
# Australian and New Zealand College of Veterinary Scientists

# Fellowship Examination

June 2012

# Veterinary Emergency Medicine and Critical Care

# Paper 1

Perusal time: **Twenty (20)** minutes

Time allowed: **FOUR (4)** hours after perusal

**Section A**: Answer the **ONE (1)** question

**Section B**: Answer **ALL FIVE (5)** questions

**Section C**: Answer **ALL TEN (10)** questions

All questions within each section are of equal value

**Section A**: Essay style: Answer the **ONE** question ..... total 25 marks
**Section B:** Short Answer: Answer **FIVE** questions each worth 10 marks..... total 50 marks
**Section C**: Short Answer: Answer **TEN** questions each worth 2½ marks..... total 25 marks

# Paper 1: Veterinary Emergency Medicine and Critical Care

**Section A: Essay Question**
**Answer all parts of this question.**

1. A 7-year-old male shepherd mix weighing 25kg presents in marked respiratory distress. He has a known history of severe, chronic bronchial disease. Initial arterial blood gas on room air reveals $PaO_2$ 45mmHg and $PaCO_2$ 45mmHg.

   You anaesthetise the dog with injectable anaesthetics, intubate him with an endotracheal tube and place him on FiO2 1.0 at an adequate flow rate. Thoracic radiographs reveal a severe diffuse bronchial pattern static from the last assessment three months ago, and consolidated right cranial and middle lung lobes consistent with concurrent aspiration pneumonia.

   a) Discuss the advantages and disadvantages of placing this dog in right versus left lateral recumbency with regard to the oxygenating efficiency of the lung. *(5 marks)*

   b) Explain in detail the mechanisms by which pneumonia can lead to alveolar collapse, and how that collapse leads to systemic arterial hypoxemia. *(10 marks)*

   c) Draw with solid lines a normal pulmonary pressure-volume curve and label the graphic axes. Superimposed over this normal curve, draw with dashed lines a theoretical pressure-volume curve for this dog. *(3 marks)*

   d) State the **two (2)** equations used to calculate dynamic pulmonary compliance and static pulmonary compliance. *(5 marks)*

   e) On a $FiO_2$ of 1.0, you repeat an arterial blood gas evaluation, which reveals $PaO_2$ 110mmHg and $PaCO_2$ 85mmHg. Based on this dog's known pulmonary pathology, explain the change in $PaCO_2$ observed with this patient. *(2 marks)*

**End of Section A**

**Section B: Short Answer Questions**
**Answer ALL five (5) questions.**

1. Answer **all** subparts of this question.

   a) Describe the major structural characteristics of a normal platelet. *(3 marks)*

   b) Briefly discuss the role of von Willebrands factor in normal coagulation. *(1½ marks)*

   c) Briefly discuss the mechanism by which Von Willebrand factor can contribute to the development of a prothrombotic disease state. *(1½ marks)*

   d) Describe the mechanism of action of **both** aspirin (acetylsalicylic acid) and clopidogrel as anticoagulant therapy for animals at risk of thrombosis. *(4 marks)*

2. Describe in detail the physiologic compensatory mechanisms that occur during acute, severe haemorrhage. *(10 marks)*

3. Answer **all** subparts of this question.

   a) An elevated blood lactate concentration most commonly arises due to compromised oxygen delivery. List **four (4)** causes of an altered blood lactate concentration in patients with **normal or increased** oxygen delivery. *(2 marks)*

   b) Describe the generation of lactic acid as occurs in an anaerobic cellular environment. Contrast this with how lactate can be generated without the development of a concurrent acidosis. Give **one (1)** clinical example of when this might occur, other than from contamination with lactate-containing fluids. *(6 marks)*

   c) State whether it is physiologically appropriate to treat patients that have Type A lactic acidosis using Hartmanns' solution and justify your answer. *(2 marks)*

**Section B continued over page**

4. Regarding pharmacology:

a) Define 'potency.' *(2½ marks)*

b) Define 'efficacy.' *(2½ marks)*

c) Briefly compare and contrast the potency and efficacy of morphine and buprenorphine, and explain the basis for their comparative potency and efficacy. *(2½ marks)*

d) Explain and briefly discuss a pain management plan for a cat following intestinal resection and anastomosis for a septic abdomen that has failed to improve 30 minutes after the administration of 0.01mg/kg buprenorphine IM. *(2½ marks)*

5. Answer **all** subparts of this question.

Regarding tetanus in the dog:

a) Name the two major exotoxins produced by the vegetative form of *Clostridium tetani*. *(2 marks)*

b) Name the most clinically significant toxin and its target tissue. Describe **three (3)** mechanisms of action of this toxin and how it is transported. *(4½ marks)*

c) Describe the mechanism of action of the other, less clinically significant toxin. *(1 mark)*

d) Describe the typical clinical symptoms of tetanus and how they can lead to death. *(1½ marks)*

e) Explain the mode of action of the tetanus antitoxin and discuss its efficacy in a clinically affected patient. *(1 mark)*

**End of Section B**

**Section C: Short Answer Questions**
**Answer ALL ten (10) questions.**

1. Briefly explain why ascites develops in patients with right-sided congestive heart failure. *(2½ marks)*

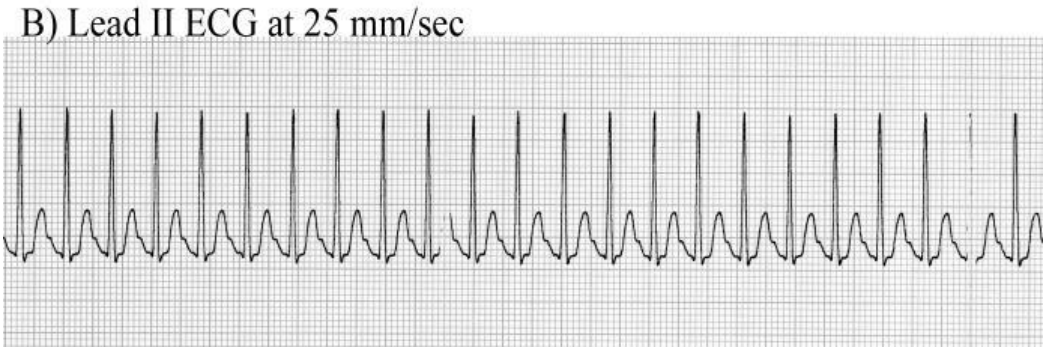
2. Answer **all** subparts of this question.

   a) A capnometer should be used to monitor patients undergoing cardiopulmonary cerebral resuscitation (CPCR). State the target value for end-tidal carbon dioxide tension in a dog undergoing CPCR. *(½ mark)*

   b) Explain the difference behind the rationale for using capnometry during anaesthesia and the rationale for using capnometry during CPCR. *(1½ marks)*

   c) If the end-tidal carbon dioxide fails to meet your stated target value during CPCR, list steps that could be taken to improve it. *(½ mark)*

3. Answer **all** subparts of this question.




   a) Identify the rhythm abnormality in this ECG, recorded from a dog. *(½ mark)*

   b) Identify anatomically where this rhythm originates. *(½ mark)*

   c) Name **three (3)** therapies that can be used to terminate this abnormality and a very brief explanation of where/how each works. *(1½ marks)*

**Section C Continued over page**

4. Answer **all** subparts of this question.

   a) Briefly define the "Gibbs-Donnan" effect. *(1¼ marks)*

   b) Briefly explain how the Gibbs-Donnan principle affects the way an intravenous infusion of 25% albumin changes vascular volume. *(1¼ marks)*

5. Answer **both** subparts of this question.

   a) Venous blood contains significantly more carbon dioxide than arterial blood, yet their partial pressures of $CO_2$ are quite similar. Describe the mechanisms by which this extra $CO_2$ carriage is achieved. *(2 marks)*

   b) State the name of this phenomenon. *(½ mark)*

6. List **two (2)** mechanisms by which hypokalemia contributes to metabolic alkalosis *in vivo*, using the Siggard-Anderson (traditional) perspective to formulate your answer. *(2½ marks)*

7. Answer **both** subparts of this question.

   a) Describe the specific mechanism of action of furosemide, including the targeted region of the kidney, the receptor involved, and the receptor site affected. *(1 mark)*

   b) Explain why co-administration of a thiazide may enhance the diuretic effects of furosemide. *(1½ marks)*

8. Describe the mechanism of action of the drug mycophenolate mofetil and cite **one (1)** of its uses in veterinary medicine. *(2½ marks)*

**Section C continued over page**

9. A bedside screening test (BST) is developed for a newly found virus, Deadly Virus A. During development, a population of 200 dogs is tested, 110 of which are known to have Deadly Virus A and 90 of which are known not to have Deadly Virus A. Of the 110 dogs with Deadly Virus A, 97 of them test positive and 13 of them test negative using the BST. Of the 90 dogs known not to have Deadly Virus A, 22 of them test positive and 68 of them test negative using the BST.

   a) Calculate the sensitivity and specificity of the BST and demonstrate your method of calculation. *(2 marks)*

   b) Calculate the positive predictive value of the BST and demonstrate your method of calculation. *(½ mark)*

10. Briefly explain **two (2)** metabolic complications that can occur when instituting total parenteral nutrition (TPN) therapy in a patient. Briefly mention how to avoid these complications. *(2½ marks)*

**End of paper**

Australian and New Zealand College of Veterinary Scientists

# Fellowship Examination

June 2012

# Veterinary Emergency Medicine and Critical Care

# Paper 2

Perusal time: **Twenty (20)** minutes

Time allowed: **Four (4)** hours after perusal

Answer **ALL <u>FIVE (5)</u>** questions

All questions are of equal value

Questions 3d, 3f and 5c require completion of specific tables located in Answer Booklet A (attached)

Answer **<u>FIVE</u>** questions each worth 20 marks.....total 100 marks.

# Paper 2: Veterinary Emergency Medicine and Critical Care

**Answer ALL five (5) questions.**

1. A 20kg MN Kelpie arrives at your clinic after being hit by a car. On examination you find him to be comatose, he has bilaterally miotic pupils and haemorrhage is evident in the right external ear canal. His cardiovascular parameters suggest hypovolemic shock with pale mucous membranes, slow capillary refill time, a heart rate of 160 bpm, weak femoral pulses and cool extremities. Rectal temperature is 35°C. There is displacement and crepitus of the right humerus indicating a humeral fracture.

   a) Describe your initial therapeutic plan for this patient (first 30 minutes). State doses of any medications given. *(3 marks)*

   b) Venous blood collected before any therapy was administered reveals the following results (see below). These blood gas results are measured at 37°C by default on the blood gas machine. If you were to temperature correct the blood gas results to the patient's actual temperature what parameters would change and in what direction (increase or decrease)? *(1½ marks)*

   PCV = 39%
   TP = 55 g/L
   pH = 7.15
   $PvCO_2$ = 58 mmHg
   $PvO_2$ = 32 mmHg
   $HCO_3$ = 16 mmol/L
   Standardized base deficit = -8 mmol/L
   Lactate = 4.1 mmol/L
   Glucose = 10.5 mmol/L

   c) Briefly explain why temperature affects blood gas results. *(1 mark)*

   d) Indicate which blood gas results you would use to base your management decisions upon; those measured at 37°C or the temperature corrected values. Justify your answer. *(1½ marks)*

   e) The venous blood gas in this case reveals an elevated $PCO_2$. List clinical conditions that could explain this abnormality. *(2 marks)*

**Question 1 continued over page**

f) List clinical conditions that could explain the haemorrhage evident in the right external ear canal. *(1 mark)*

g) Briefly explain the relevance and the pathophysiological mechanisms underlying the hyperglycemia in this dog. *(4 marks)*

h) List the advantages and disadvantages of the use of opioid analgesic drugs in this patient. *(2 marks)*

i) Two hours after presentation the dog develops bradycardia with a heart rate of 45 bpm. Describe your diagnostic and therapeutic approach to this problem. Include a justification for any diagnostic or therapeutic interventions chosen. *(4 marks)*

2. A 4-year-old, female spayed Cocker Spaniel weighing 15kg is referred to you for treatment of suspected immune-mediated hemolytic anaemia (IMHA). The dog has been inappetant and vomiting for three days. On physical examination the dog has 40 breaths per minutes, icteric and pale mucous membranes, strong femoral pulse quality, and warm paws. The patient is mentally dull but responsive. During your examination the dog voids urine that is grossly the colour of red wine. You catch some in a bowl. The referring veterinarian performed in-house automated bloodwork two days ago, and the results are available below.

| Complete blood count | Normal range |
|---|---|
| Haematocrit 24% | (40% - 60%) |
| MCV 70fl | (63fl – 76fl) |
| MCHC 36g/dL | (32g/dL – 36g/dL) |
| WBC 25.0 x $10^{-3}$/mL | (5.3 – 19.8 x $10^{-3}$/mL) |
| Neutrophils 20.0 x $10^{-3}$/mL | (3.1 – 14.4 x $10^{-3}$/mL) |
| Band neutrophils 2.0 x $10^{-3}$/mL | (0 – 0.2 x $10^{-3}$/mL) |
| Lymphocytes 0.5 x $10^{-3}$/mL | (0.9 – 5.5 x $10^{-3}$/mL) |
| Monocytes 2.0 x $10^{-3}$/mL | (0.1 – 1.4 x $10^{-3}$/mL) |
| Eosinophils 0.5 x $10^{-3}$/mL | (0-1.6 x $10^{-3}$/mL) |
| Platelets 42 x $10^{-3}$/mL | (177 – 398 x $10^{-3}$/mL) |

| Serum biochemistry panel | |
|---|---|
| Blood urea nitrogen 17.9 mmol/L | (3.1 – 9.2 mmol/L) |
| Creatinine 221 umol/L | (44.3 – 138.4 µmol/L) |
| Alanine aminotransferase (ALT) 250 IU/L | (8.2 – 57.3 IU/L) |
| Alkaline phosphatase (ALKP) 300 IU/L | (10.6 – 100.7 IU/L) |
| Total bilirubin 42.8 µmol/L | (0.9 – 10.6 µmol/L) |
| Blood glucose 6.6 mmol/L | (3.4 – 6.0 mmol/L) |
| Total protein 65g/L | (55.1 – 75.2 g/L) |
| Albumin 25g/L | (25.8 – 39.7 g/L) |
| Globulin 40g/L | (20.6 – 37.0 g/L) |

**Question 2 continued over page**

a) Name the **three (3)** major, general causes that result in the production of urine that is the colour of red wine. *(1½ marks)* After each of these three major causes, list the most likely aetiology for that cause in this dog. *(1½ marks)*

b) List the in-house tests you will perform to determine which of the three major causes of red urine is present in this dog, and describe how these tests will lead you to the answer. *(2 marks)*

c) Name the diagnostic test(s) you would perform in-house today to confirm the suspected diagnosis of IMHA in this dog, and briefly explain what you are evaluating with each test. *(2 marks)*

d) State the type of immunologic hypersensitivity reaction that causes IMHA. Explain how extravascular haemolysis results in the development of hyperbilirubinemia. *(4 marks)*

e) The owner of this dog requests that you send blood to an outside laboratory for a Coomb's test to confirm the diagnosis, of which you are already quite certain. When the results return, the Coomb's test is negative at the 1:2, 1:4, 1:8 and 1:16 dilutions, but becomes weakly positive at the 1:32 dilution and is strongly positive at the 1:64 dilution. Interpret these results, and explain briefly how the Coomb's test is performed. *(2 marks)*

f) While you await results of today's in-house blood-work, you must decide what your transfusion trigger will be. Define "transfusion trigger" and state what your trigger will be for this dog. Justify your decision. *(3 marks)*

g) The dog's haematocrit today is 8%. Based on the information available, you decide to transfuse the dog. State what your target haematocrit would be for this individual and justify your decision. State what product you would choose to transfuse the patient and the dose you would administer to reach your target haematocrit demonstrating your dosage calculations. *(4 marks)*

**Continued over page**

3. A 3-year-old MC domestic shorthaired cat weighing 4kg is presented by its owners. The cat has been inadvertently locked in a closet for five days without access to food or water. It was previously healthy.

On physical examination, the cat is quiet, and is 10% dehydrated by skin turgor with decreased tear film and dry mucous membranes. He has a somewhat poor body condition (2/5), and his coat is poorly kempt. Hard faeces are palpable in his colon and he has a 2/6 parasternal, systolic heart murmur. His examination is otherwise normal.

Your initial problem list includes dehydration and lack of food and water intake for five days. You perform a blood chemistry panel with electrolytes to evaluate further the cat's status; results are as follows:

| | |
|---|---|
| BUN 23.2 mmol/L | (5.5 – 11.1 mmol/L) |
| creatinine 274 µmol/L | (48.6 – 165.0 µmol/L) |
| ALT 175 IU/L | (8.3 – 52.5 IU/L) |
| ALP 142 IU/L | (12.0 – 65.1 IU/L) |
| total bilirubin 17.1µmol/L | (1.2 – 7.9 µmol/L) |
| $Na^+$ 192 mmol/L | (145.8 – 158.7 mmol/L) |
| $K^+$ 2.5 mmo/L | (3.8 – 5.3 mmol/L) |

a) Considering all available information, list the cat's abnormalities. *(1 mark)*

b) Considering these abnormalities, construct a problem list for this cat. *(2 marks)*

c) Calculate the cat's free water deficit. Demonstrate your calculations and begin with the free water deficit equation. *(4 marks)*

d) In Answer Booklet A, fill in the corresponding table with the correct information, as pertains to the fluids' use <u>in a normal individual</u>. *(4 marks)*

e) Describe in detail your initial fluid therapy and monitoring plan for this cat, including any causes for concern as your plan progresses. *(6 marks)*

f) You instill 1L of 5% dextrose in water into a hypothetical animal intravenously, and 1L of 0.9% NaCl into another hypothetical animal intravenously. In Answer Booklet A, fill in the corresponding table to indicate how many mL of that litre end up in each fluid compartment. Explain your answer in the space below the table. *(3 marks)*

**Continued over page**

4 A 3-year-old spayed female Chihuahua weighing 5kg is presented to your clinic immediately after having been struck by a car. The dog was healthy prior to today's accident. On physical examination the dog has mildly obtunded mental status, rectal temperature 36.8° C, heart rate 180 beats / minute, pale mucous membranes, capillary refill time of 3 seconds, weak femoral pulse quality, and cool paws. When you palpate her abdomen, she tenses and cries quietly; her respiratory rate is 60 breaths / minute; and she has crepitus palpable in her pelvis. The remainder of her examination is within normal limits.

You administer oxygen by facemask and order 6% hydroxyethyl starch to be administered intravenously for shock. You order morphine for pain.

a) State the gauge and length of intravenous catheter you recommend to be used in this case. Explain how the gauge and length of a catheter affect fluid flow rates. *(3 marks)*

b) Discuss the advantages and disadvantages of using 6% hydroxyethyl starch as your resuscitation fluid in this dog. *(4 marks)*

c) You determine with FAST examination that the dog has free peritoneal fluid in the abdomen. You perform abdominocentesis and find that the fluid is red in colour. Name **six (6)** specific tests you could perform on this fluid to determine its origin, citing specifically what endpoints would lead you to a diagnosis. For example, bilirubin could be measured, in which case an endpoint of fluid bilirubin > peripheral serum bilirubin would indicate biliary system rupture. No marks are awarded for listing the example. *(3 marks)*

d) You diagnose the dog with a uroabdomen, and after appropriate stabilisation, you take the dog to surgery for an exploratory laparotomy. Intraoperatively you diagnose the dog with a urinary bladder rupture and there are cystic calculi free in the abdominal cavity. The bladder is bruised and appears thickened and friable. Describe your surgical technique for management of these problems, including a description of any diagnostic samples that should be collected at the time of surgery. *(5 marks)*

e) After correctly performing surgical repair of the problem you have admitted the patient to the ICU. As the clinician in charge of this case writing the instructions for ICU care, do you believe antibiotic therapy is indicated? Justify your answer. *(1 mark)*

f) Eight hours following surgery the patient's urine output drops to 0.2ml/kg/hour. List **six (6)** differential diagnoses for this problem. *(3 marks)*

**Question 4 continued over page**

g) The following urine electrolytes are measured at this time. Explain briefly how result(s) here indicate the presence of a pre-renal cause for low urine output. *(1 mark)*

Urine sodium < 10 mmol/L
Urine chloride = 15 mmol/L
Urine potassium = 28 mmol/L

5. You have diagnosed a previously healthy, 6-year-old male Labrador Retriever with aspiration pneumonia. He remains dyspneic despite bilateral nasal oxygen insufflation at 15 litres per minute, the most oxygen you can provide in your clinic. You perform an arterial blood gas with the following results:

PaO2 49mmHg, PaCO2 43mmHg

You decide to institute mechanical ventilation to support the dog.

a) List here the three major general indications for mechanical ventilation in the dog or cat. *(1½ marks)*

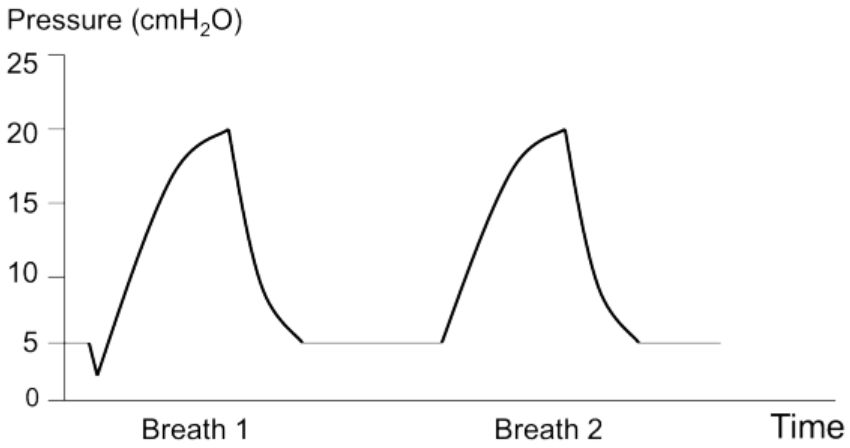
b) Describe your anaesthetic induction and maintenance plan, including medication(s), route(s), and reasoning behind these choices. *(2 marks)*

c) You elect to use pressure control in assist/control ventilation mode. In Answer Booklet A, complete the corresponding table with the initial settings you will use to institute mechanical ventilation for this dog. Include standard units of measure. *(5 marks)*

d) Define 'SIMV'. Explain how this mode of ventilation differs from assist-control mode, and state two indications for the use of SIMV. *(5 marks)*

**Question 5 continued over page**

e) Evaluate the scalar provided below from a normal patient.




i. Identify the:

control variable *(1 mark)*

trigger variable. *(1 mark)*

ii. Name the mode of ventilation. *(1 mark)*

f) By day 2 of mechanical ventilation, the dog's PaO2 is 50mmHg on the following ventilator settings:

FiO2 0.6, RR 30bpm, PEEP 5cmH2O, PIP 25cmH2O

i. List changes, if any, that you would make to the ventilator settings and justify your decision *(3½ marks)*

**End of paper**

**Question 3 d)**

| Fluid name | $Na^+$ mmol/L | $K^+$ mmol/L | Osmolarity: Hypo, Iso, or Hyper? | Tonicity: Hypo, Iso, or Hyper? | COP: Hypo, Iso, or Hyper? |
|---|---|---|---|---|---|
| 5% dextrose in water | | | | | |
| 0.45% NaCl | | | | | |
| Hartmanns Solution | | | | | |
| 6% Hetastarch | | | | | |

**Question 3 f)**

| Fluid type, 1L | Intravascular compartment | Interstitial compartment | Intracellular compartment |
|---|---|---|---|
| 5% dextrose in water | | | |
| 0.9% NaCl | | | |

Explain your answer in this space below the table:

**Question 5 c)**

| | |
|---|---|
| Respiratory rate | |
| Positive end-expiratory pressure | |
| Peak inspiratory pressure | |
| $FiO_2$ | |
| Inspiratory trigger | |