The Hong Kong College of Anaesthesiologists

Intermediate Fellowship Examination

Written Paper in Physiology

15 July 2022 (Friday)

09:00 - 11:00 hours

Instructions:

a. There are twelve pre-labelled answer books. Please make sure you answer the questions in the respective answer book.
b. Write your candidate number on the cover of each answer book.
c. Use ink or ball-point pen.
d. Answer ALL questions. They are worth equal marks and you should spend approximately **ten minutes** for each question. For questions with multiple parts, allocation of marks is indicated in the brackets.

1. Following a laparotomy for haemoperitoneum, below are the results for biochemistry and arterial blood gas analysis of the patient on admission to Intensive Care Unit:

Test	Value	Normal Range	Unit
Sodium	147	135-145	mmol/L
Potassium	3.6	3.2-4.5	mmol/L
Chloride	124	100-110	mmol/L
Hemoglobin	10.6	11.5-15.5	g/dL
pH	7.32	7.35-7.45	
pCO2	4.3	4.6-5.9	kPa
pO2	8.4	10.5-14.5	kPa
Bicarbonate	16.0	24-32	mmol/L
Base excess	-9.0	-2.0 - +2.0	mmol/L

(a) Describe the acid-base status. (20%)

(b) What is the most likely cause of the acid-base disturbance? (10%)

(c) Explain the Stewart's theory of strong ion difference in acid-base physiology. How might this theory explain the acid-base status in this scenario? (70%)

(Calculations need not be shown in your answer)

2. What are the factors determining the movement of fluid between intravascular and interstitial compartments? (50%) Describe how these factors may interact and contribute to the development of pulmonary edema. (50%)

3. **With regard to electrocardiogram (ECG) as a monitor for intraoperative myocardial ischaemia,**

   (a) Outline the difference between the monitor mode and the diagnostic mode. (30%)

   (b) Explain how the use of 5-lead ECG could improve the detection of myocardial ischaemia as compared to 3-lead ECG. (70%)

4. **Describe the lower oesophageal sphincter (30%). Describe the physiological factors that contribute to the competence and tone of the lower oesophageal sphincter (70%).**

5. **Discuss the physiological factors that prevent clot formation within normal blood vessels.**

6. **Describe the maternal cardiovascular changes during pregnancy and labor and outline their clinical significance.**

7. **Define cerebral metabolic rate of oxygen consumption ($CMRO_2$) and give its normal value (30%). Explain why the brain is particularly susceptible to ischaemia (30%). Describe how $CMRO_2$ is affected by body temperature (40%)**

8. **What are the factors that regulate renin secretion from the juxtaglomerular cells inside the kidney (60%)? How does normal pregnancy affect renin secretion (40%) ?**

9. **Describe the gradient between arterial and end-tidal carbon dioxide tension (a-$ETCO_2$ gradient) in normal subjects (40%). Outline the factors affecting the a-$ETCO_2$ gradient (60%).**

10. **Describe and explain the factors that affect airway resistance.**

11. **List the physiological changes following complete autonomic failure of both the sympathetic and parasympathetic systems.**

12. **Describe the complement cascade (50%) and outline its role in an immunological response (50%).**

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