COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

REPORT OF THE
INTENSIVE CARE FIRST PART EXAMINATION

MARCH / JUNE 2022

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:	92
Number of candidates scoring > 50% in the written:	38
Number of candidates scoring 45 – 50% in the written:	11
Number of candidates carrying a written score:	1
Total number invited to the oral section based on written marks:	50
Total number of candidates successful at the CICM First Part Exam:	44

SUCCESSFUL CANDIDATES

Dr Mohamed Abdelhamid
Dr Felix Anderson
Dr Angus Banh
Dr Philip Boey
Dr Adam Bowman
Dr Kyle Brogan
Dr Emma Cooper
Dr Aurelie Copin
Dr Jacinta Cox
Dr Maria de Freitas
Dr Ransika De Silva
Dr Xizi Duo
Dr Nicole Foo
Dr Daniel Gaines-Burrill
Dr Thomas Garry
Dr Georgia Henry
Dr Lisa Hunt
Dr Keegan Hunter
Dr Jane Hutchinson
Dr Kasun Jayasekera
Dr Cindy Jin
Dr Andre Kubler
Dr Yan Yu Stephanie Law
Dr Amadea Lazaro
Dr Daniel Li
Dr Peter Lioufas
Dr Erin Maylin
Dr Laura McDonald
Dr Wesley Meintjes
Dr Dominic Merriott
Dr Tarsh Pandit
Dr Bianca Rajapakse
Dr Nathalie Rasko
Dr Samuel Reade
Dr Kirsten Rowcliff
Dr Daniel Schlosberg
Dr Rachel Smith
Dr Senthuran Thillainathan
Dr Benjamin Verstandig
Dr Jack Wilson
Dr Rachel Yeo
Dr Jessamine Yong
Dr ZhenTi Yong
Dr India Zweng

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 "level I" topics. Candidates are strongly encouraged to read widely to gain a high level of understanding and are reminded to ensure writing is legible.

SHORT ANSWER QUESTIONS

1. Outline the effects of critical illness on drug pharmacokinetics, including examples.

47% of candidates passed this question.

The effects of critical illness on the physiological factors that influence drug pharmacokinetics was used to analyse the candidates understanding of this core pharmacological principle. Better responses were able to identify the key elements perturbed by critical illness as well as outlining outline the potential cause and effect on the specific PK aspect being discussed. Stronger answers also included specific drug examples. The failure to utilise a structure (absorption, distribution, metabolism, and elimination) with very superficial detail and limited examples limited marks and was common in poorly scoring answers.

2. Explain the mechanisms of transport of substances across cell membranes including appropriate examples (75% marks). Outline the structure and function of the Na+/K+-ATPase pump (25% marks).

61% of candidates passed this question.

This question examined core cellular physiology knowledge. This knowledge is crucial as it underpins much of the electrochemical responses within the syllabus. Mechanisms of diffusion and the role of individual pathways were well presented in many responses. Answers that scored well generally classified the mechanisms of transport into active and passive processes which ensured an appropriate breadth of answer. Many answers failed to provide any examples which was requested. The structure of the Na+/K+ ATPase pump was less well described, however pleasingly most candidates were able to accurately articulate its role and function.

3. Define respiratory compliance, include its components and their normal values (25% marks). Explain the factors that affect respiratory compliance (75% marks).

27% of candidates passed this question.

This question covers a core principle of respiratory physiology and would be expected to have a high pass rate. Most candidates were able to provide a concise definition and distinguish between the different types of compliance. The imprecise use of terminology often created the impression of a lack of fundamental understanding of this key concept. Candidates are encouraged to be accurate and concise in their definitions. A lack of detail in describing the relevant components of compliance and the factors that influence it, immediately limited the capacity of some candidates to achieve an adequate score. Most candidates provided less than half of these factors and only provided a list rather than explaining how compliance was impacted. Marks were maximised by dividing the impacts into those that altered lung compliance versus those that impacted on chest wall compliance, and the better candidates explained how and why compliance was affected. Confusion often arose from the imprecise use of arrows with the result that candidates frequently demonstrated an incorrect fact in relation to the

direction of the arrow. Candidates are reminded to take care when using abbreviations or arrows to ensure they are not relying on the examiner to interpret a cause and effect relationship.

4. Describe the mechanisms of action and potential adverse effects of inhaled nitric oxide and prostacyclin.

15% of candidates passed this question.

Most candidates were able to describe the mechanism of action of inhaled nitric oxide (iNO), however many demonstrated very little knowledge about prostacyclin and the adverse effects of both commonly used drugs. General statements about NO, it's delivery and pharmacological effects did not attract marks candidates are encouraged to read the question and provide information specific to the question. Methaemoglobin and its effects were reasonably described with many understanding the rational for restricting the concentration of iNO (ppm) because of the risk of N02 formation. The knowledge related to prostacyclin was very limited. Such limited detail as to its mechanism of action prevented any discussion regarding any differences from iNO. Many reasonable answers to the iNO component were limited overall due to a paucity of knowledge and incorrect facts in the prostacyclin section.

5. Write short notes on the pharmacology of labetalol and esmolol, highlighting their differences.

32% of candidates passed this question.

Overall, this question was poorly answered. Most answers demonstrated limited knowledge about the major differences between the two drugs' including the target receptors and subsequent effects. Antiarrhythmic effects were often omitted in answers, and scant or incorrect details provided about the metabolism and overall pharmacokinetics of the drugs. Generic vague statements about pharmacokinetic properties of medications do not attract marks. Better scoring answers demonstrated a factual knowledge about both individual drugs and specific details related to any differences influencing the potential application of these differences. A table superficially listing aspects of both drugs would not be of a passing standard. Many answers demonstrated significant incorrect facts.

6. Describe the cardiovascular changes seen throughout pregnancy.

51% of candidates passed this question.

It was expected that candidates would give a detailed description of the changes that occur throughout pregnancy, labour and post-delivery (a timeline). This should include but not be limited to, cardiac output, total peripheral resistance, blood flow distribution, uterine blood flow and blood volume changes. Better answers were able to relate these changes to the underlying mechanisms (such as progesterone induced vasodilatation etc). A detailed description of aortocaval compression and its importance was also required. Vague and imprecise statements attracted fewer marks (for example simply stating that heart rate increases without discussing the magnitude, time course and influences). This topic is well covered in some of the recommend texts.

7. Write notes comparing the use of serum creatinine and creatinine clearance in the assessment of renal function in the critically ill.

11% of candidates passed this question.

It was expected that candidates would define both components of the question, discuss the factors which affect serum creatinine and creatinine clearance and demonstrate their interrelationship. More complete answers described the advantages, disadvantages and limitations of their use in critical illness. In many cases candidates failed to correctly define creatinine clearance. Answers that scored well clearly utilised the above-mentioned breadth of knowledge and linked these to pertinent specific changes that may be associated with critical illness.

8. Describe the regulation of body water.

43% of candidates passed this question.

Better answers for this question used the “sensor, integrator/controller, effector” structure. They also included appropriate detail relating to the site and mechanism of angiotensin II and the subsequent stimulation of ADH and aldosterone release. A detailed description of ADH was necessary to score well. Lengthy descriptions of body water distribution or renal handling of water did not attract additional marks. Answers that scored less well were often disorganised, with limited structure and incorrect facts.

9. Describe the pharmacology of 4% albumin.

41% of candidates passed this question.

This question required the candidate to consider 4% albumin from a pharmacological perspective. The examiners were therefore after a description that included presentation, pharmaceutics (including correct content description and osmolality), indications, pharmacodynamics, pharmacokinetics, adverse effects, special precautions and dosing.

10. Discuss the determinants of intracranial pressure (80% marks) and outline how it can be measured (20% marks).

64% of candidates passed this question.

In the good answers to this question, and there were a number, the candidates included the volumes of the cranium and a correct description of the Monroe Kellie doctrine. A good answer should have included the compensations and consequences of increases in intra-cranial volumes; a discussion of all three components (brain tissue, blood, and CSF) and how they affect intracranial pressure; and then information on intra-ventricular and parenchymal devices in measuring ICP, briefly including their pros and cons. A common issue was writing quite a lot more than was needed on the relationship of cerebral blood flow to cerebral blood volume, and/or on the physiological consequences of raised ICP, which seemed to leave little time for discussion elsewhere. A few candidates did not provide any response for ICP measurement (worth 20% of the marks). Few candidates provided the intra-cranial elastance equation. A significant proportion of candidates missed out a part of the question, either the factors that affect CBV or ICP measurement.

11. Outline the structure and function of the N-methyl-D-aspartate (NMDA) receptor (25% marks). Discuss the pharmacology of ketamine (75% marks).

74% of candidates passed this question.

The first part of this question required a description of both the receptor structure and its function. This includes, but is not limited to, its location, the natural ligand, how the channel may be regulated and the results of receptor stimulation. The second part of this question related to ketamine. Marks lost here often related to vague statements and incorrect facts. The examiners also commented that some candidates got confused between the R and S enantiomers. Few candidates commented on the nature of the metabolites and generally the PD section was vaguely answered.

12. Describe the process of excitation-contraction coupling and relaxation in smooth muscle.

36% of candidates passed this question.

This is a straightforward fact-based and process related question. It is important that candidates take the time to read the entire question prior to starting to write an answer. Unfortunately, many candidates wrote about skeletal muscle contraction which scored no marks. A good answer template included a description of the contractile elements of smooth muscle, the regulatory proteins and the role of calcium,

and highlighted how these elements interact. They included descriptions of both the contractile and relaxation processes.

13. Compare and contrast the pharmacology of suxamethonium and rocuronium.

75% of candidates passed this question

Suxamethonium is a level 1 drug and therefore requires a detailed knowledge of the drug from a PK and PD perspective as well as consideration of important side effects and considerations when used.

The examiners commented that a table structure with the structured pharmacology headings and clear concise facts was the best way to approach this question. Answers that scored poorly often displayed incorrect facts, limited appreciation of side effects and vague statements on the pharmacological particularities of this drug. For example, muscle relaxants are major culprits for anaphylaxis in hospitals, and nuanced facts about this were generally missing from candidate's answers.

14. Describe the neural integration of vomiting, highlighting the site and mechanism of action of antiemetics.

60% of candidates passed this question.

The examiners commented that a well-drawn and labelled diagram was a very useful adjunct to answering this question. Consideration of stimulus, sensors, integrators/processors, and effectors was also useful to ensure that all components of the question were covered by a candidate's answer. Incorrect facts or a lack of detail about the various receptors and their locations was a common theme in answers that scored poorly. Classes of antiemetics, with specific drugs given as examples, were expected to gain marks.

15. Describe the sequence of haemostatic events following injury to a blood vessel wall until clot stabilisation.

46% of candidates passed this question.

A good answer was well structured and covered the areas of vasoconstriction, platelet adhesion, activation and aggregation, coagulation, clot retraction and anticlotting mechanisms. Many answers gave an overview of the haemostatic process but revealed insufficient knowledge of the processes involved. It was acceptable to give a classical view of clotting or to describe the cell-based model; or both. However, in several cases answers became confused by mixing up elements of the classical approach and cell-based model approach. Errors concerning details of the cell-based model were frequent. Many candidates did not include how the clot is limited to just the site of injury which happens in parallel with the formation of clot. Candidates should be aware that writing lengthy introductory statements attracted no marks and wastes time.

16. Outline the impact of sedative agents on thermoregulation (40% marks) and describe the physiological effects of a low body temperature (60% marks).

33% of candidates passed this question.

Sedation reduces body temperature by interfering with heat production and increasing heat loss, along with widening of hypothalamic inter-threshold range. This portion of the question was generally well answered. The question asked to "outline" the answer. Many candidates actually "described" the thermoregulation process in general but were unable to relate those with the impact of sedation. The second part of the question (physiological effect of low body temperature) was answered by most of the candidates with the structure of organ-system wise description. A few candidates scored extra marks by relating these effects with degree of hypothermia and by describing how thermogenesis responses (including shivering) can influence those effects. Some candidates restricted their answers to the effect of thermogenesis in response hypothermia and did not include the overall physiological consequences of low body temperature. Better answers displayed an understanding of core temperature regulation, inter-

threshold range and the effects of sedatives on thresholds for thermogenic responses, although only a few mentioned gain and maximal response. Better answers included specific detail (mentioned bradyarrhythmia, slow AF, VF, prolonged PR/QRS / J waves rather than just stating arrhythmia) across several organ systems. Marks were not awarded for generic statements such as 'decreased liver function' without some additional detail. Inadequate depth of knowledge was main reason behind overall poor scores.

17. Write notes on:

- **The principles of ultrasound**
- **Transducer properties and image resolution**
- **The Doppler effect**

23% of candidates passed this question.

This question was taken from core syllabus that requires level one (L1) understanding. Physical principles of ultrasound can be illustrated by outlining how ultrasound waves are generated from piezoelectric crystals, how they travel through the tissues, how they interact with different tissue planes and how the reflected waves return to the transducer and create images. Properties of ultrasound transducers include different geometric configurations of transducer probes and frequency-wavelength-bandwidth properties of the crystals used in diagnostic ultrasound. Understanding of physical concepts of image resolution including its various aspects (e.g., spatial, temporal, contrast resolution) is required to address the next portion of the question. “Doppler effect” can be illustrated by a definition and equation along with some practical implications. This question was not answered well by majority of the candidates. Lack of knowledge and limited understanding resulted in poor average mark.

18. Describe the anatomy of the left subclavian vein.

14% of candidates passed this question.

An ideal answer includes origin of subclavian vein, its tributaries, course in relation to mediastinal structures and surface anatomy for central line insertion. Vague comments like: “it follows the subclavian artery”, or “it passes between 1st rib and clavicle”, attract minimal marks. Similarly, no marks were awarded for describing technique of central line insertion and complications of procedure. Answers scored poorly due to a combination of the following, a lack of depth to their answers or inaccurate facts and limited structure/approach to an anatomical SAQ. Good answers described the course of the subclavian vein from its origin at the lateral border of the first rib, along the subclavian groove on the upper surface of the first rib, medially to its termination posterior to the sternoclavicular joint at the medial border of the scalenus anterior, where it joined the IJV to form the bracheoceaphalic vein. In addition, high scoring candidates described tributaries (e.g., the thoracic duct, external jugular) where they joined and went on to describe relations in reasonable detail, specifying whether patient is supine or erect.

19. Describe the physiological factors that affect $PaCO_2$.

33% of candidates passed this question.

Candidates who scored well generally defined PaCO2 and proceeded to describe factors in terms of those related to production and elimination. Good answers described the key production factor as being rate of production through aerobic metabolism which is in turn influenced by substrate and BMR. Those who scored well described elimination as being dependent upon minute ventilation, which in turn is influenced by CO2 detection by chemoreceptors, specifically detailing the difference between peripheral and central. Many candidates detailed pathophysiological factors which unfortunately did not gain any marks.

20. Describe the physiological control of systemic vascular resistance (SVR).

22% of candidates passed this question.

A definition or description of SVR that recognised the importance of radius in small arteries/arterioles as the major determinant attracted marks. Resistance is ΔP/flow; where ΔP is not only MAP and flow is volume/time. The systemic vascular resistance is the resistance of several circuits in parallel, which have both common and independent factors in their regulation. As they are in parallel the sum of reciprocals is used, 1/SVR = 1/R1 + 1/R2 to determine the overall value. A detailed explanation of the Hagen-Pouiselle law was not required, attracted few marks and wasted writing time. The remainder of the answer focus was on the factors that control the radius of these vessels. As a question regarding control, an approach that included sensors, integrators and effectors tended to yield a more comprehensive answer with resultant higher marks. Other useful structures included divisions into intrinsic/local factors (including endothelial input and autoregulation), neural control (reflexes and central controller) and hormonal control. As the question was regarding physiological control, no marks were awarded to pharmacological manipulation of SVR. Given the potential scope of the question, detailed descriptions of how noradrenaline exerts its effect were not required beyond receptor level although stating 'sympathetic nervous system activation results in vasoconstriction' were too simplistic to attract full marks.

MULTIPLE CHOICE QUESTIONS – PAPERS 1 AND 2

92% of candidates passed overall:

93% of candidates passed Paper 1.

92% of candidates passed Paper 2.

ORAL SECTION

DAY 1

VIVA 1

This viva will explore your understanding of coagulation.

How do viscoelastic haemostatic assays like TEG and ROTEM measure coagulation?

VIVA 2

This viva will explore your understanding of gentamicin pharmacology.

How does gentamicin work against bacteria?

VIVA 3

This viva will explore your understanding of cardiovascular physiology.

How may stroke volume change with heart rate?

VIVA 4

This viva will explore your understanding of the immune system.

What are the key features and possible benefits of innate immunity?

VIVA 5

This viva will explore your understanding of acid-base physiology.

List the abnormalities in this arterial blood gas analysis.

FiO_2	0.5
pH	7.1
PCO_2	25 mmHg (3.3 kPa)
PO_2	100 mmHg (13.3 kPa)
HCO_3^-	7 mmol/L
Base deficit	-19.9
Na^+	133 mmol/L
K^+	4.5 mmol/L
Cl^-	105 mmol/L
Anion gap	25
Lactate	7 mmol/L

VIVA 6

This viva will explore your understanding of respiratory physiology.

How might the functional residual capacity change when you preoxygenate a patient with 100% oxygen in the supine position?

VIVA 7

This viva will explore your understanding of the physiology and pharmacology of oxygen.

What is the role of oxygen in the body?

How would you calculate the total oxygen content in blood when the haemoglobin oxygen saturation rises from 90% to 95% and the PaO_2 rises from 60 mmHg (8 kPa) to 75 mmHg (10 kPa)?

VIVA 8

This viva will explore your understanding of dialysis and fluid physiology.

Describe the principles by which substances are cleared by dialysis.

DAY 2

VIVA 1

This viva will explore your knowledge of neurophysiology and pharmacology.

Tell me about the structure and function of $GABA_A$ receptors.

VIVA 2

This viva will explore your knowledge of neurophysiology and pharmacology.

Tell me about the structure and function of GABAA receptors.

VIVA 3

This viva will explore your understanding of renal physiology and pharmacology.

Describe the processes by which renal blood flow is regulated.

VIVA 4

This viva will explore your understanding of the oxygen cascade.

Describe the stepwise changes in the partial pressure of oxygen observed in the oxygen cascade.

VIVA 5

This viva will explore your understanding of the circulation of blood.

How is blood distributed in different parts of circulation?

VIVA 6

This viva will explore your understanding of hepatic physiology.

This is a hepatic lobule. Please indicate the structures numbered 1 to 5.

(Image removed from report.)

VIVA 7

This viva will explore your understanding of central venous pressure.

Describe the components of this normal waveform.

(Image removed from report.)

VIVA 8

This viva will explore your understanding of microbiology, antimicrobials and resistance.

A patient develops a rash receiving meropenem and a change of antibiotics is required.

What pharmacological properties would you need to consider when choosing an alternative option and provide examples.

DAY 3

VIVA 1

This viva will explore your understanding of respiratory physiology.

Describe the V/Q ratios throughout the lung in the erect position for a healthy individual.

VIVA 2

This viva will explore your understanding of parasympathetic nervous system physiology and cranial nerve reflexes.

What are the physiological consequences of interrupting vagal nerve transmission at the level of C2?

VIVA 3

This viva will explore your understanding of immunology.

What are the immunological events leading to IgE mediated anaphylaxis?

VIVA 4

This viva will explore your understanding of neuromuscular monitoring, physiology and pharmacology.

Name the test and describe how it is performed.

(Image removed from report.)

VIVA 5

This viva will explore your understanding of physiology of the acetylcholine receptors.

Describe the acetylcholine receptor at the neuromuscular junction.

VIVA 6

This viva will explore your understanding of the control of blood sugar and metabolic responses to insulin.

Explain how fluctuations of blood sugar level are minimized between meals.

VIVA 7

This viva will explore your understanding of pain pathways.

How is pain sensed following a skin incision?

VIVA 8

This viva will explore your understanding of urea and renal tubular function.

Why do we produce urea and how effective is it as an osmole?

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 synthesize 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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