentosa*
2. *Pseudoloma neurophilia*
3. *Mycobacterium marirum*
4. *Piscinoodinium pillulare*
5. *Flavobacterium columnare*

**Answer: b. *Pseudoloma neurophilia***

**References:**

1. Murray KN, Dreska M, Nasiadka A, et al. Transmission, Diagnosis, and Recommendations for Control of *Pseudoloma neurophilia* Infections in Laboratory Zebrafish (*Danio rerio*) Facilities. Comparative Medicine2011;61(4):322-329.<http://zebrafish.org/health/diseaseManual.php#Microsporidiosis>. Image taken from this site.
2. Murray KN, et al. 2011. Transmission, Diagnosis, and Recommendations for Control of *Pseudoloma neurophilia* in Laboratory Zebrafish (Danio rerio) Facilites. Comp med 61(4): pp. 322-329.

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

54. Which of the following statements is **TRUE** regarding the method of euthanasia displayed below in frogs such as *Lithobates pipiens*?

1. This may be used only in unconscious animals as a secondary method of euthanasia
2. This method may be used only after ensuring the absence of respirations and heartbeat by either palpation or auscultation
3. This is prohibited as either a primary or secondary form of euthanasia
4. This may be used as a primary method of euthanasia in awake animals only by skilled individuals
5. The above method shown is incorrect as the preferred entry site is within the oral cavity

**Answer: a. This may be used only in unconscious animals as a secondary method of euthanasia**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 edition, p78.
2. Torreilles, SL, McClure, DE, & Green, SL. 2009. Evaluation and Refinement of Euthanasia Methods for *Xenopus laevis*.  *JAALAS* *48*(5): 512–516.

**Domain 2; Tertiary Species**

55. Cells isolated from the animal above are commonly used to:

a. Propagate LCMV

b. Test efficacy of compounds used to treat diabetes mellitus

c. Produce recombinant proteins

d. Generate orthotopic tumours

**Answer: c. Produce recombinant proteins.**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, p. 190.
2. Suckow MA, Stevens KA, Wilson RP. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Chapter 35 – The Chinese or Striped Back Hamster, p. 908.

**Domain 3; Tertiary Species: Other rodents (Chinese hamster, Cricetulus griseus)**

56. What is the minimum space requirement of a primary enclosure for the pictured animals?

1. 60 square inches
2. 101 square inches
3. 121 square inches
4. 180 square inches

**Answer: b. 101 square inches**

**References:**

1. 9 CFR. 2013. Animal Welfare Regulations. Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Part 3 – Standards, §3.28 Primary enclosures. (b) Space requirements for primary enclosures acquired on or after August 15, 1990 – (1) Guinea pigs – (iii) table. , p. 74-75. 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)**

57. The pictured apparatus may be used to determine which of the following respiratory parameters in *Mus musculus*?

1. Lung compliance
2. Minute ventilation
3. PaCO2
4. Total lung capacity

**Answer: b- minute ventilation.**

**References:**

1. Fox JG, Barthold SW, Davisson MT, et al., eds. The Mouse in Biomedical Research: Vol. 3- Normative Biology, Husbandry, and Models*,* 2nd edition. Academic Press: San Diego, CA. Chapter 2- Mouse Physiology, pages 55 (Table 2-5) and 59 (Fig. 2-8).
2. Rasid O, Chirita D, Iancu AD, et al. *Assessment of routine procedure effect on breathing parameters in mice by using whole-body plethysmography*. 2012. JAALAS 51(4), page 472.

**Domain 3, Primary species -mouse**

58. An investigator asks for your help because one of his highly valued transgenic mouse lines has a very low breeding rate. The picture above represents what you are observing during physical examinations of the mice. What do you recommend to this investigator?

1. The mice appear normal so the investigator should send several male and female mice to necropsy for a complete evaluation
2. Some of the mice appear to have vaginal septa which can be surgically removed to provide breeding performance that is identical to nonseptate females
3. The mice have vaginal plugs indicating normal breeding is occurring
4. Some of the mice appear to have vaginal septa. This is a hereditary condition that is polygenic and transmitted by affected females, as well as unaffected females and males

**Answer: d. Some of the mice appear to have vaginal septa. This is a hereditary condition that is polygenic and transmitted by affected females, as well as unaffected females and males**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pgs. 17, 19, 22, 26.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research: Diseases, 2nd edition. Academic Press: San Diego, CA. Chapter 2 – Mouse adenoviruses, p. 56.

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

59. What identification number is assigned to this packaging if the material inside is an infectious agent that is capable of causing life-threatening or fatal disease in healthy humans?

a. UN 3373

b. UN 2814

c. UN2900

d. UN 2810

**Answer: b. UN 2814**

**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. 5thed. U.S. Government Printing Office, Washington, D. C. Appendix C – Transportation of Infectious Substances, pp. 336-342. **(**<http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5_sect_IV.pdf>)
2. http://www.phmsa.dot.gov/pv\_obj\_cache/pv\_obj\_id\_54AC1BCBF0DFBE298024C4C700569893C2582700/filename/Transporting\_Infectious\_Substances\_brochure.pdf

**Domain 5**

60. This rabbit had clear nasal discharge that became thick and mucoid. It was anorexic, pyrexic, lethargic and dyspneic. It adopted the stance shown in the picture. What would be the most likely cause?

1. Clostridial enterotoxemia
2. Coccidiosis
3. Pasteurella multocida, inner ear infection
4. Fracture of the spine

**Answer:** **c. Pasteurella multocida, inner ear infection**

**References:**

1. Barthold SW, Percy DH. 2007. Pathology of laboratory rodents and rabbits. Blackwell Publishing, Ames, Iowa. Chapter 6, pp. 264-267.
2. Suckow MA, Schroeder V. 2010. The Laboratory Rabbit, 2nd edition. CRC Press: Boca Raton, FL. Chapter 4, p. 39.

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

61. With regard to the husbandry and care of the pictured animal, what is the largest concern?

* 1. The animal will need to be sedated frequently for procedures, so dietary supplementation will be needed.
  2. The animal may develop skin lesions that will need to be treated clinically.
  3. The animal will need to be exempted for social housing, which means that extra enrichment will need to be provided.
  4. The study will need to be halted if the jacket becomes damaged or soiled.
  5. Caging change will be need to be coordinated with the study schedule, because the animal will need to be moved into the tether cage the same day the study is started.

**Answer: b. The animal may develop skin lesions that will need to be treated clinically.**

**References:**

1. Kelly R et al. 2014. Evaluation of the use of primate undershirts as a refinement practice for jacketed rhesus macaques (*Macaca mulatta*). *JAALAS 53*:267-272
2. Association of Primate Veterinarians. [Internet]. 2013. Guidelines for jacket use for nonhuman primates. Available at: http://www.primatevets.org/Content/files/Public/education/NHP\_Jacket\_Use\_Guidelines.pdf

**Domain 4; Primary Species – Macaques (Macaca species)**

62. What is an effective approach to preventing the condition below?

1. Class II type A2 biosafety cabinets
2. Depopulation of immune compromised mice
3. Microisolation cages
4. Tunnel washer (≥180°F) and autoclaved individually ventilated cages

**Answer: d. Tunnel washer (≥180°F)** **and autoclaved individually ventilated cages.** Depopulation of immune compromised mice is not expected to eliminate the condition as C. bovis has been detected in furred immunocompetent mice previously exposed to infected athymic nude mice and in the nasopharynx of humans. *C. bovis* has been documented to transmit within biosafety cabinets. Microisolation cages have also been documented as ineffective.

**References:**

1. Burr HN, Wolf FR, Lipman NS. 2012. *Corynebacterium bovis*: epizootiologic feature and environmental contamination in an enzootically infected rodent rodent. *JAALAS* 21(2):189-198.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 72-73.

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

63. What is the suspected etiology of this condition seen in a hamster?

1. Eimeria
2. Coronavirus
3. Adenovirus
4. Cryptosporidium
5. Rotavirus

**Answer: c. Adenovirus**

**References:**

1. Percy, DH, and Barthold SW, eds. 2007, Pathology of Laboratory Rodents and Rabbits, 3rd Edition, Blackwell Publishing, Ames, IA. Ch.3, Hamster, page 180.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds.2002, Laboratory Animal Medicine, 2nd Edition, Academic Press, San Diego, CA.Ch 5, Biology and Management of Hamsters, page 185

**Domain 1: Secondary species—Syrian Hamster (Mesocricetus auratus)**

64. Which of the following is the most likely explanation for the appearance of the bird shown in the image below?

1. Aggression
2. Heat stress
3. Defensiveness
4. Pain
5. Respiratory distress

**Answer: d. Pain**

**References:**

1. Recognition and alleviation of pain in laboratory animals. 2009. Washington, D.C.: National Academies Press. Chapter 3: Recognition and Assessment of Pain, p. 63.
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 8 – Strategies for Assessing and Minimizing Pain, pp. 207-210.

**Domain 2; Tertiary Species**

65. In the image below from a rabbit, what is the name of the structure indicated by the letter “b” which may be inadvertently entered during urinary bladder catheterization?

1. vesicular gland
2. proprostate
3. prostate
4. bulbourethral gland
5. preputial gland

**Answer: a. vesicular gland.**

**References:**

1. Uthamanthil RK, Hachem RY, Gagea M, Reitzel RA, Borne AT, Tinkey PT. 2013. Urinary Catheterization of Male Rabbits: A New Technique and a Review of Urogenital Anatomy. *JAALAS.* 52(2): 180-185.
2. Suckow MA, Stevens KA, Wilson RP. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Part II – Rabbits, Chapter 8 – Anatomy, Physiology and Behaviour, pp. 203-207

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

66. Which of the following pathologic findings is commonly seen in mice that have recovered from the disease shown in the picture?

1. Bone marrow necrosis
2. Lymphocytic choriomeningitis
3. Chronic hyperplastic typhlocolitis
4. Splenic fibrosis

**Answer: d. Splenic fibrosis**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, IA. Chapter 1- Mouse, page 27.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research: Diseases, 2nd edition. Academic Press: San Diego, CA. Chapter 3- Mousepox, page 79.

**Domain 1, primary species (mouse)**

67. This rodent species is commonly used as a model to investigate the effects of which of the following infectious agent in humans?

* 1. Arboviruses (Yellow fever)
  2. Trypanosoma cruzi
  3. Leishmania
  4. Yersinia pestis
  5. Paramyxoviruses (respiratory syncytial virus)

**Answer: e. Paramyxoviruses (respiratory syncytial virus)**

**Reference:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, p.270.
2. Ayers JD, Rota PA, Collins ML, Drew CP. 2012. Alternatives to retroorbital blood collection in hispid cotton rats (Sigmodon hispidus). *Journal of the American Association for Laboratory Science.* 51(2): 239-45.

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

68. What is the best method for detecting the organism below in the rat?

1. Urine filtration
2. Fecal floatation
3. Cecal scrape
4. Perineal tape test

**Answer: a. Urine filtration**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 150.
2. Bowman MR, Pare JA, Pickney RD. 2004. Trichosomoides crassicauda infection in a pet hooded rat. *Veterinary Record,* 154(12): 374-5.

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

69. Which of the following training aids can be used for teaching endotracheal intubation?

1. Photo A - MD PVC rat model
2. Photo B - Mimolette rat model
3. Photo C - Koken rat model
4. Photo D - Curvet rat model

**Answer: b. Photo B – Mimolette rat model**

**References:**

<http://www.braintreesci.com/prodinfo.asp?number=MIMOLETTE>

**Domain 6: Primary Species- Rat *(Rattus norvegicus)***

70. The image on the left depicts a fundus of a mouse homozygous for the rd1 mutation. What is an affected mouse strain and common manifestations in such mice?

1. C3H and all substrains; vessel attenuation, retinal degeneration
2. DBA/2; vessel attenuation, retinal degeneration
3. BALB/c; vessel attenuation, corneal dystrophy
4. C57BL/6; vessel attenuation, corneal dystrophy

**Answer: a. C3H and all substrains; vessel attenuation, retinal degeneration**

**References**:

1. <http://eyemutant.jax.org/rd1.html>
2. Fox JG, Davisson MT, Quimby FW, Barthold SW, Newcomer CE and Smith AL, eds*.*. The Mouse in Biomedical Research, second edition, Elsevier, 2007, Chapter 25, p.661

**Domain 1: Primary species – Mouse (*Mus musculus*)**

71. For which rat strain is this spontaneous lesion the most common?

* 1. Sprague Dawley
  2. Wistar-Furth
  3. Brattleboro
  4. Fisher 344

**Answer: d. Fisher 344 (Interstitial cell tumor 78% incidence)**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds.  2002.  Laboratory Animal Medicine, 2nd edition.  Academic Press: San Diego, CA.  Chapter 4 – p154
2. Percy DH and Barthold SW, eds. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, IA. Chapter 2 – p174

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

72. The following images are from a 129S4/SvJae mouse upon necropsy. What’s your diagnosis?

1. Acidophilic macrophage pneumonia
2. Amyloidosis
3. Reye’s-like syndrome
4. Pneumocystis sp.

**Answer: b. Acidophilic macrophage pneumonia**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 95-96.
2. Taylor Fox JG et al, eds. 2007. The Mouse in Biomedical Research, Volume 2, 2nd Edition. Academic Press: San Diego, CA. Chapter 25 – Spontaneous Diseases in Commonly Used Mouse Strains, p.634-635.

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

73. This technique represents which of Russell & Burch’s “Three R’s” for surgical mouse embryo transfer?

1. Replacement
2. Refinement
3. Reduction
4. Regulation

**Answer: b. Refinement**

**Reference:**

1) Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals Academies Press: Washington, D.C. Chapter 1 – Key Concepts, p. 4-5.

2) Cui, L. et al. 2014. Transcervical embryo transfer in mice. JAALAS 53(3): 228- 231.

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

74. Of the following partial logos, which one is affiliated with the Office of Laboratory Animal Welfare?

**Answer: A.**

**References**:

1. OLAW: <http://grants.nih.gov/grants/olaw/olaw.htm>
2. Humane Society: <http://www.humanesociety.org/>
3. Peta: <http://www.peta.org/>
4. Animal Health international: <http://events.animalhealthinternational.com/>

**Domain 5**

75. What procedure is being performed here and which structure is best examined using this technique?

1. Slit lamp biomicroscopy/Adnexal structures and cornea
2. Slit lamp biomicroscopy/Anterior vitreous
3. Direct ophthalmoscopy/Fundus
4. Indirect ophthalmoscopy/Fundus

**Answer: d. Indirect ophthalmoscopy/Fundus**

**Reference**:

1. Gelatt KN, ed. 2008. Essentials of Veterinary Ophthalmology. 2nd Edition, Blackwell Publishing, Ames, Iowa. Chapter 1- Ophthalmic Examination and Diagnostics p.13.
2. Gelatt KN, ed. 2007. Veterinary Ophthalmology. 4th Edition, Volume 1, Blackwell Publishing, Oxford, UK. Chapter 9 – Ophthalmic Examination and Diagnostics, p.428.

**Domain 3**

76. The pictured animal displays which of the following captive breeding behaviors?

1. Eusocial, one breeding queen with several non-reproductive workers participating in cooperative brood care
2. Harem breeding, one male for every 4-6 females
3. Monogamous, one male, one female pairings
4. Promiscuous, females and males mate multiple times with multiple mates with no cooperative brood care

**Answer: a. Eusocial, one breeding queen with several non-reproductive workers participating in cooperative brood care**

**References:**

1. Suckow MA, Stevens KA, Wilson RP. 2012. The laboratory rabbit, guinea pig, hamster, and other rodents, 1st ed. London ; Waltham, MA: Academic Press/Elsevier. p.1059 and 1069
2. Ke, Z., et al., *Novel husbandry techniques support survival of naked mole rat (Heterocephalus glaber) pups.* J Am Assoc Lab Anim Sci, 2014. 53(1): p. 89-91.

**Domain 4; Tertiary Species- Naked Mole Rat (Heterocephalus glaber)**

77. This piece of equipment is used to

1. Wash cage racks with multiple sanitation levels
2. Isolate biohazardous agents in class 3
3. Quarantine, contain or house different species in the same area
4. Air shower for entrance into containment facilities
5. Primate enrichment arena

**Answer: C. Quarantine, contain or house different species in the same area**

**Reference:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 21 Design and Management of Animal Facilities, p. 912.
2. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 4 – The Planning, Design and Construction Process, p. 196.

**Domain 4**

78. Which of the following has been shown to occur in mice and/or rats by the euthanasia method portrayed below?

a. Nociceptive responses beginning at CO2 levels of 15%

b. Respiratory alkalosis

c. Decreased corticosterone levels during long exposures to low CO2

d. Lower in vitro fertilization rates as compared to cervical dislocation

e. Decreased exposure times needed for neonates

**Answer: d. Lower in vitro fertilization rates as compared to cervical dislocation**

**References:**

1. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 24-26.

https://www.avma.org/kb/policies/documents/euthanasia.pdf

1. Hazzard KC, Watkins-Chow DE, Garrett LJ, 2014. Method of Euthanasia Influences the Oocyte Fertilization Rate with Fresh Mouse Sperm*. JAALAS* 53(6), p 641-646.
2. McIntyre, AR, Drummond RA, Riedel ER, and Lipman NS, 2007. Automated Mouse Euthanasia in an Individually Ventilated Caging System: System Development and Assessment. *JAALAS* 46(2), p 65-73.

**Domain 2; Primary species - Mice (Mus musculus) and Rat (Rattus norvegicus)**

79. According to the 2013 AVMA Guidelines for the Euthanasia of Animals, the following are acceptable without conditions methods of euthanasia for this species **except**?

1. Injected barbiturates
2. Inhaled anesthetics
3. Topical buffered tricaine methanesulfonate
4. Topical buffered benzocaine hydrochloride

**Answer: c. Inhaled anesthetics**

**References**

1) AVMA Guidelines for the Euthanasia of Animals: 2013 edition.

2) DeNardo, D. Amphibians as Laboratory Animals. ILAR J (1995) 37 (4): 173-181.

**Domain 5; Tertiary Species – Other amphibians**

80. How would you evaluate the following picture of a rat using the rat grimace scale?

1. Moderate orbital tightening and moderate nose/cheek flattening.
2. No orbital tightening and no nose/cheek flattening.
3. Obvious orbital tightening and moderate nose/cheek flattening
4. Moderate orbital tightening and no nose/cheek flattening

**Answer: a. Moderate orbital tightening and moderate nose/cheek flattening**

**References:**

1. [Matsumiya LC](http://www.ncbi.nlm.nih.gov/pubmed?term=Matsumiya%20LC%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Sorge RE](http://www.ncbi.nlm.nih.gov/pubmed?term=Sorge%20RE%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Sotocinal SG](http://www.ncbi.nlm.nih.gov/pubmed?term=Sotocinal%20SG%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Tabaka JM](http://www.ncbi.nlm.nih.gov/pubmed?term=Tabaka%20JM%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Wieskopf JS](http://www.ncbi.nlm.nih.gov/pubmed?term=Wieskopf%20JS%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Zaloum A](http://www.ncbi.nlm.nih.gov/pubmed?term=Zaloum%20A%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [King OD](http://www.ncbi.nlm.nih.gov/pubmed?term=King%20OD%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Mogil JS](http://www.ncbi.nlm.nih.gov/pubmed?term=Mogil%20JS%5BAuthor%5D&cauthor=true&cauthor_uid=22330867). 2012. Using the Mouse Grimace Scale to reevaluate the efficacy of postoperative analgesics in laboratory mice. *JAALAS,* 51(1):42-9.
2. Sotocinal SG, Sorge RE, et al. 2011. The Rat Grimace Scale: A partially automated method for quantifying pain in the laboratory rat via facial expressions. *Molecular Pain* 7, 55-65.

**Domain 2; Primary species – Rat (Rattus norvegicus)**

81. The picture breeding scheme pictured above is used to produce what type of mice?

1. **Coisogenic**
2. **Conplastic**
3. **Consomic**
4. **Congenic**

**Answer: d. Congenic**

**References:**

1. Armstrong NJ, Brodnicki TC, Speed TP. 2006. Mind the gap: analysis of marker-assisted breeding strategies for inbred mouse strains.  *Mamm Genome* 17(4):273-87.
2. 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, p. 37.

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

82. What does this sign indicate?

a. biological hazard

b. chemical hazard

c. explosive hazard

d. radioactive hazard

**Answer: d. radioactive hazard**

**References:**

1. AALAS. 2012. Laboratory Animal Technologist Training Manual. Drumwright & Co.: USA. Ch 6 –Occupational Health & Safety, pg. 70.
2. <http://www.ehs.psu.edu/radprot/rad_signs.cfm>

**Domain 5**

83. At one week with static caging, this effect, likely due to ammonia levels, occurred in mice in which bedding substrate?

1. Irradiated corncob
2. Aspen wood chips
3. Reclaimed wood pulp
4. Recycled newspaper

**Answer: c. Reclaimed wood pulp**

**Reference:**

1) 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. 70.

2) Ferrecchia, C. E., K Jensen, and R. Van Andel. 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)**

84. The investigator pictured below was awarded the Nobel prize for studies involving the invertebrate shown and for which significant scientific breakthrough?

1. Modulation of the cell cycle and programmed cell death
2. Signal transduction in the nervous system
3. Organization of individual and social behavior patterns
4. Genetic mutation and screening for genes in metazoan development
5. Sensitive detection of endotoxin

**Answer: b. Signal transduction in the nervous system** (Species is*Aplysia* *californica)*

**References:**

1. Andrews PL. (2011). Introduction: laboratory invertebrates: only spineless, or spineless and painless? *ILAR J*. 52(2): 121-125.
2. Sattelle DB and Buckingham SD. (2006). Invertebrate studies and their ongoing contributions to neuroscience. *Invert Neurosci*. 6(1): 1-3.

**Domain 5**

85. Which one of the following testing apparatuses is used to evaluate anxiety related behavior in rodents in a novel environment?

1. A
2. B
3. C
4. D
5. E

**Answer: a. A. Elevated Plus Maze**

**References:**

1. Heiderstadt KM, Vandenbergh DJ, Gyekis JP, Blizard DA. 2014. Communal nesting increases pup growth but has limited effects on adult behavior and neurophysiology in inbred mice. *J Am Assoc Lab Anim Sci*. 53(2):152-60.
2. Crawley JN. 2003. Behavioral phenotyping of rodents. *Comp Med*. 53(2):140-6.

**Domain 3, Primary Species (Mouse and Rat)**

86. These spherical structures are a normal finding on urinalysis in which laboratory animal species?

1. *Oryctolagus cuniculus*
2. *Sus scrofa*
3. *Felis catus*
4. *Macaca mulatta*
5. *Mustela putorius furo*

**Answer: a. *Oryctolagus cuniculus***

**References:**

1) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press:San Diego, CA. Chapter 3 – Clinical Biochemistry and Hematology, p. 71; Chapter 8 – Anatomy, Physiology, and Behavior, p. 205.

2) Fox JG, Anderson LC, Loew FM, Quinby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press:San Diego, CA. Chapter 9 – Biology and Diseases of Rabbits, pp. 333, 358.

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

87. The most common site of the condition seen in the guinea pig shown above is:

* 1. The right ventricle
  2. The left ventricle
  3. The right atrium
  4. The left atrium
  5. The epicardium

**Answer: b. The left ventricle.**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 6. Biology and Diseases of Guinea Pigs, p. 239.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, Iowa. Chapter 5 – Guinea pig, p. 220.

**Domain 4; Secondary species – Guinea pig (*Cavia porcellus*)**

88. Which of the following is **TRUE** regarding the disease depicted in mice?

a. It occurs frequently in C57BL, BALB/c and SJL mice

b. It occurs with high frequency in BALB/cByJ mice at a young age

c. It is a common pathologic lesion at necropsy

d. It is associated with a missense mutation in the Abcc6 gene in BALB/c mice

e. Lesions are most often found at the level of the right atrium

**Answer: b. It occurs with high frequency in BALB/cByJ mice at a young age**

**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, p 105-106.
2. Glass AM, Coombs, W, Taffet SM. 2013. Spontaneous Cardiac Calcinosis in BALB/cByJ Mice. *Comparative Medicine* 63(1), p29-37.

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

89. This equipment is required to protect personnel from what hazard?

1. Exposure to ABSL2 infectious agents
2. Contact with temperatures greater than 180F
3. Exposure to noise levels exceeding 85 dBA
4. Muscle injury associated with lifting more than 50 pounds

**Answer: b. Exposure to noise levels exceeding 85 dBA (**Where levels exceed 85dBA, the exposed employees need to participate in a hearing-conservation program that includes monitoring, audio- metric testing, hearing protection, training, and record-keeping).

**References:**

1) 29 CFR 1910.95

2) Occupational Health and Safety in the Care and Use of Research Animals. Institute of Laboratory Animal Resources, National Research Council. National Academy Press, Washington, DC, 1997, p. 41.

**Domain 5**

90. Which condition is most commonly associated with the electrocardiogram changes seen below?

1. 3rd degree atrioventricular block
2. Atrial fibrillation
3. 1st degree atrioventricular block
4. Myocardial infarction
5. Ventricular septal defect

**Answer: d. Myocardial infarction**

**References:**

1. Munz MR, Faria MA, Monteiro JR, Águas, A. P., &Amorim, M. J. 2011. Surgical porcine myocardial infarction model through permanent coronary occlusion. *Comparative Medicine*, 61(5), 445.
2. Preda MB, Burlacu A. 2010. Electrocardiography as a tool for validating myocardial ischemia–reperfusion procedures in mice. *Comparative Medicine*,60(6), 443.

**Domain 1; Primary Species – Mouse (Mus musculus), Pig (Sus scrofa)**

91. According to the Animal Welfare Regulations, which of the following statements is correct regarding the animal pictured below?

* 1. If the animal’s primary enclosure is a sheltered unit, auxiliary ventilation must be supplied if the ambient temperature exceeds 85 degrees F for more than 4 hours
  2. Only animals that are acclimated, as determined by the IACUC, to the prevailing weather conditions may be kept in outdoor facilities
  3. If the animal’s primary enclosure is an indoor housing facility, the ambient temperature must not fall below 45 degrees F or rise above 85 degrees for more than 4 consecutive hours
  4. In outdoor enclosures, the animals must safely provide heat to prevent the ambient temperature from falling below 50 degrees F, except as directed by the attending veterinarian

**Answer: c. If the animal’s primary enclosure is an indoor housing facility, the ambient temperature must not fall below 45 degrees F or rise above 85 degrees F for more than 4 consecutive hours**

**Reference:** CFR 42, Part 3 – Standards, Subpart D – Specifications for the Humane Handling, care, Treatment, and Transportation of Nonhuman Primates, § 3.76 Indoor housing facilities, § 3.77 Sheltered housing facilities, § 3.78 Outdoor housing facilities

**Domain 5; Primary Species – Macaques**

92. The pictured animal is a natural model for what human disease?

1. craniofacial hypoplasia
2. obstructive sleep apnea
3. cutaneous hyperplasia
4. early onset cataracts

**Answer: b. obstructive sleep apnea**

**References:**

1. Toth LA and Bhargava P. 2013. Animal models of sleep disorders. *Comp Med* 63(2):91-104.
2. Hendricks JC et al. 1987. The English bulldog: a natural model of sleep-disordered breathing. *J Appl Physiol* 63(4):1344-1350.

**Domain 3; Primary Species – Dog (Canis familiaris)**

93. For rat IVC racks sanitized semiannually, this effect resulted in what by as early as day 5 after cage change, when sanitation frequency and procedure was assessed?

1. Ammonia levels < 20 ppm
2. Ammonia levels > 20 ppm
3. Condensation in the cage
4. Respiratory problems in the rats

**Answer: b. ammonia levels > 20 ppm**

**Reference:**

1) 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. 71, 73.

2) Creamer, M. A. et al. 2014. Implications of natural occlusion of ventilated racks on ammonia and sanitation practices. JAALAS 53(2): 174- 179.

**Domain 4; Primary Species – Rat (Rattus norvegicus)**

94. What material is this bottle stopper most likely made out of?

* 1. Siliconized rubber
  2. Synthetic neoprene
  3. Polysulfone
  4. Borosilicate

**Answer: b. Synthetic neoprene**

**Reference:**

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 for Mice, pg. 307.

**Domain 4; Primary Species**

95. When using the device pictured below, which of the following considerations is correct?

1. Habituation is never required as there is minimal impact on the animal’s normal behavior
2. Animals may be individually housed with IACUC approval
3. When used for more than 12 consecutive hours, the device must be removed and the animal allowed at least one continuous hour of unrestrained activity daily
4. Animals will always have increased urinary cortisol when the device is being used
5. Behavioral assessments are not a reliable method of assessing that an animal has adapted to the device

**Answer: b. Animals may be individually housed with IACUC approval**

**References:**

1. Institute for Laboratory Animal Research. Guidelines for the Care and Use of Mammals in Neuroscience and Behavioural Research, Committee on Guidelines for the Use of Animals in Neuroscience and Behavioural Research, National Research Council, Division on Earth and Life Studies,. 2003. p.49.
2. Institute for Laboratory Animal Research**.** 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. Washington (DC): National Academies Press. p.29.
3. <http://www.sai-infusion.com/pages/tethered-primate-system>

**Domain 5; Primary Species – Macaques (Macaca spp)**

96. These gross and histologic lesions in the heart of a guinea pig are indicative of what nutritional imbalance?

1. Hypovitaminosis C
2. Hypervitaminosis D
3. Folic acid deficiency
4. Hypovitaminosis E
5. Choline deficiency

**Answer: b. Hypervitaminosis D**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quinby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press:San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, p. 235; Chapter 9 – Biology and Diseases of Rabbits, pp.335-337.

2) Jensen JA, Brice AK, Bagel JH, Mexas AM, Yoon SY, Wolfe JH. 2013. *Hypervitaminosis D in guinea pigs with α-mannosidosis*. Comp Med 63(2):156-162.

Holcombe H, Parry NM, Rick M, Brown DE, Albers TM, Refsal KR, Moris J, Kelly R, Marko ST. 2014.

3) *Hypervitaminosis D and metastatic calcification in a colony of inbred strain 13 guinea pigs, Cavia porcellus*. Vet Pathol DOI: 10.1177/0300985814551423.

**Domain 1; Guinea pig (secondary species)**

97. All work involving inoculation of Hantavirus-containing samples into the depicted species must be conducted at which Animal Biosafety Level?

a. ABSL 1

b. ABSL 2

c. ABSL 3

d. ABSL 4

**Answer: d. ABSL 4**

**References:**

1. CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th Ed., NIH Guidelines. Sept. 2009

**Domain 5; Tertiary Species – Peromyscus maniculatus**

98. Which of the following methods is unconditionally acceptable to euthanize the mice depicted here?

1. CO2 narcosis
2. Hypothermia
3. Decapitation
4. Inhaled agents
5. Injectable barbiturates

**Answer: e. Injectable barbiturates**

**References:**

1. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition. https://www.avma.org/kb/policies/documents/euthanasia.pdf

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

99. This must be used to order which of the following drugs:

a. Buprenorphine

b. Tramadol

c. Ketamine

d. Fentanyl

e. Chloral hydrate

**Answer d: Fentanyl. (**DEA Form 222 or CSOS electronic ordering required for schedule I and II controlled substances).

**References:**

1)CFR Title 21, Part 1305.03

2) USC Title 21, Chapter 13, Section 828

**Domain 5; Multiple species**

100. The species depicted in the picture has been a useful animal model for numerous human diseases. Which of the following statements is **NOT CORRECT** about this species?

1. Prone to develop obesity when fed with a high-energy diet.
2. An appropriate model to study circadian mechanisms that are involved in mood and anxiety disorders in humans
3. They are easy to breed and maintain in captivity
4. Most important reservoir host of zoonotic cutaneous leishmaniasis

**Answer. c. They are easy to breed and maintain in captivity**

**References:**

1. Kane JD, Steinbach T, Sturdivant R, Burks R.Sex-Associated 2012.Effects on Hematologic and Serum Chemistry Analytes in Sand Rats (*Psammomys obesus*) *JAALAS,* 51(6): 769-774.
2. Walder KR, et al. Characterization of Obesity Phenotypes in *Psammomys obesus* (Israeli Sand Rats). .*International Journal of Experimental Diabetes Research*. 2000; 1(3): 177–184.

**Domain 4: Tertiary Species – Other rodents - (Psammomys obesus)**

101. What type of virus is responsible for the development of these lesions in fish?

1. Iridovirus
2. Adenovirus
3. Filovirus
4. Pox virus

**Answer: a. Iridovirus**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 20 – Biology and Health of Laboratory Fishes, p. 904-5.
2. Gibson-Kueh S, Netto P, Ngoh-Lim GH, Chang SF, Ho LL, Qin QW, Chua FHC, Ng ML, Ferguson HW. 2003. The pathology of systemic iridoviral disease in fish. *Journal of Comparative Pathology,* 129 (2-3): 111-119.

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

102. The following depicts a common live food source for what species?

a. *Danio rerio*

b. *Macaca mulatta*

c. *Xenopus laevis*

d. *Heterocephalus glaber*

**Answer: a. *Danio rerio* - *Drosophila* larvae**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Management of the Zebrafish, p. 874.
2. Koerber AS and Kalishman J. 2009. Preparing for a Semiannual IACUC Inspection of a Satellite Zebrafish (*Danio rerio*) Facility. *J Am Assoc Lab Anim Sci* 48(1):65-75.

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

103. What disinfection procedure would be most appropriate for this disease in a Danio rerio colony maintained on a recirculating life-support system? (A) H and E stain of swim bladder. (B) Acid-fast stain of swim bladder bifurcation?

1. Weekly tank cleaning by scrubbing with autoclaved scouring pads and siphoning of debris.
2. Addition of kanamycin into the recirculating tank system for 3 days followed by a complete water change over 3 days. Repeat treatment.
3. Quarantine of life-support system and cessation of breeding for 3 months.
4. Culling of all fish in life-support system, discarding all disposable equipment, and disinfection of the water system and surfaces with bleach for 3 days. Repeat treatment.

**Answer: d. Culling of all fish in life-support system, discarding all disposable equipment, and disinfection of the water system and surfaces with bleach for 3 days. Repeat treatment.**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Management of the Zebrafish, p. 876-877.

2) Murray KN, Bauer J, Tallen A, Matthews JL, Westerfield M, Varga ZM. 2011. Characterization and Management of Asymptomatic Mycobacterium Infections at the Zebrafish International Resource Center. JAALAS 50(5): 675-679.

3) Astrofsky KM, Schrenzel MD, Bullis RA, Smolowitz RM, and Fox JG. 2000. Diagnosis and Management of Atypical Mycobacterium spp. Infections in Established Laboratory Zebrafish (*Brachydanio rerio*) Facilities. Comparative Medicine 50(6): 666 - 672. This reference provided the photo

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

104. This species is considered a valid animal model for which human lentiviral disease?

1. Epstein-Barr Virus (EBV)
2. Human Immunodeficiency Virus (HIV)
3. Human foamy virus (HFV)
4. Kaposi’s Sarcoma-associated Herpes virus (KSHV)

**Answer: b. Human Immunodeficiency Virus (HIV)**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 22 - Preanesthesia, Anesthesia, and Analgesia, p. 460.
2. Guardo, G. D. "Cat Transgenesis and Feline Versus Human AIDS." *Veterinary Pathology Online* 49.5 (2012): 882-883.

**Domain 3; Secondary species- Cat**

105. The pictured device is used for which one of the following tests:

1. Detection of environmental bacterial contamination
2. Antibiotic sensitivity testing
3. ATP detection
4. Bacterial endotoxin testing

**Answer: b. Antibiotic sensitivity testing**

**References:**

1. Towne JW, Wagner AM, Griffin KJ, Buntzman AS, Frelinger JA, Besselsen DG. 2014. Elimination of *Pasteurella pneumotropica* from a mouse barrier facility by using a modified enrofloxacin treatment regimen. *J Am Assoc Lab Anim Sci.* 53(5):517-22
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press, San Diego, CA. Chapter 10 – Microbiological Quality Control for Laboratory Rodents and Lagomorphs, p. 373.
3. https://www.sigmaaldrich.com/content/dam/sigma-aldrich/docs/Fluka/Usage/70191\_2\_mueller\_hinton\_agar\_broth.pdf

**Domain 1**

106. What is the most common clinical sign in *Callithrix jacchus* infected with the RNA virus that caused these lesions on the tongue of *Macaca mulatta*?

1. None
2. Dyspnea
3. Ulcerative dermatitis
4. Polyuria
5. Diarrhea

**Answer: e. Diarrhea**

**References:**

1) Abee C, Keeling ME, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research Volume II: Diseases, 2nd edition. Academic Press:San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 43-46; Chapter 12 – Digestive System Diseases of Nonhuman Primates, p. 605.

2) Ludlage E and Mansfield K. 2003. *Clinical care and diseases of the common marmoset* (*Callithrix jacchus*). Comp Med 53(4):369-382.

**Domain 1; Secondary species – Marmoset/tamarins (Callitrichidae)**

107. These images depict devices used to model what human condition in rodents?

a. learned helplessness

b. depression

c. despair

d. fear

**Answer: b. Depression**

**References:**

1. Mulder GB, Pritchett K. 2004. Rodent models of depression. *Contemp Top Lab Anim Sci*. 43(6):52-4
2. <http://www.harvardapparatus.com/webapp/wcs/stores/servlet/haisku1_10001_11051_60411_-1_hai_ProductDetail_N_37367#fulldescriptiontab>

**Domain 3; K2**

108. Which of the following is **true** regarding the pictured environmental enrichment for primates?

1. This is an example of manipulanda enrichment
2. Time spent on this behavior is reduced in captive research macaques compared to their wild counterparts
3. The picture above shows a macaque interacting with an “Astroturf” board
4. Primates spend about the same amount of time interacting when given one of these items versus when given in combination with other enrichment items

**Answer: b. Time spent on this behavior is reduced in captive research macaques compared to their wild counterparts**

**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, p. 717.
2. Lutz CK, Novak MA. 2005. Environmental enrichment for nonhuman primates: theory and application. *ILAR*, 46(2): 178-91.

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

109. A Principal Investigator requires placing a macaque in the pictured restraint device for more than 12 hours for a study. Which of the following statements is **false** regarding environment enhancement plans for macaques?

1. The macaque must be provided the opportunity daily for unrestrained activity for at least one continuous hour during the period of restraint
2. The attending veterinarian may exempt an individual macaque from participating in the environment enhancement plan because of its health or condition or in consideration of its well-being
3. The IACUC Committee at the research facilities may exempt an individual macaque from participating in the environment enhancement plan for scientific reasons set forth in the research proposal
4. Once attending veterinarian exempts an individual macaque from participating in the environment enhancement plan, the exemption need not be reviewed if the basis for the exemption is a permanent condition
5. Once the IACUC committee exempts an individual macaque from participating in the environment enhancement plan, the basis of the exemption in the approved proposal need not be reviewed for 2 years

**Answer: e. Once the IACUC committee exempts an individual macaque from participating in the environment enhancement plan, the basis of the exemption in the approved proposal need not be reviewed for 2 years**

**References:**

1. 9 CFR. 2013. Animal Welfare Regulations. Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Part 3 – Standards, §3.81 (d) Restraint devices, p. 96. http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf
2. 9 CFR. 2013. Animal Welfare Regulations. Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Part 3 – Standards, §3.81 (e) Exemption. P.96-97.

**Domain 5; Primary species – Macaque (Macaca spp.)**

110. A baboon in your facility presented with weight loss, water diarrhoea, inappetance and apparent abdominal pain. Its fecal sample was collected and fecal flotation performed. Identify the egg shown in the picture below.

1. Anatrichosoma cynomolgi
2. Trichuris trichiura
3. Ascaris lumbricoides
4. Strongyloides cebus
5. Enterobius vermicularis

**Answer: b. Trichuris trichiura**

**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, p. 697.
2. Reichard, M.V, Wolf, R. F., Clingenpeel, L.C., Doan, S.K., Jones, A.N., Gray, K.M. 2008. Efficacy of Fenbendazole Formulated in a Commercial Primate Diet for Treating Specific Pathogen-free Baboons (Papio cynocephalus Anubis) Infected with Trichuristrichiura. *JAALAS*, 27(6):51-55.
3. <http://www.theparasitologist.com/wp-content/uploads/2013/06/Trichuris_trichiura_egg1.jpg>

**Domain 1; Secondary Species – Baboon (Papio spp.)**

111. A gram stain of the causative agent of this disease would show:

1. Slender, gram-positive rods
2. Gram-positive cocci
3. Small, gram-negative rods
4. Gram-negative cocci
5. Pleomorphic, gram-negative coccobacilli

**Answer: a. Slender, gram-positive rods**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 15 – Biology and Diseases of Swine, p. 632-3.
2. Bender JS, Shen HG, Irwin CK, Schwartz KJ, Opriessnig T. 2010. Characterization of Erysipelothrix species isolates from clinically affected pigs, environmental samples, and vaccine strains from six recent swine erysipelas outbreaks in the United States. *Clinical and Vaccine Immunology,* 17(10): 1605-11.

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

112. One of your investigators is planning on capturing the pictured animals and keeping them in flight cages in the Mexican desert for no more than 20 hours, in order to complete a privately funded study involving behavioral testing. As a member of the IACUC at Great Eastern University, which regulations must you consider?

1. Animal Welfare Act holding of regulated species for greater than 12 hours makes this a Study Area
2. Animal Welfare Act holding of regulated species for less than 24 hours does not make this a Study Area
3. Animal Welfare Act does not have to be considered as these are wild-caught bats.
4. Animal Welfare Act does not have to be considered as these are wild-caught bats on a privately funded study.

**Answer. a. Animal Welfare Act holding of regulated species for greater than 12 hours makes this a Study Area**

**References:**

1. Animal Welfare Act, 1.1 Definitions Study Area, Animal.
2. <http://awic.nal.usda.gov/animal-welfare-act-quick-reference-guides#Q11>
3. Wildlife Research and the IACUC; <http://www.nal.usda.gov/awic/newsletters/v10n1/10n1will.htm>

**Domain 5; Tertiary species – Little Brown Bat (*Myotis lucifugus*)**

113. According to the 8th edition of the *Guide*, what is the appropriate space recommendation and housing density for adults of the pictured species?

1. 1.5 L of water per frog
2. 2 L of water per frog
3. 2.5 L of water per frog
4. 5 L of water per frog

**Answer: b. 2 L of water per frog**

**References:**

1. The Guide for the Care and Use of Laboratory Animals. 8th Edition. 2011. Institute of Laboratory Animal Resources, National Research Council, National Academy of Sciences. National Academy Press, Washington, DC, p. 83..
2. http://vivarium.wikia.com/wiki/African\_Clawed\_Frog

**Domain 5. Secondary Species – African clawed frog (Xenopus spp.)**

114. The following condition was found in numerous mice in an institution. Choose the **LESS** likely etiological agent that may cause this condition:

a. *Citrobacter rodentium*

b. Coronavirus

c. Rotavirus

d. Reovirus

e. Polyoma virus

**Answer: e. Polyoma virus**

**References**

1) Miller CL, et. Al. “Isolation of Helicobacter spp. from Mice with Rectal Prolapses”. 2014. [*Comp*](http://www.ingentaconnect.com.ezproxy.library.wisc.edu/content/aalas/cm) *Med*. 64(3):171-178

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. p. 85, 95,-97,108

3) Percy and Barthold. 2007. Pathology of Laboratory rodents and rabbits. 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2- Rats, p. Pg. 8, 55-90

**Domain 1- Primary species – Mouse (*Mus musculus*)**

115. The equipment in this image is used to perform which one of the following tests:

1. Bacteriology testing
2. Environmental testing
3. PCR testing
4. Serology testing
5. Parasite testing

**Answer: d**. **Serology testing**

**References:**

1) Qualification of EZ-Spot® dried-blood-spot (DBS) samples for rodent serology. [Internet]. Charles River Laboratories International, Inc; 2013. [Cited 2014 June 9]. Available from:<http://www.criver.com/files/pdfs/research-models/rm_ld_r_ez_spot.aspx>

2) Opti-Spot: Revolutionizing serology testing by simplifying rodent blood collection. [Internet]. IDEXX Laboratories, Inc; 2013. [Cited 2014 July 25]. Available from:<http://www.idexxbioresearch.com/radil/userfiles/download_files/OptiSpot_SellSheet_072013_US.pdf>.

**Domain 4**

116. Once surgically implanted into a mouse, the device pictured below can be used for **all but which** of the following purposes:

1. Monitoring animal activity
2. Determining systemic blood pressure
3. Measuring core body temperature
4. Blood sampling
5. Recording ECG

**Answer: d. Blood sampling**

**References**:

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 23 – Techniques of Experimentation. p.1034

2) Newsom DM., Bolgos GL, Colby L, and Nemzek JA. 2004. Comparison of Body Surface Temperature Measurement and Conventional Methods for Measuring Temperature in the Mouse. *Contemporary Topics in Laboratory Animal Science,* 43(5): 13-17.

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

117. The use of this material with circle breathing circuits is intended to remove which of the following?

1. Moisture
2. Carbon dioxide
3. Nitrogen
4. Waste anesthetic gases

**Answer: b. Carbon dioxide**

**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 5 – Anesthesia Delivery Systems. pp. 134-135.

2) Smiths Medical – Sodasorb®

<http://www.smiths-medical.com/catalog/sodasorb/sodasorb-low-flow/sodasorb-lf-co-sub.html>

**Domain 2**

118. Which of the following bedding types results is **least** effective at controlling ammonia in mouse cages.

**Answer: c. Reclaimed wood pulp, aka Tek-Fresh.**

**References:**

1. Ferrecchia, CE, Jensen K, VanAndel R. 2014. Intracage ammonia levels in static and individually ventilated cages housing C57BL/6 mice on 4 bedding substrates. *JAALAS*, 53(4):146-151.
2. Smith E, Stockwell JD, Schweitzer I, Langley SH, Smith AL. 2014. Evaluation of cage microenvironment of mice housed on various types of bedding materials. *Contemporary Topics in Laboratory Animal Science*, 43:12-17.

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

119. Which of the following statements is **false** regarding the organism depicted in the image below with Ziehl-Neelsen acid-fast stain?

1. HIV infection is a serious risk factor for development of active disease in humans
2. It can be spread to humans by consumption of non-pasteurized milk and milk products, by handling of infected carcasses and by inhalation
3. An attenuated live vaccine is available and used in other countries but is not used in the United States for immunization
4. BSL-2 practices and procedures, containment equipment, and facilities are required for non-aerosol-producing manipulations of clinical specimens
5. Animal studies using guinea pigs or mice requires Animal Biosafety Level – 3 (ABSL-3)

**Answer: e. Animal studies using guinea pigs or mice requires Animal Biosafety Level – 3 (ABSL-3)**

**References:**

1. CDC and NIH. 2009. Biosafety in Microbiological and Biomedical Laboratories (BMBL), 5th edition. Government Printing Office: Washington, DC. Section VIII – Agent Summary Statements, Section VIII-A – Bacterial Agents, Myobacterium tuberculosis complex, p. 145–147. <http://www.cdc.gov/biosafety/publications/bmbl5/BMBL.pdf>
2. National Research Council. 1997. Occupational Health and Safety in the Care and Use of Research Animals. National Academies Press: Washington DC. Chapter – 5 Zoonoses, p. 85-87.

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

120. For which disease is this non-human primate an important animal model?

1. Atherosclerosis
2. Malaria
3. Tuberculosis
4. Hypertension
5. Osteoporosis

**Answer: b. Malaria**

**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, p. 697.
2. Garland GG. (). Role of squirrel monkey in parasitic disease research. *Institute for Laboratory Animal Research Journal*, 2000 (41) 37-43.
3. <http://www.ietravel.com/sites/default/files/gallery_assist/1/gallery_assist859/prev/squirrel-monkey.jpg>

**Domain 3; Secondary Species - Squirrel monkey (Saimiri sciureus)**

**END OF EXAM!!!!!!!!!!!!!!!!!!!!!!!!**