COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

REPORT OF THE

INTENSIVE CARE FIRST PART EXAMINATION

March/May 2023

This report is prepared to provide candidates, tutors, and their supervisors of training with information about the examination. The report does not constitute model answers but is a guide as to what was expected.

Unsuccessful candidates should read and then discuss the report with their tutors to prepare appropriately for future examinations.

The exam included two 2.5 hour written papers, each comprised of ten short answer questions and fifty multi-choice questions. Candidates were required to perform at a satisfactory level in the written before being eligible to present for the oral part of the exam. The oral was comprised of eight ten-minute viva stations.

OVERALL STATISTICS

Total number of candidates presenting for the written examination: **76**

Number of candidates scoring > 50% in the written: **30**

Number of candidates scoring 45 – 50% in the written: **7**

Number of candidates carrying a written score: **0**

Total number invited to the oral section based on written marks: **37**

Total number of candidates successful at the CICM First Part Exam: **34**

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WRITTEN SECTION

EXAMINERS' COMMENTS

Candidates are reminded that all questions are scored equally, hence time should be apportioned accordingly. On occasion some questions were not attempted, and this denies the candidate an opportunity to gain valuable marks. Candidates are encouraged to attempt all questions.

Candidates are expected to have a detailed knowledge and depth of understanding of the syllabus and are strongly encouraged to read widely. Candidates should refer to the Glossary of Terms provided in the exam to determine the depth and breadth required to answer each question. Answers in point form are acceptable and recommended. Candidates are also reminded to ensure their writing is legible.

MULTIPLE CHOICE QUESTIONS

86% of candidates passed overall.

92% of candidates passed Paper 1.

82% of candidates passed Paper 2.

SHORT ANSWER QUESTIONS

1. Outline the abnormalities in the following arterial blood gas (25% of Marks). Explain the Stewart approach to acid-base interpretation (75% of Marks).

21% of candidates passed this question.

High performing answers correctly outlined the ABG findings including consideration of electrolyte abnormalities, A-a gradient, acid-base disturbance (including anion gap and strong ion difference) and whether compensation was appropriate. The best explanations of the Stewart approach described its physicochemical basis, discussed the independent variables (strong ions, total weak acids, and pCO2) in detail, and described their effect on the dependent variables and how they result in acid-base derangements.

The ABG provided depicted an incorrect base excess with an omission of (-) symbol. Candidates were marked accordingly depending on their response to this and all candidates were compensated equally for the confusion that this may have caused.

2. Describe the factors affecting drug absorption throughout the gastrointestinal tract.

39% of candidates passed this question.

This question required candidates to draw on knowledge across the syllabus. Many candidates did not appreciate the breadth required to adequately address this question unfortunately providing very detailed information on only aspects of the answer required to pass.

Excellent answers described the following: differences between different GI routes/ sites of absorption, mechanisms of absorption including Fick's law of diffusion, drug formulations, drug factors (including concentration gradient, lipid solubility, ionisation, and molecular weight), site factors (including surface area, first pass metabolism, GI wall thickness, blood flow, and GI motility/ transit time). Marks were also given for consideration of drug interactions, enterohepatic recycling, and luminally active drugs.

3. Outline the principles of measurement of end-tidal CO_2 using infrared radiation (25% of Marks). Describe the potential sources of error when using this modality and how they may be mitigated (75% of Marks).

21% of candidates passed this question.

The principles of infrared (IR) measurement of expired CO_2 was answered in acceptable detail by most candidates. Sources of error were rarely identified nor explained in acceptable detail. Many candidates demonstrated errors of understanding when attempting to answer this section. Important concepts not covered by numerous candidates included side-stream vs mainstream techniques; how the Beer-Lambert law is applied and how concentration is used for partial pressure; what is the role of sapphire glass and the difference between collision broadening and additional IR absorption by N_2O.

4. Explain the structural features of the alveolus that facilitate its function?

14% of candidates passed this question.

The question asked for an explanation of the structural features of the alveolus that facilitate its function. Candidates who scored well integrated the specific anatomical and structural elements of the alveolus with the multiple functions of the alveolus, including the relevant explanation regarding mechanisms. No marks were given for simply listing the structural features of an alveolus without an explanation on how this facilitates function, nor for listing functional requirements of an alveolus without explaining whether or how they are met by its structure. For the same reason, this was one question where simply listing equations with no discussion as to how these relate to the structure and function of the alveoli garnered no marks. Equations were not required for full marks but may be an efficient way to represent physical relationships that are hard to write in a few words. Common omissions included a description and the role of collagen and elastin fibres, capillary structure, the filtration function of the membrane, lymphatic drainage, recruitment and distensibility and metabolic functions. Candidates are encouraged to practice model answer templates for these integrative questions in the months leading up to the exam.

5. Describe renal handling of potassium (60% of Marks), including physiological factors that may influence it (40% of Marks).

33% of candidates passed this question.

This question related to the renal handling of potassium, the physiology of potassium in the rest of the body was not relevant. Ultimately net potassium flux is a function of filtration, reabsorption, secretion and excretion. Good candidates divided the nephron into relevant sections and described how potassium was handled in each section. They correctly described the percentage reabsorption along each section, as well as the relevant active and passive pathways for reabsorption and/or secretion including the cells and channels/pumps involved. The physiological factors regulating each of these mechanisms were then described in correct detail.

6. Describe pancreatic secretions and their regulation.

21% of candidates passed this question.

It was vital to recognise and describe both the exocrine and endocrine secretions of the pancreas and their regulation. Insulin, glucagon, and somatostatin are all secreted from the pancreas and their omission was the most common reason for not passing this question. Many candidates unfortunately wrote solely on exocrine secretions. Satisfactory answers provided a moderate amount of detail on both the endocrine (insulin, glucagon and somatostatin) and exocrine (bicarbonate and digestive enzymes; trypsin/chymotrypsin, pancreatic amylase and lipase) secretions of the pancreas including what determines their secretion.

7. Define basal metabolic rate and outline the factors that affect it (60% of marks). Outline the ways it may be measured (40% of Marks).

64% of candidates passed this question.

The first part of the question required candidates to define basal metabolic rate (BMR), identify the standardised conditions under which it is estimated and then elaborate on those conditions which affect it. Most candidates provided reasonable definitions but lost marks for not describing the standard conditions under which it is defined. Many were able to give a comprehensive list of factors that affected BMR however lacked the additional pertinent facts required in an outline question to achieve full marks. Candidates are again referred to the glossary to understand the difference between a list and outline question.

The second part of the question pertained to the measurement of BMR which was not as well answered and understood. Overall, there was a limited ability to discuss direct and indirect calorimetry clearly and some responses confused the two.

8. Describe the cardiovascular and respiratory effects of positive pressure ventilation.

21% of candidates passed this question.

This question required a breadth of response that was largely unrepresented in the answers provided by candidates. Better answers divided responses into cardiovascular effects and respiratory effects however many did not provide sufficient detail or provided only detail on some of the effects and missed the breadth of the question. Cardiovascular effects could be grouped into effects on the; right heart, left heart, ventricular interdependence, cardiac output, other circulations, baroreceptor and hormonal reflexes. Respiratory effects could be grouped into lung volumes, dead space, V/Q matching, compliance, airway resistance and the effect of excessive pressures on the lung. Despite this division in the question many candidates abandoned a structure which made their answers and explanations lack clarity. The examiners commented that most candidates who wrote an answer in paragraph format were likely to provide long vague answers rather than those more factual and succinct answers presented in a format with headings as above and pertinent associated dot point descriptions underneath these headings.

9. Define pain (10% of Marks). Describe how pain is detected and modulated in response to a peripheral noxious stimulus? (90% of Marks)

26% of candidates passed this question.

Candidates were expected to give a reasonable definition of pain incorporating the experience and tissue damage. Most candidates only partially incorporated both the actual or perceived harm and the sensory and emotional experience that is included in its formal definition. This question was then best answered by breaking down pain transmission and modulation into; peripheral, spinal cord, cortex, and central downregulation pathways. Good answers provided detailed and specific descriptions of the sensors, neural pathways, synapses, receptors, and neurotransmitters. Whilst pain transmission at the level of the spinal cord is complex, breaking this down into 1st and 2nd order neurons, main neurotransmitters and accessory neurotransmitters from interneurons and descending pathways was helpful. Whilst many covered some of this conceptually most answers did not provide sufficient detail to be considered a pass level answer. Many candidates described the withdrawal reflex to pain in detail which was not asked for and therefore did not attract marks.

10. Describe the pharmacology of salbutamol (70% of Marks), including the principles and efficacy of methods of delivery (30% of Marks).

20% of candidates passed this question.

Good candidates answered this question in 4 parts; pharmaceutics, pharmacokinetics, pharmacodynamics and delivery devices. The most common reason for not passing this question was providing vague statements without explanation or the specific information required. Candidates were expected to comment on importance of particle size and drug delivery, patient compliance, the effect of a spacer and systemic effects of different routes of administration. Whilst some candidates did make reference to this it lacked the detail required to demonstrate that they understood the concepts.

11. Outline the Vaughan Williams classification of anti-arhythmic drugs with examples (30% of Marks). Describe the relevant pharmacology of adenosine (70% of Marks)

67% of candidates passed this question.

The high pass rate of this question was largely due to the ability of most candidates to reproduce the VW classification, with correct information regarding each class with examples. The pharmacology of adenosine was less consistently covered and whilst most kept to the usual pharmacology structure correct detail was often lacking to achieve high marks for this section.

12. Describe the physiology of cerebrospinal fluid (CSF).

88% of candidates passed this question.

This question has been repeated multiple times. Better answers demonstrated a structured approach to discussing the physiology of CSF dividing concepts into; Formation and Composition, Regulation and Circulation, and Functions of CSF with the appropriate level of detail.

13. Describe the structure and function of adult hemoglobin.

25% of candidates passed this question.

Good answers provided detail about the specific composition of haemoglobin and related the pertinent features of the molecule to its functions in the carriage of oxygen, carbon dioxide and its role in acid-base balance, including the appropriate mechanistic description. Many candidates provided information on the production and breakdown of haemoglobin which was not required. Many candidates provided an unnecessary amount of detail and diagrams of the oxygen haemoglobin dissociation curve which did not score additional marks.

14. Describe the pharmacology of oxygen.

51% of candidates passed this question.

Candidates who approached this question in a structured pharmacology approach were able to score well, outlining the pharmaceutics, pharmacodynamics, and pharmacokinetics. Many candidates limited their pharmacodynamic discussion to adverse effects of oxygen only or listed effects without demonstrating understanding of their mechanism or consequences which limited their ability to score marks.

15. Describe the adult coronary circulation (50% of Marks) and its regulation (50% of Marks).

66% of candidates passed this question.

For this question a good answer should have encompassed a description of the following components; the arterial supply (epicardial, endocardial supplies), venous supply (major and minor venous drainage), the phasic ventricular blood supply, a description of and the relevance of the high oxygen extraction ratio, an emphasis on metabolic autoregulation whilst including any other mechanisms of physiological regulation.

Most candidates provided reasonable detail surrounding the arterial-circulation and the area of the heart these vessels supply. Less well described were the perforating branches, the capillary network and the venous drainage, these components were often incorrectly described or left out of the candidate answers. Most candidates correctly identified the phasic flow and the difference in flow that occurs between the right and left ventricle. Those candidates that used diagrams to explain this were rewarded when these diagrams were labelled and accurate with respect to their systolic and diastolic distinction. The control of regulation was less well answered with generic statements not specifically identifying the local metabolic controls importance over any other mechanism. Those answers that scored well coupled the metabolic control to the flow dependence highlighting the high oxygen extraction within the coronary circulation.

16. Outline the role of the hypothalamus.

29% of candidates passed this question.

This question required candidates to integrate parts of the syllabus that are often not presented together in the reference texts. Many candidates provided only an incomplete list of the roles of the hypothalamus as their answer which did not score enough marks to pass. Additionally, presenting information succinctly and in a format that demonstrated an understanding of priority of function with respect to the CICM syllabus, was critical for time management and ensuring that more the important/major roles were presented in more detail. This question required candidates to cover roles including autonomic control, thermoregulation, hormonal regulation, body rhythms and regulation of drives with feedback control mechanisms where appropriate. Those who scored well demonstrated a comprehensive breadth of knowledge of these areas as well as giving the pertinent points around areas of positive and negative feedback and the sensor areas and effector responses required to answer an outline question.

17. Explain the following components of an electrocardiogram (ECG) machine; electrodes, leads, amplifiers and filters. (70% of Marks) Outline methods employed to reduce artefact. (30% of Marks)

39% of candidates passed this question.

Good answers described electrode components, intensity of signals measured (requirement for and levels of amplification), lead position and differences between unipolar and bipolar leads. Rationale and mechanisms of filtering were less well described. Description of high- and low-pass filtering along with detail on monitoring and diagnostic modes scored marks. Patient-related, electrical and environmental methods of reducing artefact attracted marks.

18. Explain the respiratory changes that occur at term in pregnancy.

43% of candidates passed this question.

Good answers addressed the following in an ordered way: anatomic changes (including to airway, thoracic dimensions, dead space, airways resistance); what changes there are to respiratory volumes, capacities, and compliance; what happens to oxygen consumption and oxygen tension; and the acid-base changes that occur. Good answers didn't just list these changes, but also provided an explanation for them. Few candidates mentioned the changes in oxygen tension and oxygen consumption, and why these occurred.

19. Describe factors that prolong the action of neuromuscular blocking agents (60% of Marks) Outline the pharmacokinetics and pharmacodynamics of vecuronium (40% of Marks).

20% of candidates passed this question.

The first part of the question required a description of the factors prolonging neuromuscular blockade which would include a description of the reasoning behind the prolongation. Many candidates missed the important factors and most did not include any explanation. Some candidates confused the causes of "delayed onset" and "prolonged action". For vecuronium mechanism of action all the details were expected, superficial explanations did not score well. The following key words were expected to be included in the mechanism description; competitive binding/ Nicotinic ACH (N2)/alpha subunit/post synaptic. In pharmacokinetics, details on hepatic metabolism to active metabolites, renal and biliary excretion along with accurate values of the volume of distribution, protein binding and half-life were expected to score full marks. These facts were frequently lacking in candidate answers.

20. Compare and contrast the relevant pharmacology of intravenous adrenaline and vasopressin.

20% of candidates passed this question.

The major emphasis of this question and opportunity to score marks reside in “comparing the two drugs” in various aspects – pharmaceutics, indication, mechanism of action, pharmacodynamics, and pharmacokinetics. Although most of the candidates were able to list pharmaceutics, indications, kinetics and dynamics of both the drugs in reasonably structured and tabulated format, many failed to highlight the important commonalities and differences between the two. In mechanism of action, details of the receptor, their location and second messenger system were expected. In pharmacodynamics, similarities and differences in cardiovascular, respiratory, haematological, renal and metabolic effects were needed. There are additional neurological effects and genito-urinary (tocolysis and sphincter tone) of adrenaline which were rarely mentioned. There were frequent significant omissions or incorrect details in the pharmacokinetics sections of both drugs.

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ORAL SECTION

DAY 1

VIVA 1

This VIVA will examine opioid pharmacology.

What classifications of opioid receptors do you know?

VIVA 2

This VIVA will examine respiratory physiology.

Compare the pulmonary and bronchial circulations?

(Image removed from report.)

VIVA 3

This VIVA will examine hepatic physiology and immunology.

This is a hepatic lobule. Please indicate the structures labelled 1-5?

(Image removed from report.)

VIVA 4

This VIVA will examine the autonomic nervous system.

Describe the anatomy of the sympathetic nervous system?

VIVA 5

This VIVA will examine oxygen measurement and sodium channel physiology.

In what ways can oxygen tension or concentration be measured?

VIVA 6

This VIVA will examine cardiovascular physiology.

Please identify and describe the key features of this graph.
What are the main factors that affect venous return to the heart?

(Image removed from report.)

VIVA 7

This VIVA will examine upper airway functional anatomy and theophylline pharmacology.

This is a view of the larynx as seen during intubation. Identify the structures indicated?

VIVA 8

This VIVA will examine fluid physiology.

How is water distributed in the body and how are these compartments measured?

DAY 2

VIVA 1

This VIVA will examine applied cardiovascular physiology.

Describe the structural changes in the cardiovascular system in the elderly?

VIVA 2

This VIVA will examine neurophysiology, pharmacology and anatomy.

Describe the n-methyl-d-aspartate (NMDA) receptor?

VIVA 3

This VIVA will examine haematological physiology and pharmacology.

How are packed red blood cells (PRBCs) prepared by the blood bank?

VIVA 4

This VIVA will examine adrenergic and steroid pharmacology.

Describe the beta-adrenergic receptors and how signal transduction occurs?

VIVA 5

This VIVA will examine respiratory physiology including work of breathing.

What is described by this graph?

(Image removed from report.)

VIVA 6

This VIVA will examine cardiovascular physiology.

Please identify and describe the key features of this graph.
What are the main factors that affect venous return to the heart?

(Image removed from report.)

VIVA 7

This VIVA will examine renal physiology.

Name and describe the components of the nephron shown here?

VIVA 8

This VIVA will examine anti-bacterial pharmacology.

What factors determine the ability of an intravenously administered anti-bacterial to treat a localised infection?

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SUMMARY OF THE EXAMINATION

The CICM First Part Examination explores the knowledge of the basic sciences that form the basis of Intensive Care practice. A detailed syllabus has been developed and clearly sets out the Level of Understanding expected for each listed topic and drug. It is important that Candidates study the Syllabus in its entirety. All questions are sourced from the Syllabus and the recommended texts are a guide to study. Some sections will require more extensive research and the use of other textbooks.

Candidates are expected to attain a level of knowledge that goes beyond just the listing of pure facts but should be able to explain, describe, collate, and synthesise that knowledge across different scenarios as they apply to Intensive Care practice. Sufficient depth of understanding and a structured approach to topics continues to remain an area of weakness for many candidates.

Candidates must allow sufficient time to prepare (typically approximately 12 months to study). Candidates are strongly encouraged to discuss their level of preparedness and to trial written and oral questions, with their Supervisor of Training and other CICM Fellows, prior to undertaking the CICM First Part Examination. The examination reports are available as a guide to areas that are covered but do not provide model answers and should be read as such.

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May 2023