COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

REPORT OF THE
INTENSIVE CARE FIRST PART EXAMINATION

FEBRUARY / APRIL 2015

This report is prepared to provide candidates, tutors and their Supervisors of Training with information about the examination. Answers provided are not model answers but guides to what was expected. Candidates should discuss the report with their tutors so that they may prepare appropriately for the future examinations.

The exam included two, 2.5 hour written papers, each comprising of twelve short answer questions and twenty short fact 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:	24
Number of candidates scoring > 50% in the written:	12
Number of candidates scoring 45 – 50% in the written:	6
Number of candidates carrying a written score:	2
Total number invited to the Oral section based on written marks:	20
Total number of candidates successful at the CICM Primary:	19

24 candidates sat the written component of this examination and 18 were invited to the viva examination based on their performance in the written paper.

20 candidates (2 carried a previous written pass) attended the viva component of the examination and 19 were successful.

SUCCESSFUL CANDIDATES

Dr Alex Battistini Diaz
Dr Sadie Callahan
Dr Claire Corrigan
Dr Christopher Dugan
Dr Sebastien Haiart
Dr Edward Heydon
Dr Hooi Hooi Koay
Dr Jessica Lane
Dr Joanna Longley
Dr Ailbhe Mcalister
Dr Owen Milne
Dr Aniket Nadkarni
Dr Renesh Nair
Dr Matthew Ostwald
Dr Sankalp Purwar
Dr Eamon Raith
Dr Marie Scott
Dr Ashima Sharma
Dr Gavin Wooldridge

WRITTEN SECTION

EXAMINERS' COMMENTS

Candidates are reminded that all questions are worth equal marks and so time should be apportioned accordingly. On occasions it appeared some questions were completed in haste or not attempted at all and this denies the candidate an opportunity to gain valuable marks.

Questions from previous examinations may be repeated and candidates are encouraged to review examination reports.

Some answers failed to appreciate key concepts and in particular often lacked the depth expected. Candidates are expected to have a detailed knowledge and depth of understanding of level I topics such as cardiovascular and respiratory physiology. As a guide, the level of detail expected goes beyond that often outlined in a general physiology textbook and candidates are strongly encouraged to read widely so as to gain high level understanding. Some candidates scored full marks in some questions illustrating it is possible. Candidates are reminded to ensure writing it is legible if the examiner cannot read the writing, the candidate cannot be awarded marks.

SHORT ANSWER QUESTIONS – PAPERS 1 AND 2

1. Explain the control of breathing.

71 % of candidates passed this question.

This question was generally well done. It was expected answers would include discussion of the three core elements of sensors, a central controller and effectors. Central control involves three main groups of neurones in the brainstem with some cortical voluntary control also possible. More in depth answers included graphs of the ventilatory response to oxygen and carbon dioxide tensions.

2. Describe the foetal circulation and the changes that occur at birth.

55 % of candidates passed this question.

This topic is well covered in standard texts and has been asked previously. Better answers displayed knowledge of the key concepts, such as the parallel circulations in the foetus and preferential flow of better oxygenated blood to the brain and upper limbs.

Some candidates spent time on the maternal and placental circulations which were not required to answer the question asked.

3. Describe the structure and function of the blood brain barrier.

33 % of candidates passed this question.

There was general lack of understanding of the conceptual framework of the blood brain barrier (BBB) and its function. To attain a pass, candidates were required to describe the concept of BBB as a physical and a transport barrier, describe the role of tight junctions and glial cells and identify important barrier functions with some examples of things commonly transported across or excluded.

4. Describe the mechanisms by which water and electrolytes are reabsorbed across the renal tubules.

33 % of candidates passed this question.

The intent of the question was to have the candidate describe in the context of a classification the mechanisms by which water and electrolytes may cross a cell membrane and use the renal tubule to provide an example of each mechanism.

It was expected the answer would talk about transport “mechanisms” across membranes. These would include processes such as reabsorption, diffusion, facilitated diffusion, primary and secondary active transport, endocytosis, osmosis and solvent drag. Many candidates used colloquial and vague language to describe precise concepts.

Some candidates structured their answer as an outline of the principal mechanisms at each segment of the tubule. Thus there was repetitive reference to mechanisms without a description as requested in the question. This approach also resulted in some candidates omitting some mechanisms altogether.

5. Classify gram positive bacteria with examples (20% of marks). Outline the pharmacology of vancomycin (80% of marks).

75 % of candidates passed this question.

The classification should have demonstrated a framework that covered relevant gram positive pathogens. Examples should have included both genus and species. More detail than “strep" or “Staph" was expected.

Knowledge of vancomycin was expected to include an outline of pharmaceutics, pharmacodynamics, pharmacokinetics, dosing and adverse effects. In particular, pharmacokinetics should be well understood as there are significant implications for dosing.

Common errors included incorrect examples such as "clostridium" or classifications lacking detail with respect to examples.

6. Outline the physiology of pancreatic secretion (80% of marks) and outline the pharmacology of octreotide (20% of marks).

38 % of candidates passed this question.

An outline of exocrine function should have included the sources of secretions, secretions involved in the digestion of proteins, carbohydrates and fats, the roles of trypsin inhibitors and bicarbonate secretion and the regulation of enzyme and bicarbonate secretion.” Knowledge of endocrine physiology was good whereas the depth of knowledge regarding exocrine function was generally shallow with many errors.

Only some general facts around the pharmacology of octreotide were required to pass this section of the question. Responses revealed limited knowledge and contained many errors.

7. Outline the physiological responses to the rapid intravenous administration of 1 litre of 0.9 % saline to a 70 kg euvolaemic person.

25 % of candidates passed this question.

Answering this question required the integration of information from areas of cardiovascular, body fluid and renal physiology which proved difficult for most candidates. Both breadth and depth was expected so as to score well.

This question is best answered using a time-based approach. For example, upon the rapid infusion of a litre of normal saline there will be a brief period of hypervolemia, increase in arterial blood pressure and an associated physiological reflex response to these changes (e.g. baroreceptors, atrial stretch receptors, etc.). There will also be an associated increase in renal perfusion and stimulation of intrarenal receptors (e.g. juxtaglomerular apparatus). Candidates were expected to outline these changes, their effector responses (e.g. autonomic nervous system reflexes and humoral changes) and their physiological consequences.

A more prolonged redistribution phase of the administered saline then occurs. This saline redistributes throughout the extracellular fluid space. Candidates were expected to briefly describe this effect as well as the subsequent management of the sodium and water load by the kidney.

Most candidates spoke about the pressure effects, and only some compared these with the volume effects. The effect of redistribution and other effects were not considered by the majority of the candidates.

8. How does warfarin exert its anti-coagulant effect (50% of marks)? Outline the pharmacology of the agents that can be used to reverse the effects of warfarin, giving examples (50% of marks).

38 % of candidates passed this question.

Warfarin is a competitive inhibitor of the enzyme vitamin K epoxide reductase which converts oxidised or inactive vitamin K to reduced or active vitamin K Reduced vitamin K is required for the gamma carboxylation of the glutamate residues in the vitamin K dependant factors (II, VII, IX and X) and proteins C and S. This gamma carboxylation converts these clotting factors from their inactive to their active form resulting in coagulation. The presence of warfarin inhibits this conversion process resulting in anticoagulation. The presence of inactive protein C and S explains the initial hypercoaguable effect of warfarin.

The three main agents used to reverse the effects of warfarin are vitamin K, prothrombinex and fresh frozen plasma (FFP). It was expected answers would provide a brief overview of all three agents. Most candidates did not highlight the fact that parenteral vitamin K requires a few hours to work whereas prothombinex and FFP work immediately.

Better answers noted additional facts such as oral vitamin K because it is fat soluble requires the presence of bile salts to be absorbed from the gut or the rare but life threatening hypersensitivity reaction caused by intravenous vitamin K possibly related to its preservative benzyl alcohol.

A common omission was the amount of coagulation factors in international units (IU) in an ampoule of prothormbinex or the dose required to reverse warfarin anticoagulation. A description of the clinical pros-cons of the various agents was not required to answer the question.

9. Classify and describe mechanisms of drug interactions with examples.

33 % of candidates passed this question.

This question was best approached by classifying drug interactions as physicochemical or pharmaceutical, then pharmacokinetic and finally pharmacodynamic. Pharmacokinetic drug interactions could then be further sub classified into those affecting the rate and extent of absorption of other drugs by mechanisms such as surface adsorption, chelation, altering gastric pH and altering gastrointestinal motility. Drug interactions affecting the distribution of drugs mainly involve competition for protein binding and the displacement of highly protein bound drugs. Drug metabolism interactions usually involve drug induction or inhibition of hepatic microsomal enzymes either increasing or decreasing the metabolism of other drugs.

Examples of drug interactions affecting drug excretion include drugs altering urinary pH or drugs altering the tubular rate of secretion of other drugs. Pharmacodynamic drug interactions include potentiation of one drug by another, antagonism and combined toxicity at the tissue level. Combined toxicity can be due to the potentiation of adverse effects of two drugs.This is a broad question with plenty of opportunity to score marks. A structured approach such as that described above and providing an example for each mechanism was important.

10. Compare and contrast the pharmacology of mannitol and hypertonic saline.

8 % of candidates passed this question.

A structured approach is important and a table worked best for most candidates, although a few attempted this in free text. Despite attempting a structured answer very few candidates provided information in regards to preparation, dose, monitoring of osmolarity, adverse effects or contraindications. Understanding of the action of these drugs was expected and factual inaccuracies were common with many candidates suggesting hypertonic saline acts as an osmotic diuretic. Better answers mentioned other potential mechanisms of action of mannitol. Many candidates failed to appreciate the impact on raised intracranial pressure.

11. Outline the pharmacology of sodium nitroprusside (50% of marks). Discuss the mechanisms of toxicity and their management (50% of marks).

38 % of candidates passed this question.

Most candidates presented a structured answer and exhibited a good understanding of the pharmacology of sodium nitroprusside. Few candidates demonstrated an understanding of the mechanisms of SNP toxicity and details on management of cyanide toxicity were lacking. Cobalt EDTA is no-longer recommended as initial therapy in the management for cyanide toxicity.

More specific detail was expected beyond a generic comment on "mechanisims of toxicity" such as potentially causes of respiratory, renal, hepatic or CNS failure.

Few candidates mentioned adverse effects other than that of cyanide toxicity. Many candidates also failed to outline the management of sodium nitroprusside toxicity.

12. Describe the effects of resonance and damping on an invasive arterial blood pressure tracing.

33 % of candidates passed this question.

Many candidates seemed to get some of the basic concepts but few were able to expand on simple concepts.

It was expected that candidates could describe that the arterial pressure waveform is made up of many different sine waves (as determined by Fourier Analysis) with each sine wave having a specific frequency. Every system has its own natural oscillatory frequency, or resonant frequency. If this is less than 40 Hz, it falls within the range of frequencies present in the blood pressure waveform and oscillations may produce a sine wave which is superimposed on the blood pressure wave form.

Some damping is inherent in any system and acts to slow down the rate of change of signal between the patient and pressure transducer. It may be caused by air bubbles or blood clots or occlusion. This reduces the deflection of the transducer diaphragm and hence the size of the waveform. The effect of damping on temporal response was rarely mentioned.

Accurate graphical representations of invasive pressure traces are important. Many candidates provided poor drawings without axis, labels, reference to normal or discussion in text.

13. Describe how carbon dioxide (CO_2) is carried in the blood.

79 % of candidates passed this question.

It was expected answers would describe each of the main categories of how CO_2 is carried: Dissolved (10%), Plasma Bicarbonate (70%) and conjunction with plasma proteins and Hb as Carbamino Hb (20%). An opening statement quantifying the amount of CO_2 dissolved in arterial (48mL/100mL) and venous blood (52mL/100mL) (4mL/100mL) and how this compares with Oxygen was expected (20 times more soluble).

For dissolved CO_2, the application and description of Henry's Law was awarded marks.
A description of the consequences of the Haldane effect: difference in CO_2 carriage of oxygenated and deoxygenated blood was expected. A diagram of pCO_2 v CO_2 content was helpful

14. How is blood typed and cross-matched?

38 % of candidates passed this question.

An opening statement of the importance of compatibility testing helped explain the relevance of the process. A brief description/table of agglutinogens (membrane antigens) along with Agglutinins (IgM Antibodies) was helpful.

Typing is the testing of individual red blood cells (donor and recipient) with anti-sera containing anti-A, B and AB antibodies. A positive test results in agglutination. Red cells with known antigens (A, B and O) are then tested with sera (reverse grouping). When discussion antibody screening, a mention of Rhesus antibodies along with testing for minor antibodies (Kell, Duff etc.) was expected.

Cross matching consists of the saline agglutination test andiIndirect Coombs testing. (This involves incubation, washing and testing with antiglobulin serum).

Many answers confused the processes of typing, antibody screening and cross matching.

15. Describe the different types of hypersensitivity reactions including an example of each.

79 % of candidates passed this question.

This question can be answered in tabular form and details have been described in a previous exam report (2007). Details of each of the four main types were expected. A description of the timing of reactions was also expected.

16. Describe the physiology of cerebrospinal fluid.

83 % of candidates passed this question.

Most candidates answered the question well. The most common mistake was incorrect CSF composition. Better answers also discussed raised ICP and CSF's role in the compensation for raised ICP.

17. Describe the oxygen cascade in a person breathing room air at sea level.

63 % of candidates passed this question.

This question could be answered with a description or a diagram but required an ordered journey from the atmosphere to the mitochondria. This is commonly available in many texts and most candidates answered the question well. Most candidates said the alveolar PO_2 fell solely because CO_2 came out of the pulmonary capillary. Very few talked about oxygen uptake into the capillary. Another common omission was failure to state normal values for the A-a gradient.

18. Outline the role of the liver in the metabolism of fat (1/3 of marks), carbohydrate (1/3 of marks) and proteins (1/3 of marks).

50 % of candidates passed this question.

Most candidates seemed not to have thought about this before and so collated information from answers about insulin and glucagon, and starvation. Many added information about absorption and digestion which was not required.

Metabolic functions of the liver form part of the "standard list" of functions of the liver yet few details could be provided beyond that. It was expected answers would detail the central role of the liver as a "glucostat" and its role in glucose utilization. It has two main roles in lipid metabolism, the synthesis of fatty acids and the partial oxidation of fatty acids to ketone bodies. The liver also plays a central role in protein catabolism and anabolism. It plays a major role in the breakdown of amino acids gluconeogenesis and protein synthesis. The liver also releases amino acids into the blood for utilization by peripheral tissues.

19. Describe the effects of ageing on the cardiovascular system.

29 % of candidates passed this question.

Many candidates described the pathological processes which might affect the aging heart rather than the physiological ones.

Recognition that aging reduces cardiovascular reserve followed up with an outline of the effects of aging on the heart, the vasculature, endothelial function and the conducting system would be rewarded with a good mark.

Few answers quantified the decrease of cardiac output with age and only even fewer ventured into the contribution of ventricular filling by atrial systole. No answer discussed endothelial changes with aging.

Some answers were repetitious. Some answers included a significant discussion of information that was not asked for (Laplace law/Poiseuille's law).

20. Describe the anatomy of the sympathetic nervous system.

25 % of candidates passed this question.

A definition of the sympathetic system, followed by a systematic description of the central sympathetic centres; what happens at the spinal cord; the anatomy of the pre and post ganglionic fibres would have been awarded with a pass mark. Additional information about the sympathetic ganglia and the neurotransmitters involved would have rounded off a good answer.

Many answers lacked anatomical detail and described the actions (function) of the sympathetic system which was not asked for.

Most answers lacked any structure. The most common reason for not passing this question was that significant sections of the anatomy from central to peripheral were not mentioned. Most had a simple sketch understanding of the question asked but could not add enough of the next layer to be awarded a pass mark.

21. Describe the pharmacodynamic effects and indications for the use of anticholinesterase drugs.

25 % of candidates passed this question.

It was expected the answer would provide a structured approach to describing the pharmacodynamics (what the drug does to the body) of this discreet class of drugs. A brief acknowledgement of the drugs in this class followed by a catalogue of the various clinical uses of this class of drugs would be a good start. If this was followed up with a description of the effects of these drugs on the CVS, GIT, Salivary glands, eye, NMJ and the lungs a good mark would have been awarded.

A number of candidates described the actions at the receptors in detail which did not attract marks. The extensive range of clinical uses for this class of drugs was poorly appreciated.

Few answers demonstrated any understanding of the PD effects of the drug class. There was generally a good knowledge of representative drugs within this class. Failing to achieve a pass mark reflected scant/brief answers that just did not cover enough of the expected material.

22. Compare and contrast dexmedetomidine and ketamine

50 % of candidates passed this question.

The majority of candidates were able to describe the mechanism of action, uses, dose and some side effects of each drug. The better answers were in a table format. It is of course possible to include much of the relevant information without using a table; however without the visual prompt of a table it makes it likely sections will be omitted.

When comparing two drugs it would be useful to note that though they both provide sedation with analgesia they are used in different circumstances. In ICU, dexmedetomidine is mainly used for sedation peri-extubation and may be continued post-extubation but this was not often mentioned.

The pharmacodynamic effects often omitted the cardiovascular and respiratory effects of ketamine (particularly bronchodilation).

The pharmacokinetic information required was not detailed but only minimal marks can be awarded for 'administered IV with 100% bioavailability, liver metabolism and renal excretion' which was a common answer. Noting dexmedetomidine is metabolised to inactive metabolites and ketamine is metabolised to norketamine gained marks, specific pathways were not required. Both drugs are licenced for administration intravenously (and ketamine may be administered IM); however other routes of administration are emerging in clinical practice for both drugs.

23. How can the 'central tendency' of data be measured (50% of marks)? How is the 'degree of dispersion' is described (50% of marks)?

8 % of candidates passed this question**.**

There was a lack of sufficient knowledge to pass this question. The first question required a definition of mean, median and mode and some explanation about when the use of one would be preferred over another. One candidate gave an example of a simple data set (a set of numbers) and calculated the mean, median & mode and explained the effect of an outlier. This simple exercise demonstrated they had a very good understanding of the terms.

The degree of dispersion was poorly answered. A list of measures with a sentence or equation describing each would have scored well. The list could have included range, inter-quartile range (and box and whisper plots), mean absolute deviation, variance and standard deviation and coefficient of variation. Not all measures needed to be discussed to pass the question.

Many candidates confused standard deviation and standard error of the mean and many candidates failed to discuss ranges which are the simplest way to describe dispersion.

24. Outline the anatomy of the larynx.

13 % of candidates passed this question**.**

It was expected that an answer would include the names of the three single and three paired laryngeal cartilages, intrinsic and extrinsic muscles (names were not required), nerve supply (motor and sensory) and blood supply. Many candidates had good illustrations though a drawing was not essential.

The majority of candidates failed to name the laryngeal cartilages. There was much confusion about whether certain structures were bones or cartilage or even muscle. The relation of the larynx to the thyroid gland was frequently misunderstood.

Many answers focussed on the relations of the larynx but omitted basic information about the larynx itself. No marks were awarded for the contents of the carotid sheath or the course of the recurrent laryngeal nerve both of which were frequently included in answers.

SHORT FACT QUESTIONS – PAPERS 1 AND 2

100 % of candidates passed this section.

Cloze Questions	100 % pass rate
Rank Questions	63 % pass rate
Match Questions	100 % pass rate

ORAL SECTION

20 candidates were invited to attend the oral section based upon their written marks.

VIVA 1

75% of candidates passed this question.

This Viva tested knowledge of cardiovascular physiology, ECG and Antiarrhythmic pharmacology.

VIVA 2

65% of candidates passed this question.

This Viva tested knowledge of respiratory physiology. It explored the understanding of ventilation and perfusion of the lung, dead space and moved on to discuss capnography.

VIVA 3

85% of candidates passed this question.

This Viva tested knowledge of renal physiology and related pharmacology. It explored understanding about acid base balance, renal handling of bicarbonate and moved on to the pharmacology of diuretics.

VIVA 4

100% of candidates passed this question.

This Viva tested knowledge on neuromuscular physiology and pharmacology. It explored the anatomy of a reflex arc, the physiology of neuromuscular transmission on and pharmacology of neuromuscular blocking drugs.

VIVA 5

90% of candidates passed this question.

This Viva tested knowledge on cardiovascular pharmacology and pharmacodynamics. It explored the pharmacology of betablockers and pharmacodynamic concepts around agonist and antagonist drugs.

VIVA 6

90% of candidates passed this question.

This Viva tested knowledge on nutrition and metabolism.

VIVA 7

45% of candidates passed this question.

This Viva tested knowledge on obesity and focused on the physiological cardiovascular changes, consequences for various other organ systems and drug pharmacology.

VIVA 8

100% of candidates passed this question.

This Viva tested knowledge on the physiology and pharmacology of iron and haemoglobin.

SUMMARY OF THE EXAMINATION

The CICM First Part Examination explores the knowledge of the basic sciences that form the basis to 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 follow 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 to also 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.

This is a challenging exam. 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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