

MCQS **FOR THE** PRIMARY FRCA

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and Leslie William Gemmell



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Introduction

This book contains 540 questions in 6 papers as they might appear in the examination. Each paper has 90 questions, each with 5 parts. There are 30 physiological questions, 30 pharmacology questions and 30 physics, clinical measurement and statistics questions.

The questions have been constructed using information remembered by candidates sitting the London college examination in recent years. These may not be the exact questions as they appeared in the examination but will be of the same degree of difficulty and cover the same topics.

In order to pass the primary anaesthesia examination, knowledge is required and it is essential to learn about all the topics that might be examined. These questions are a guide to the syllabus and the subjects that should be covered before appearing in the examination.

It is probably not realistic to try to learn by just reading an MCQ book. But once the trainee has studied for 6 months or more then a book such as this is one way of testing whether enough of the topics have been covered and then the level of knowledge and understanding that has been achieved.

It is important to practise a technique for answering MCQ questions. In the examination hall it is a good idea not to record the answers on the answer sheet during the first 15 minutes as that is when mistakes of entering the answers under the wrong question number occur. But it is important that, every time a question is read, a decision is made about the answer and that decision should be recorded on the question sheet, before transferring anything to the answer sheet. Use a code that allows you to record a decision every time you read a question. Place a mark against each question on the question paper such as T (true), F (false) or X (do not know). Start to transfer your certain answers to the answer sheet only once the adrenaline is settling down. Go back again and re-read the questions you were not certain about. Look at what you thought the answer was the first time and if you think it is the same on a second reading it may be worth transferring that answer. Use the suggested answers in the book to check if you are guessing too much and getting it wrong too often or not transferring some of your hunches which are proving to be correct.

It is always difficult to be certain of the pass mark, but below 50% will not be a pass, between 50% and 55% will sometimes be a pass, between 55% and 60% should be a pass, but it will vary between each sitting of the examination.

If the examination changes to one correct answer for every five questions the answering technique will remain the same. Record your answer on the question paper to start with and only transfer answers when you are certain and when your adrenaline has settled. Then go back and check the ones you have not transferred. If there is no negative marking you should answer all the questions with your best guess but you want to avoid making too many changes on the answer sheet.

Read each question carefully. Some common problems include seeing a question on a familiar topic but not checking the decimal point, the units used or the negative phrasing. The words 'may' and 'can' are usually true but not always and 'always' will usually be false in medical matters.

MCQ tutor program

To complement this book, but separate from the book, the MCQ Tutor program has been developed by Dr Richard Shillito, who is an anaesthetist. The aim of the program is to specifically help candidates to work out if they are too cautious and do not answer questions that they would probably get right or are inclined the other way and guess too much and so score a lot of negative points.

For details of the program visit the Cambridge University Press website www.cambridge.org/9780521705097.

You will need Microsoft 2000 or XP in order to run this program. The program uses the same test papers that are in this book. The reader is asked to enter their answers – true/false – or if you are uncertain mark true/false and possible or do not know.

When the test paper is finished two scores will be calculated. One for all the answers given and a second score for the answers only marked as certain. From the two scores it will be possible to determine whether all the certain answers by themselves would have been enough to pass, or whether the 'possible' answers should be included.

This is the first program that we are aware of that allows the candidate to find out if their guesses are good guesses that should be used to add to their total score or bad guesses that are reducing their overall score. The authors are very grateful to Richard Shillito for all his efforts in writing this program.

Abbreviations

2,3-DPG	2,3-diphosphoglycerate
AA	amino acids
ACEI	angiotensin converting enzyme inhibitor
ACTH	adrenocorticotrophic hormone
ADH	antidiuretic hormone
ADP	adenosine diphosphate
ALT	alanine aminotransferase
ANP	atrial natriuretic peptide
aPTT	activated partial thromboplastin time
ARDS	acute respiratory distress syndrome
AST	aspartate aminotransferase
ATP	adenosine triphosphate
AUC	area under the curve
AV	atrioventricular
AVP	arginine vasopressin
BBB	blood–brain barrier
BiS	bispectral analysis
cAMP	cyclic adenosine monophosphate
CBF	cerebral blood flow
CMRR	common mode rejection ratio
CoHb	carboxyhaemoglobin
CPAP	continuous positive airways pressure
CPP	coronary perfusion pressure
CSF	cerebrospinal fluid
CTZ	chemoreceptor trigger zone
CV	closing volume
DCT	distal convoluted tubule
DINAMAP	devices for indirect non-invasive automated mean arterial pressure measurement
DPPC	dipalmitoylphosphatidylcholine
DRA	dosage regimen adjustment
ECFV	extracellular fluid volume

EDP	end-diastolic pressure
EF	ejection fraction
EPSP	excitatory postsynaptic potential
FFA	free fatty acids
FRC	functional residual capacity
GFR	glomerular filtration rate
GIP	gastric inhibitory peptide
HbA	adult haemoglobin
HbF	fetal haemoglobin
ICFV	intracellular fluid volume
IOP	intraocular pressure
IP ₃	inositol trisphosphate
IPPV	intermittent positive-pressure ventilation
IPSP	inhibitory postsynaptic potential
ISFV	interstitial fluid volume
IVC	inferior vena cava
LOH	loop of Henle
LOS	lower oesophageal sphincter
LVEDP	left ventricular end-diastolic pressure
MAO	monoamine oxidase
MAC	minimum alveolar concentration
MAP	mean arterial pressure
MetHb	methaemoglobin
MRI	magnetic resonance imaging
NANC	non-adrenergic, non-cholinergic
NIDDM	non-insulin-dependent diabetes mellitus
NIST	non-interchangeable screw thread
NMDA	N-methyl-D-aspartate
NSAIDs	non-steroidal anti-inflammatory drugs
ODC	oxyhaemoglobin dissociation curve
P ₅₀	oxygen tension of 50% saturation
PA	pulmonary artery
PAH	para-aminohippuric acid
PCT	proximal convoluted tubule
PCV	packed cell volume
PDE	phosphodiesterase
PEEP	positive end-expiratory pressure
PEFR	peak expiratory flow rate
PONV	postoperative nausea and vomiting

PT	prothrombin time
PTH	parathyroid hormone
PV	plasma volume
PVR	pulmonary vascular resistance
RAM	random access memory
REM	rapid eye movement
ROM	read only memory
RPF	renal plasma flow
RQ	respiratory quotient
RV	residual volume
SA	sinoatrial
SD	standard deviation
SELV	safety extra low-voltage
SEM	standard error of the mean
SIADH	syndrome of inappropriate ADH secretion
SLE	systemic lupus erythematosus
SVP	saturated vapour pressure
SVT	supraventricular tachyarrhythmias
TBG	thyroxine-binding globulin
TBPA	thyroxine binding pre-albumin
TBW	total body water
TENS	transcutaneous electrical nerve stimulation
TLC	total lung capacity
TmG	tubular maximum
TMP	transmembrane pressure
TOE	transoesophageal echocardiography
TSH	thyroid-stimulating hormone
UF	ultrafiltrate
V/Q	ventilation/perfusion
VIC	vaporiser inside the circle

Note: Certain drug names used are known by alternatives:

- adrenaline–epinephrine
- noradrenaline–norepinephrine
- lidocaine–lignocaine
- amitriptyline–amitriptiline

Physiology

1 Pulse pressure

- (a) is the median value between the systolic and the diastolic blood pressures
- (b) is reduced during tachycardia
- (c) is determined by the compliance of the arterial tree
- (d) decreases in old age
- (e) at a given time is the same throughout the arterial tree

2 Myocardial work increases when there is an increase in

- (a) stroke volume
- (b) ventricular systolic pressure
- (c) contractility
- (d) heart rate
- (e) systemic vascular resistance

3 Fetal haemoglobin

- (a) forms 60% of circulating haemoglobin at birth
- (b) is normally replaced by haemoglobin A (HbA) within 6–9 months
- (c) has a sigmoid-shaped dissociation curve
- (d) has a greater oxygen content at any given PO_2 than adult haemoglobin
- (e) binds 2,3-DPG more avidly than HbA

4 In the normal ECG the

- (a) Q wave is normally present in lead V6
- (b) T wave is normally inverted in aVR
- (c) Q wave is normally present in V1
- (d) R wave is larger than the S wave in V1
- (e) QRS duration depends on the recording electrode

5 Pulmonary vascular resistance is

- (a) increased when the haematocrit is abnormally high
- (b) decreased when breathing 21% oxygen in 79% helium
- (c) increased by the application of 5 cmH₂O positive end-expiratory pressure
- (d) increased by hypercapnia
- (e) decreased by moderate exercise

6 Concerning baroreceptors

- (a) they are located in the carotid sinus and aortic arch
- (b) they are stretch receptors
- (c) the neuronal discharge decreases as the mean arterial pressure increases
- (d) the neuronal firing increases as the heart rate increases
- (e) baroreceptors in the carotid sinus are more sensitive than aortic receptors to changes in blood pressure

7 Lung compliance

- (a) describes the relationship between pressure and flow
- (b) decreases with age
- (c) is reduced in the supine position
- (d) is normally 1.5–2.0 l/kPa
- (e) is related to body size

8 During normal inspiration there is an increase in

- (a) intrapleural pressure
- (b) alveolar pressure
- (c) intra-abdominal pressure
- (d) the relative humidity of air in the trachea
- (e) the partial pressure of oxygen in the trachea

9 Alveolar dead space is increased in

- (a) pulmonary embolism
- (b) haemorrhage
- (c) increased tidal volumes
- (d) changing from the supine to the erect posture
- (e) intermittent positive-pressure ventilation

10 Functional residual capacity (FRC)

- (a) measurement by the helium dilution technique gives a higher value than that given by body plethysmography
- (b) is equal to total lung capacity minus the reserve volume
- (c) is increased by changing from the erect to the supine posture
- (d) is reduced during pregnancy
- (e) is decreased in old age

11 The ascending limb of the loop of Henle

- (a) is impermeable to sodium
- (b) is involved in the active transport of potassium ions into the lumen
- (c) is involved in the transport of chloride out of the lumen
- (d) actively transports water
- (e) contains hypotonic urine at the distal end

12 In an awake, healthy individual assuming the lateral position the

- (a) dependent lung has less ventilation
- (b) dependent lung has more perfusion
- (c) $\dot{V}/\dot{Q}$ ratio is higher in the dependent lung
- (d) PO_2 is higher in the lower lung
- (e) P_aCO_2 is lower in the lower lung

13 A pressure volume curve can be used for measuring

- (a) the work of breathing
- (b) compliance
- (c) functional residual capacity (FRC)
- (d) respiratory quotient
- (e) anatomical dead space

14 Cerebrospinal fluid

- (a) is formed by the choroid plexus
- (b) has a specific gravity of 1030 at body temperature
- (c) total volume in a 70-kg adult is 500 ml
- (d) normal pressure in the lateral position is 70–150 kPa
- (e) total protein content is more than that of serum proteins

15 Concerning the transport process in the proximal convoluted tubules (PCT)

- (a) about 50% of the normal filtered load of HCO_3^- ion is absorbed in the proximal tubule
- (b) absorption of glucose is linked to sodium reabsorption
- (c) normally most of the phosphate filtered is excreted
- (d) there are active secretory mechanisms for penicillin and *para*-aminohippuric acid (PAH)
- (e) amino acid absorption is independent of sodium reabsorption

16 The stretch reflex

- (a) consists of only one synapse within the central nervous system
- (b) involves gamma motor fibres as the efferent link
- (c) causes jerkiness of body movements
- (d) involves glutamate as a neurotransmitter at the central synapse
- (e) is highly facilitated in a decerebrate animal

17 Following major surgery a young fit 70-kg man will normally excrete, in 24 h

- (a) 500 ml water
- (b) 30 mmol Na^+
- (c) 10 mmol K^+
- (d) 20 mmol urea
- (e) 10 mmol Cl^-

18 During periods of starvation in humans

- (a) glycogen stores are depleted in 24 h
- (b) amino acids are converted to glucose
- (c) tissue breakdown initially provides 900 calories per day
- (d) urinary nitrogen loss progressively increases
- (e) a loss of 40% body cell mass is compatible with survival

19 In the fetal circulation the

- (a) foramen ovale closes due to pressure change
- (b) ductus venosus carries mixed venous blood
- (c) blood can reach the aorta from the superior vena cava without passing through the left atrium or the left ventricle
- (d) saturation of fetal haemoglobin (Hb F) in the descending aorta is more than in the aortic arch
- (e) oxygen saturation in the umbilical vein is 45%

20 Delta waves on the EEG are associated with

- (a) hypoxia
- (b) hypercarbia
- (c) sleep
- (d) closing eyes
- (e) deep general anaesthesia

21 Erythropoietin

- (a) is a circulating hormone without which hypoxia has little or no effect on red cell production
- (b) is formed in the kidney and in the liver
- (c) production is stimulated by epinephrine and norepinephrine
- (d) production is increased within minutes of the development of hypoxia
- (e) activity is decreased when the red cell volume is increased

22 The following receptors are present in the chemoreceptor trigger zone (CTZ)

- (a) opioid
- (b) dopaminergic D₁ receptors
- (c) muscarinic M₃ receptors
- (d) adrenergic α ₁ and α ₂
- (e) serotonergic 5HT₃

23 With regard to the vomiting reflex the

- (a) diaphragm relaxes
- (b) glottis opens
- (c) epiglottis closes
- (d) oesophageal sphincter closes
- (e) respiration stops

24 Aldosterone

- (a) does not directly affect renal blood flow
- (b) increases the acidity of urine
- (c) reduces the sodium content of sweat
- (d) potentiates the effects of vasopressin in hypovolaemia
- (e) is excreted in response to angiotensin

25 The respiratory quotient (RQ)

- (a) is the ratio of CO_2 to O_2 at any given time
- (b) is the ratio in the steady-state of the volume of CO_2 produced to the volume of O_2 consumed per unit of time
- (c) is 0.7 with a diet of carbohydrate
- (d) is decreased during hyperventilation
- (e) increases during severe exercise

26 Compensatory reactions activated by haemorrhage include

- (a) decreased movement of interstitial fluid into the capillaries
- (b) decreased plasma protein synthesis
- (c) increased secretion of ADH
- (d) decreased glomerular filtration rate
- (e) decreased filtration fraction

27 In the renal tubule

- (a) hydrogen ions are excreted in combination with ammonia
- (b) hydrogen ions are excreted mostly as phosphate
- (c) aldosterone increases sodium absorption in the distal convoluted tubule (DCT) and collecting duct
- (d) ADH increases water permeability in the DCT
- (e) almost 99% of the glomerular filtrate is reabsorbed

28 When compared to normal people athletes have

- (a) a larger stroke volume at rest
- (b) a lower heart rate at any given level of exercise
- (c) a decreased maximal oxygen consumption ($\dot{V}\text{O}_{2 \text{ max}}$)
- (d) a smaller increase in blood lactate production with exercise
- (e) a higher muscle blood flow

29 Plasma proteins

- (a) exert an osmotic pressure of approximately 5.3 kPa (40 mmHg)
- (b) provide one-half of the buffering capacity of the blood
- (c) include plasminogen
- (d) are mostly in the anionic form
- (e) are the main source of carbamino groups

30 The motility of the gastrointestinal tract is increased by

- (a) vagotomy
- (b) complete transection of the spinal cord at T3

- (c) stellate ganglion block
- (d) mechanical bowel obstruction
- (e) neostigmine

Pharmacology

31 The following statements are true regarding drug receptors

- (a) they are found only in cell membranes
- (b) drug receptor activity is always G-protein-coupled
- (c) the concentration of receptors in the cell membranes is dynamic
- (d) GABA receptors are ligand-gated ion channels
- (e) competitive antagonists bind reversibly to the receptors

32 The following drugs are extensively metabolised

- (a) prilocaine
- (b) digoxin
- (c) chlorpromazine
- (d) diazepam
- (e) paracetamol

33 The following drugs are well absorbed from the stomach

- (a) morphine
- (b) diamorphine
- (c) midazolam
- (d) loperamide
- (e) propranolol

34 The following factors enhance the diffusion of a drug across the blood-brain barrier

- (a) high plasma protein binding
- (b) high degree of ionisation at physiological pH
- (c) high molecular weight
- (d) high lipid solubility
- (e) high plasma–brain concentration gradient

35 pH alters the structure of the following drugs

- (a) diazepam
- (b) midazolam
- (c) lidocaine

- (d) atracurium
- (e) suxamethonium

36 The following drugs induce the enzyme cytochrome P450

- (a) carbamazepine
- (b) nitrazepam
- (c) metronidazole
- (d) ranitidine
- (e) rifampicin

37 The following anaesthetic agents cause direct sympathetic stimulation

- (a) enflurane
- (b) sevoflurane
- (c) desflurane
- (d) halothane
- (e) isoflurane

38 The following speed up the induction of anaesthesia with volatile anaesthetics

- (a) use of CO₂
- (b) increased cardiac output
- (c) agents with a high blood/gas solubility coefficient
- (d) increased alveolar ventilation
- (e) hypotension

39 The following cause dystonic reactions

- (a) ondansetron
- (b) metoclopramide
- (c) cyclizine
- (d) prochlorperazine
- (e) domperidone

40 Etomidate

- (a) reduces intraocular pressure
- (b) is solubilised in propylene glycol
- (c) causes a higher incidence of venous sequelae than thiopentone

- (d) reduces plasma cortisol concentrations by an action on the pituitary gland
- (e) is excreted unchanged in the kidney

41 Prilocaine

- (a) has a pKa of 5.0
- (b) has a longer duration of action than lidocaine
- (c) is metabolised by plasma cholinesterase
- (d) has a higher pKa than bupivacaine
- (e) is more protein bound than bupivacaine

42 Lidocaine (lignocaine)

- (a) prolongs the duration of action of the cardiac action potential
- (b) inhibits plasma cholinesterase
- (c) causes sedation
- (d) causes atrioventricular block
- (e) has a high hepatic extraction ratio

43 Which of the following are true of the mechanisms of opioid action?

- (a) there are currently five separate opioid receptors
- (b) the mu (μ) receptor has been classified as the op1 receptor
- (c) opioid receptors are found at peripheral sites
- (d) buprenorphine is a partial agonist at the mu (μ) receptor
- (e) nalbuphine is an effective mu (μ) receptor antagonist

44 Naloxone

- (a) is a kappa receptor agonist
- (b) has a high oral bioavailability
- (c) has an elimination half-life of 1–2 h
- (d) causes pulmonary oedema
- (e) prevents conversion of angiotensin I to angiotensin II

45 The following are 5HT₃ blockers

- (a) octreotide
- (b) methysergide
- (c) cyproheptadine
- (d) ketanserine
- (e) ondansetron

46 Flumazenil

- (a) is a competitive benzodiazepine antagonist
- (b) is an inverse agonist at the benzodiazepine receptor
- (c) has a relatively short half-life
- (d) is useful in treating hepatic encephalopathy
- (e) is indicated in status epilepticus

47 Midazolam when compared with diazepam

- (a) is more lipid soluble
- (b) produces longer-acting active metabolites
- (c) causes less discomfort on injection
- (d) has a significantly lower volume of distribution
- (e) has a shorter elimination half-life

48 Neostigmine

- (a) is a tertiary amine
- (b) is metabolised in the liver
- (c) may prolong the action of suxamethonium
- (d) inhibits both cholinesterase and pseudocholinesterase
- (e) if given during pregnancy can cause fetal muscle weakness

49 Potentiation of neuromuscular block by neomycin is

- (a) more likely with a non-depolarising block than with a depolarising block
- (b) intensified by enflurane
- (c) lessened by the administration of calcium
- (d) antagonised by the administration of neostigmine
- (e) increased by simultaneously administering trimethoprim

50 Class 1a anti-arrhythmic drugs usually

- (a) slow depolarisation
- (b) increase the threshold potential
- (c) increase the action potential
- (d) are indicated for atrial arrhythmias
- (e) have local anaesthetic activity

51 The following drugs increase the gastric emptying time

- (a) ranitidine
- (b) domperidone
- (c) morphine
- (d) neostigmine
- (e) glycopyrrolate

52 Angiotensin converting enzyme inhibitors (ACEI)

- (a) reduce arteriolar tone more than venous tone
- (b) cause renal impairment in patients with renal artery stenosis
- (c) cause troublesome cough
- (d) are used to treat pregnancy-induced hypertension
- (e) cause hypokalaemia

53 Injection of intramuscular or intravenous epinephrine causes

- (a) increased pulmonary artery systolic pressure
- (b) increased pulmonary blood flow
- (c) increased pulmonary artery wedge pressure
- (d) no change in pulmonary artery pressure
- (e) an increase in diastolic blood pressure

54 Adenosine

- (a) is used to reduce atrioventricular conduction in the treatment of supraventricular tachyarrhythmias
- (b) may cause bronchospasm
- (c) has a long elimination half-time
- (d) is a potent coronary vasodilator
- (e) is contraindicated in heart block

55 Intravenous mannitol

- (a) is a polyhydric alcohol
- (b) is used as a fuel substrate for most cells in the body
- (c) extravasations can cause tissue necrosis
- (d) causes haemolysis
- (e) can cause a delayed increase in cranial pressure

56 Doxapram

- (a) acts by stimulating peripheral chemoreceptors
- (b) is contraindicated in epilepsy
- (c) interacts with aminophylline

- (d) reduces systolic arterial blood pressure
- (e) is a competitive antagonist at the mu receptor

57 Omeprazole

- (a) is a pro-drug
- (b) acts by blocking histamine (H₂) receptors
- (c) is longer acting than cimetidine
- (d) has a rapid onset of action
- (e) is effective in Zollinger–Ellison syndrome

58 Drugs which have a context-sensitive half-time which increases with time include

- (a) remifentanyl
- (b) alfentanil
- (c) fentanyl
- (d) propofol
- (e) morphine

59 The following are side-effects of heparin

- (a) thrombocytopenia
- (b) urticaria
- (c) intrauterine fetal haemorrhage
- (d) osteoporosis
- (e) alopecia

60 Glibenclamide

- (a) may cause hypoglycaemia
- (b) increases secretion of insulin
- (c) increases the peripheral action of insulin
- (d) causes lactic acidosis
- (e) is excreted by the kidney

Physics, measurement and statistics

61 Laminar flow through a horizontal tube has the following characteristics

- (a) flow rate is proportional to the viscosity
- (b) flow rate is inversely proportional to the density

- (c) flow rate is inversely related to the length of the tube
- (d) flow rate is turbulent when the Reynolds number is larger than 4000
- (e) velocity at the centre of the tube is greater than at the sides

62 The critical temperature of a gas

- (a) is the temperature above which a gas cannot be liquefied
- (b) is the temperature below which it requires a lower pressure to liquefy a gas
- (c) varies with pressure
- (d) is the temperature at which a gas exists simultaneously in the gaseous and liquid states at atmospheric pressure
- (e) is the temperature at which oxygen is liquefied by a pressure of 50 bar

63 The following are properties of a capacitor

- (a) a capacitor consists of two conductor plates separated by an insulator
- (b) the size of a capacitor depends on the number of turns of wire around the coil
- (c) the size of a capacitor depends on the surface area of the plates
- (d) the unit of capacitance is the joule
- (e) AC current flow ceases through a capacitor when fully charged

64 The ease with which a liquid will vaporise is related to

- (a) the latent heat of vaporisation of the liquid
- (b) the latent heat of crystallisation of the liquid
- (c) the blood/gas solubility coefficient
- (d) the density of the liquid
- (e) the specific gravity of the liquid

65 The following statements apply to the classification of electrical medical devices

- (a) class I is represented by the symbol $\square$
- (b) class III can be connected to the mains
- (c) type CF must have a leakage current of $<25 \mu\text{A}$
- (d) type B can be class I, II or III
- (e) class I requires a single fuse

66 The correct SI unit for

- (a) time is the second
- (b) mass is the gram
- (c) force is the pascal
- (d) energy is the watt
- (e) length is the metre

67 Regarding surgical diathermy

- (a) the degree of burning at the tip of an active electrode is dependent on the current density
- (b) bipolar diathermy operates at a higher power output than unipolar diathermy
- (c) if the plate is detached the current will not flow
- (d) the current frequency is the same at the active electrode and at the patient's plate
- (e) isolating capacitors are used because they have low impedance to a low-frequency current

68 Regarding statistical tests

- (a) the middle observation in an ordered series is the median
- (b) the mean is the most frequently occurring observation in a series
- (c) the standard deviation gives an indication of the scatter of the observations
- (d) 95% of all values lie within ± 2 SD
- (e) the standard deviation is a measure of the significance of observations

69 Pressure gauges

- (a) reduce high pressures to low pressures
- (b) regulate flow from a cylinder
- (c) are calibrated in pascals
- (d) form part of a device for measuring gas flow
- (e) utilise the principle of the Bourdon gauge

70 Principles involved in oxygen analysis intraoperatively include

- (a) the volumetric method
- (b) Graham's law

- (c) oxygen extraction
- (d) paramagnetism
- (e) absorption of oxidative energy

71 Transoesophageal Doppler

- (a) requires a probe of 50–60 cm length
- (b) gives information about stroke volume
- (c) readings are affected by temperature
- (d) measures the blood velocity in the ascending aorta
- (e) uses acceleration and peak velocity to indicate myocardial performance

72 Oxygen for medical use

- (a) is prepared by the fractional distillation of air
- (b) for pipelines contains 0.3% nitrogen
- (c) forms an inflammable mixture with oil
- (d) from concentrators provides an F_iO_2 of over 80%
- (e) has similar magnetic properties to nitrous oxide

73 The pneumotachograph

- (a) directly measures change across a resistance
- (b) must have a resistance of sufficient diameter to ensure laminar gas flow
- (c) is not suitable for accurate breath-by-breath monitoring
- (d) possesses accuracy affected by temperature change
- (e) possesses accuracy unaffected by alterations in gas composition

74 The following are true of nerve stimulators

- (a) the applied electrical potential can be as high as 150 V
- (b) the apparatus uses a square-wave electrical signal
- (c) the pulse current should be 0.5–5.0 mA when skin electrodes are used
- (d) when the resistance increases the current must decrease, at a constant voltage
- (e) stimulation at a constant current is preferable to stimulation at constant voltage

75 Serum osmolarity is

- (a) a measure of the number of particles in solution
- (b) usually expressed in milliosmoles per litre
- (c) commonly determined by the temperature at which a solution freezes
- (d) proportional to the valency of the particles in solution
- (e) dependent on the serum albumin concentration

76 The gas volume can be measured accurately using a

- (a) Wright's respirometer
- (b) vitalograph
- (c) Benedict Roth spirometer
- (d) dry gas meter
- (e) pneumotachograph

77 The following are agent specific

- (a) mass spectrometry
- (b) ultraviolet analyser
- (c) infrared analyser
- (d) piezoelectric analysis
- (e) refractometer

78 Transcutaneous electrical nerve stimulation

- (a) uses a current up to 90 mA
- (b) uses a frequency of 0–100 Hz
- (c) pulse duration is 0.1–0.5 ms
- (d) at low frequency acts by closing the gate
- (e) at high frequency acts by releasing endorphin

79 The following are true of the transfer of heat

- (a) an adiabatic change retains the heat of the reaction within the system
- (b) boiling involves transferring heat without a change in temperature
- (c) a body with a high heat capacity will transfer heat to one with a lower heat capacity at the same temperature
- (d) radiation is proportional to the fourth power of the absolute temperature
- (e) the response time of a thermometer increases with its heat capacity

80 Linear regression analysis

- (a) applies a technique of minimising squared differences
- (b) can be used to analyse variables that are not distributed normally
- (c) gives a regression coefficient
- (d) yields an intercept that defines the position of the line
- (e) finds the line that best predicts X from Y

81 Surface tension

- (a) is measured in newtons per metre
- (b) in the wall of a sphere, is directly proportional to the diameter of the sphere
- (c) is due to attraction between molecules in a liquid (molecular cohesion)
- (d) leads to a water manometer under-reading
- (e) leads to a mercury manometer over-reading

82 Plethysmography is used to measure

- (a) total lung capacity
- (b) functional residual capacity
- (c) residual volume
- (d) forearm blood flow
- (e) coronary blood flow

83 A pressure of 1 bar is equal to

- (a) 1 kg/cm
- (b) 14.5 lb/in
- (c) 7.5 torr
- (d) 1006.2 cmH₂O
- (e) 101.01 pascal

84 With regard to a substance

- (a) 1 mol equals 0.012 g carbon-12
- (b) 1 mol occupies 2.24 l at s.t.p.
- (c) In 1 mol of any substance are 6.022×10^{23} molecules
- (d) mole is the SI unit of volume
- (e) one gram molecular weight of any gas occupies the same volume

85 With regard to medical piped gases

- (a) the nitrous oxide pressure is 4 bar (4×10^5 Pa)
- (b) after maintenance of O₂ pipes the O₂ analyser is used to test the integrity of the system
- (c) the non-interchangeable screw thread (NIST) has one diameter in the shaft which is specific for each gas
- (d) the Schrader probe has a non-return valve
- (e) the pipeline oxygen supply pressure enters the machine at 420 kPa (60 psi) pressure

86 Regarding the physiological principles underlying haemofiltration

- (a) the pore size of the membrane allows molecules up to 50,000 daltons to pass through
- (b) an ultrafiltrate of up to 1000 ml per hour can be formed
- (c) plasma water is removed by convective flow
- (d) the buffer of choice is bicarbonate in very low concentrations
- (e) transmembrane potential equals hydrostatic pressure – oncotic pressure

87 Student's t-test

- (a) is used to analyse normally distributed data
- (b) is used for comparing a single small sample
- (c) should be used as a one-tailed test whenever possible
- (d) deals with the problems associated with inference based on 'small' samples
- (e) is typically used to compare the means of two populations

88 Regarding electrical safety

- (a) an electrical current of 5 mA passing through the body will cause a tingle
- (b) class II electrical equipment must be double insulated
- (c) class III equipment can only work with a low voltage (<24 V)
- (d) the leakage current from any equipment that can come in contact with the heart must be less than 50 mA
- (e) anaesthetic proof (AP) may be used in the zone of risk 5–25 cm from an enclosed medical gas system

89 A strain gauge can be used to measure

- (a) gas flow
- (b) intensity of light
- (c) arterial blood pressure
- (d) forearm blood flow
- (e) force of muscle contraction

90 Concerning trans-oesophageal echocardiography

- (a) the Doppler probe employs high-frequency sound waves
- (b) the Doppler effect is due to a change in frequency of the ultrasound waves
- (c) ultrasound gives a precise measure of cardiac output
- (d) the speed of medical ultrasound is 1540 m/s
- (e) medical ultrasound passes better through air than blood

Table for answers for primary paper 1

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Physiology

1 Coronary blood flow

- (a) occurs only during diastole
- (b) is reduced during tachycardia
- (c) is determined by the pressure difference between the aorta and the left ventricular end-diastolic pressure
- (d) is reduced in hypovolaemia
- (e) is reduced when the central venous pressure rises

2 Parathyroid hormone

- (a) is a mucopolysaccharide
- (b) inhibits osteolytic action
- (c) activates vitamin D
- (d) increases urinary excretion of phosphate
- (e) is released in response to a low extracellular concentration of free calcium

3 Concerning the absolute refractory period of the cardiac muscle

- (a) it is the period immediately following the discharge of a nerve impulse
- (b) it is the period when no further action potential can be generated
- (c) it is shorter for pacemaker tissue than for normal cardiac muscle
- (d) it is twice the length of the S-T segment
- (e) stronger than normal stimuli can cause excitation

4 The following vessels are important in physiological shunt

- (a) bronchial veins
- (b) thebesian veins

- (c) coronary sinus
- (d) ductus venosus
- (e) azygos veins

5 Pulmonary surfactant

- (a) production can be increased by a reduction in pulmonary blood flow
- (b) synthesis is stimulated by thyroxine
- (c) maturation is inhibited by glucocorticoids
- (d) deficiency in babies born to diabetic mothers is due to fetal hyperinsulinism
- (e) concentration per unit area is directly proportional to the surface tension

6 The calibre of the bronchi decreases

- (a) in response to stimulation of their parasympathetic nerve supply
- (b) during inspiration
- (c) in response to stimulation of beta receptors in their smooth muscle
- (d) during coughing
- (e) in response to histamine

7 The oxygen content of arterial blood with the same PO_2 is raised by

- (a) increased haematocrit
- (b) temperature
- (c) anaemia
- (d) increased 2,3-DPG
- (e) increased PCO_2

8 On ascending to an altitude of 3500 m the physiological changes include

- (a) an increase in cerebral blood flow
- (b) an initial increase in plasma pH
- (c) a fall in arterial PO_2
- (d) an increase in minute volume
- (e) a rise in urine pH

9 P_{50} on the oxygen dissociation curve is increased by

- (a) increased PH
- (b) fetal haemoglobin (HbF)
- (c) decreased 2,3-DPG
- (d) carboxyhaemoglobin
- (e) increased temperature

10 The following are associated with hyperventilation

- (a) decrease in $PaCO_2$
- (b) increase in PaO_2
- (c) increase in ionised calcium
- (d) decrease in CSF bicarbonate
- (e) increase in plasma bicarbonate

11 Regarding glucose handling in the kidney

- (a) re-uptake is passive
- (b) it is filtered at the rate of approximately 100 mg per minute
- (c) tubular maximum (TmG) is the same for all nephrons
- (d) reabsorption is inversely proportional to lipid solubility
- (e) tubular maximum in the nephrons is 375 mg/min

12 With regard to glomerular filtration rate (GFR)

- (a) *para*-aminohippuric acid (PAH) is used to measure GFR
- (b) the normal ratio of the GFR to renal plasma flow is about 0.3
- (c) the hydrostatic pressure in the glomerular capillary remains at 45 mmHg throughout its entire length
- (d) the oncotic pressure (π) in the glomerulus rises as blood flows through it
- (e) creatinine clearance underestimates GFR

13 Liver function can be assessed by

- (a) plasma electrophoresis
- (b) acid phosphatase
- (c) prothrombin levels
- (d) urea levels
- (e) alkaline phosphatase

14 The blood–brain barrier

- (a) is composed mainly of endothelial cells
- (b) is functionally affected by infections of the central nervous system
- (c) restricts passive diffusion of glucose from blood to brain
- (d) is less permeable in neonates than adults
- (e) is freely permeable to hydrogen ions

15 Stimulation of the parasympathetic nervous system

- (a) dilates the pupil
- (b) increases heart rate
- (c) causes vasoconstriction
- (d) decreases the rate of gastric emptying
- (e) causes contraction of the detrusor muscle in the bladder

16 During a nerve action potential

- (a) intracellular sodium and potassium ion concentrations become equal
- (b) sodium ions move into the cell
- (c) the sodium pump is inhibited
- (d) calcium slow channels are blocked
- (e) repolarisation results from increased potassium permeability

17 Active transport system includes

- (a) movements of sodium out of nerve cells
- (b) thyroxine release
- (c) H^+ ion secretion at gastric mucosa
- (d) reabsorption of H_2O at proximal convoluted tubules
- (e) H_2O reabsorption at collecting ducts

18 A reflex action

- (a) can be monosynaptic or polysynaptic
- (b) may involve simultaneous contraction of some skeletal muscles and relaxation of others
- (c) may be carried out by skeletal, smooth or cardiac muscle or by glands
- (d) is not influenced by higher centres in the brain
- (e) results from stimulation of two synapses in series

19 The ventilatory response to inhaled CO₂

- (a) can be abolished by complete section of the ninth and tenth cranial nerves
- (b) becomes more effective during hypoxia
- (c) is increased by 0.1 l/min for every 0.75 kPa increase in PaCO₂
- (d) is more prominent in peripheral chemoreceptors
- (e) is shifted to the right by sleep and morphine

20 The following enzymes are responsible for protein digestion

- (a) gastrin
- (b) amylase
- (c) trypsin
- (d) chemotrypsin
- (e) carboxypeptidase

21 The following cause hyperkalaemia

- (a) incompatible blood transfusion
- (b) blood pH of 7.2
- (c) ingestion of 200 mmol of potassium chloride per day by a healthy adult
- (d) infusion of 100 mmol of potassium chloride per hour in a healthy adult
- (e) Conn's syndrome (primary hyperaldosteronism)

22 Movement of fluid from a capillary into tissue is increased by

- (a) a rise in venous pressure
- (b) a rise in plasma oncotic pressure
- (c) closure of pre-capillary sphincters
- (d) a fall in arterial pressure
- (e) constriction of arterioles

23 The physiological effects of pregnancy include

- (a) increased functional residual volume
- (b) a shift of the oxygen dissociation curve to the left
- (c) anaemia due to a fall in red cell mass
- (d) an increase in plasma fibrinogen concentration
- (e) reduced renal threshold for glucose

24 The development of high titres of anti-D antibodies in a Rhesus-negative mother with an Rh-positive fetus

- (a) is due to fetal red blood cells entering the maternal circulation
- (b) will result in anaemia of the newborn
- (c) will result in jaundice of the newborn
- (d) is due to antigen alone entering the maternal circulation
- (e) always occurs before the third month of gestation

25 Regarding calcium

- (a) it is mainly absorbed from the stomach
- (b) it is absorbed from the small intestine
- (c) calcitonin increases the uptake of calcium into bones
- (d) parathyroid hormone increases plasma calcium by activating osteoblasts
- (e) hydroxylated vitamin D increases absorption of calcium from the gut

26 The following are true when considering the control of temperature

- (a) it involves afferent input from cutaneous cold receptors
- (b) the spinal cord is a passive conductor of afferent thermal signals
- (c) the central control is in the hippocampus
- (d) vasoconstriction occurs at a core temperature of $>37^{\circ}\text{C}$
- (e) shivering is activated at a specific temperature

27 Activation of receptors for ANP increases target cell

- (a) GTP
- (b) IP_3
- (c) cAMP
- (d) protein kinase A activity
- (e) guanylate cyclase activity

28 If the body temperature falls during a long operation

- (a) oxygen and carbon dioxide are more soluble in blood
- (b) blood viscosity is decreased
- (c) there is a shift of the oxygen dissociation curve to the left
- (d) the effect of non-depolarising drugs is reduced
- (e) alkalosis is a common problem

29 Secretion of corticotrophin

- (a) controls glucocorticoid production
- (b) controls catecholamine production
- (c) is increased by the secretion of a hypothalamic releasing factor
- (d) is suppressed by a high level of circulating glucocorticoids
- (e) has a circadian variation

30 Gap junctions are responsible for

- (a) cellular polarity
- (b) connections between cells
- (c) transmission of action potentials from one fibre to another in skeletal muscle
- (d) rapid transmission of action potentials by Purkinje fibres
- (e) transmission of action potentials from one fibre to another in smooth muscle and the gastrointestinal tract

Pharmacology**31 Binding of drugs to plasma proteins**

- (a) increases their pharmacological activity
- (b) depends on pH
- (c) allows rapid renal elimination of the drug
- (d) can be saturated at high drug concentrations
- (e) enhances metabolism of the drug by the liver

32 The following drugs have an oral bioavailability greater than 50%

- (a) atenolol
- (b) methadone
- (c) verapamil
- (d) gentamicin
- (e) propranolol

33 The blood/gas partition coefficient

- (a) is a ratio of solubilities
- (b) is a dimensionless measure
- (c) is proportional to the time to onset of anaesthesia

- (d) determines the MAC
- (e) is greater for sevoflurane than for isoflurane

34 The following drugs have membrane-stabilising activity

- (a) propranolol
- (b) atenolol
- (c) esmolol
- (d) disopyramide
- (e) diltiazem

35 The following drugs are alpha antagonists

- (a) phentolamine
- (b) clonidine
- (c) oxycodone
- (d) chlorpromazine
- (e) droperidol

36 The following drugs cause dilatation of the pupil when instilled into the conjunctival sac of a normal person

- (a) ephedrine
- (b) cocaine
- (c) timolol
- (d) amethocaine
- (e) guanethidine

37 The potency of the inhalation anaesthetic agent

- (a) is inversely related to MAC
- (b) is related to the oil/gas partition coefficient
- (c) decreases with increasing molecular weight
- (d) sevoflurane is less potent than enflurane
- (e) isoflurane is the least potent inhalational anaesthetic agent

38 Sevoflurane

- (a) is a fluorinated ether
- (b) has a higher blood/gas partition coefficient than isoflurane
- (c) causes hepatotoxicity
- (d) is non-pungent
- (e) is less vulnerable to metabolism than desflurane

39 Ketamine

- (a) is presented as a racemic mixture
- (b) is a glutamate receptor antagonist
- (c) directly causes sympathomimetic effects
- (d) is readily metabolised by hydroxylation to form nor-ketamine
- (e) increases uterine contractility

40 Methohexitone

- (a) is 6 times more potent than thiopentone
- (b) causes excitatory movements
- (c) in aqueous solution has 6 parts 100 of sodium bicarbonate by weight
- (d) has a shorter elimination half-life than thiopentone
- (e) is most commonly used for electro-convulsive therapy.

41 The following local anaesthetic agents have a liver biotransformation

- (a) lidocaine
- (b) procaine
- (c) bupivacaine
- (d) amethocaine
- (e) ropivacaine

42 Cocaine

- (a) causes bronchoconstriction
- (b) causes vomiting
- (c) rarely causes allergic reactions
- (d) is excreted largely unchanged in the urine
- (e) competes with norepinephrine for reuptake pathways

43 Morphine is metabolised by the following mechanisms

- (a) glucuronide formation
- (b) *N*-dealkylation
- (c) acetylation
- (d) hydrolysis of an ester linkage
- (e) oxidative deamination

44 Tramadol

- (a) is a racemic mixture of two enantiomers
- (b) enhances noradrenaline neuronal uptake