CAI
SALUS DUM VIGILAMUS
College of Anaesthesiologists of Ireland

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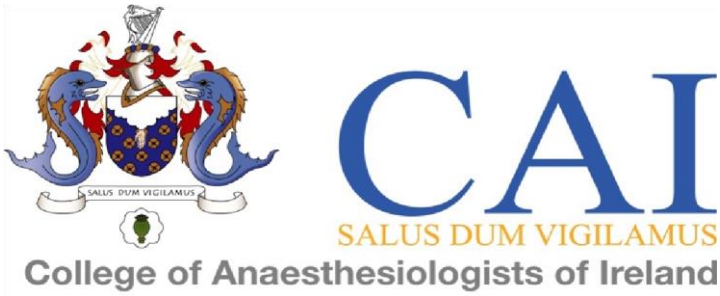
Membership (MCAI) Examination Syllabus

College of Anaesthesiologists of Ireland

Contents



Introduction

To become a **Member (MCAI)** of the College of Anaesthesiologists of Ireland (CAI) by **examination**, candidates must pass all components of the Membership Examination.

The Examinations are set and supervised by the CAI through a specialist group of Examiners who are Consultant Anaesthesiologists and experts in their fields. The College is committed to maintaining the **highest possible standards** for its Examinations. To maintain this position, the MCAI examiners and the Examinations Department **rigorously quality assures all its processes** and actively follows best medical education practice to ensure the pre-eminence of the Membership and Fellowship Examinations.

Aim of the Curriculum

The aim of this syllabus is to define the learning outcomes, teaching and assessments for a Specialist Anaesthesiologist trainee undertaking the Membership examination. More specifically it aims to:

- Highlight the knowledge, skills and behaviours required to practice as a specialist Anaesthesiologist
- Guide tutors and Fellows involved in training on suitable learning experiences for trainees
- Encourage trainees to seek self-directed learning opportunities
- Enable comparison with international training programmes to ensure equivalency of training, experience, and assessment

Focus of the Membership Examination

This examination places emphasis on those aspects of physiology, pharmacology, clinical measurement, equipment, and physics which have **direct application** to anaesthesiology, intensive care medicine, resuscitation and pain management.

It is essential for specialty anaesthesiology trainees acquire a very deep understanding and knowledge of these basic sciences to ensure patient safety.

Please note that this syllabus focuses on the scientific content required for the membership examination. The new Curriculum for the National Specialist Anaesthesiology Training Programme also contains the clinical knowledge and skills which will also be assessed during the membership objectively structured clinical examination (OSCE).

The Membership of the College of Anaesthesiologists of Ireland (MCAI) Examination

The Membership examination is composed of **three** parts:

1. The written multiple-choice examination
2. The structured oral examination
3. The objective structured clinical examination.

The Membership examination is a **national test of knowledge** as laid out in this MCAI examination syllabus agreed with the Irish Medical Council. The examination is embedded within the curriculum outcomes and specialty anaesthesiology trainees will not progress to the Fellowship examination or to SAT3 without possession of this qualification.

1. The Membership Written (Multiple Choice) Examination

The Membership written examination consists of **two parts,** completed on the **same day**:

a) **60 MTF (multiple true/false) questions**

- 20 MTF questions on physiology / biochemistry
- 20 MTF questions on pharmacology
- 20 MTF question physics / clinical measurement / equipment / statistics.

These are essentially a test of knowledge. Each MTF is composed of five parts, so in total there are 300 questions in the paper. Candidates complete this paper in 120 minutes.

b) **60 SBA (single best answers) questions,** completed in 120 minutes.

- 3 questions on anatomy
- 3 questions on statistics
- 18 questions on physiology / biochemistry
- 18 questions on pharmacology
- 18 questions on physics / clinical measurement and equipment.

These are designed to examine the application of the knowledge tested in the MTF section. The paper attracts 60 marks.

The MTF and SBA results are **added together**, giving the **MCQ** result. So, in total, the MCQ is out of 360 marks.

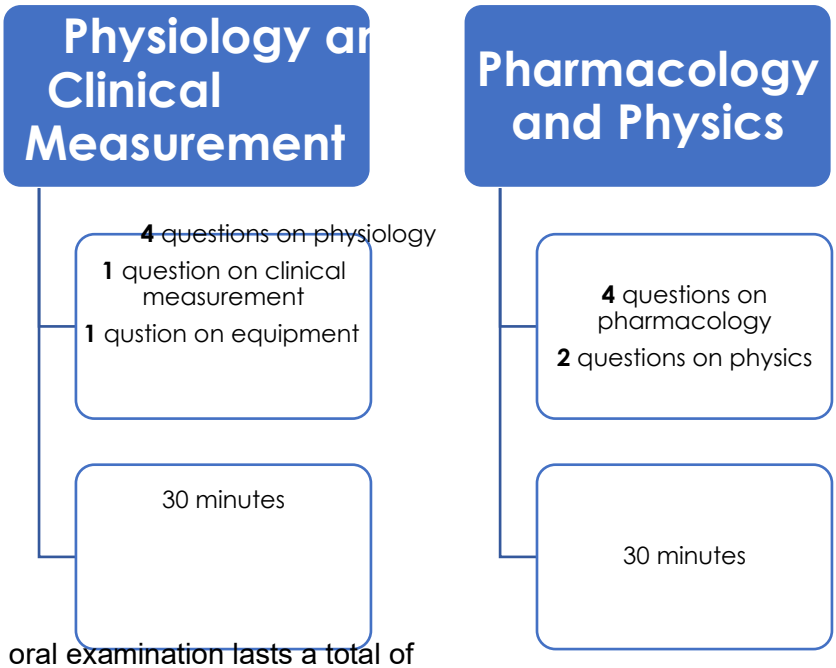
To pass the MCQ examination, candidates must achieve the overall pass mark; therefore, poor performance in one component can be **compensated** by a better performance in the other part.

All questions are mapped to a detailed blueprint, with explicit coverage of all the basic sciences, which underpin anaesthesiology practice.

2. The Membership Structured Oral Examination

Candidates may only take the Membership structured oral examination (SOE) once they have **been successful** at the **Membership MCQ examination**. The SOE section gives the opportunity for examiners to explore a candidate's **understanding** as well as their **knowledge** of clinical and basic science concepts. **SOEs are also good at linking the curriculum and the more areas sampled, the better the validity of the examination.**

The structured oral examination consists of **two parts**:



Each structured oral examination lasts a total of 30 minutes. In each section candidates are exposed to 6 questions of 5 minutes each, and 2 examiners evaluate their answers independently. Thus, a total of **4 examiners** are involved in independent scoring for each candidate. However, there is an **overall agreed score** at the end of the SOE. The 10 questions asked in both SOEs may cover **any aspect** of the MCAI examination syllabus, but are split among physiology, pharmacology, clinical measurement, equipment and physics.

Each question lasts 5 minutes, and the examiners will move from one topic to another to ensure that adequate time is allocated to allow the candidate to display the necessary **knowledge** and **understanding** in each area.

Although all questions are **structured**, the face-to-face nature of these examinations allows exploration not only of knowledge, but also of the understanding (application) of that knowledge.

Physiology and Clinical measurement and Equipment SOE

The focus of this SOE is to explore MCAI candidate's knowledge of topics specific to **physiology, biochemistry, clinical measurement, and equipment related to clinical anaesthesiology and intensive care medicine.** The physiology SOE has an emphasis on cardiorespiratory physiology. In addition, neurophysiology, gastrointestinal, renal and endocrine physiology are examined.

Pharmacology and Physics SOE

The focus of this SOE is to explore MCAI candidate's knowledge of pharmacology and physics pertinent to the practice of clinical anaesthesiology and intensive care medicine. The pharmacology areas examined are general pharmacology, anaesthetic pharmacology and systemic pharmacology (at least one question from each category) and include questions that are relevant to intensive care medicine.

3. The Membership Objective Structured Clinical Examination (OSCE)

The OSCE tests **applied knowledge** and **skills** in a variety of clinical areas. The style of the station varies e.g., interactive with an actor and/or examiner, completion of an answer sheet. The questions are chosen by the OSCE coordinator group to ensure a range of topics across the examination syllabus is included in each OSCE circuit. The process of an OSCE follows clear guidelines; the questions, instructions to candidates and examiners and the marking schedules are **specific** and **fixed.**

The OSCE comprises **18 stations** in approximately 2 hours (5 minutes per station). There are two pilot stations. These stations do not contribute to the final mark but are used to **ensure validity** of the questions before they are used in examinations. Neither the candidates nor the examiners know which stations are test stations. All of the stations are regarded as active. However, the results from the pilot stations do not contribute to the candidate's final mark. There is one rest station. Therefore 15 stations are used to calculate the result of the OSCE.

SOE / OSCE

Candidates complete both examinations on the same day. They are held twice a year (Autumn and Spring) in Dublin, Muscat and Perdana.

A Candidate who is successful in the Membership SOE and OSCE examination who has complied with such provisions as determined by the Council shall be entitled to be **admitted a Member of The College of Anaesthesiologists of Ireland**, on conferring the Member shall be entitled to use the post-nominal letters **MCAI**.

Blueprint of the Membership Examination mapped against this syllabus

	MTF	***SBA***	***Physiology, clinical measurement & equipment SOE***	***Pharmacology & physics SOE***	***OSCE***
Anatomy	Ö	Ö	´	´	Ö
Physiology & biochemistry	Ö	Ö	Ö	´	Ö
Pharmacology	Ö	Ö		Ö	Ö
Physics, equipment & clinical measurement	Ö	Ö	Ö	Ö	Ö

Statistical methods	Ö	Ö	Ö	Ö	Ö

Format of the MCAI Syllabus

Each Basic Science Unit is structured with a:

1. Title of the Competency, e.g., Pharmacology
2. Description of the learning outcomes of the Competency
3. Pre-requisites: requirements necessary for a trainee to have prior to competency being attempted or signed off.

The table is structured as follows:

Code	**Respiratory System**
CAI_M_A_0001	Mouth, nose, pharynx, larynx, trachea, main bronchi, segmental bronchi, structure of the bronchial tree; age-related changes from the neonate to the adult

These are the intended learning outcomes and MCAI candidates will be expected to know these for the examinations.

The **codes** are used by examiners to ensure an even balance of questions within the membership examination. They relate to the basic science which underpins anaesthesiology:

Code	**Basic Science it relates to:**
CAI_M_A_	Anatomy
CAI_M_P_	Pharmacology
CAI_M_PB_	Physiology and biochemistry
CAI_M_CM_	Physics, equipment & clinical measurement
CAI_M_S_	Statistical methods

Basic Sciences which underpin Anaesthesiology Practice

Section 1: Anatomy

Description:

Anaesthesiologists perform many practical clinical procedures which require a detailed knowledge of underlying anatomy. The trainee is expected to have knowledge of topographical anatomy as landmarks, radiological and ultrasound anatomy, and clinical anatomy.

Pre-requisites:

Knowledge of anatomy (as per medical degree).

Code	Respiratory System
CAI_M_A_0001	Mouth, nose, pharynx, larynx, trachea, main bronchi, segmental bronchi, structure of the bronchial tree; age-related changes from the neonate to the adult
CAI_M_A_0002	Airway / respiratory tract blood supply and innervation
CAI_M_A_0003	Pleura [including surface anatomy], mediastinum and its contents
CAI_M_A_0004	Lungs; lobes and microstructure of lungs
CAI_M_A_0005	Diaphragm, other muscles of respiration including innervation
CAI_M_A_0006	The thoracic inlet and 1st rib
CAI_M_A_0007	Interpretation of the normal adult chest x-ray
CAI_M_A_0008	Interpretation of basic lung ultrasound

Code	Cardiovascular System
CAI_M_A_0009	Heart - chambers, valves, conducting system and pericardium; blood supply and innervation
CAI_M_A_0010	Great vessels, main peripheral arteries and veins

Code	Nervous System
CAI_M_A_0011	Brain and its subdivisions; blood supply
CAI_M_A_0012	Spinal cord, structure of spinal cord, major ascending and descending pathways; blood supply
CAI_M_A_0013	Anatomical organisation of pain and sensory pathways from the periphery to the central nervous system
CAI_M_A_0014	Pain pathways relevant to the stages of obstetric labour and delivery
CAI_M_A_0015	Spinal meninges, subarachnoid and extradural space; contents of extradural space
CAI_M_A_0016	Anatomy of CSF system
CAI_M_A_0017	Spinal nerves; dermatomes; applied knowledge of dermatomes in regional anaesthesia
CAI_M_A_0018	Brachial plexus; nerves of the upper limb
CAI_M_A_0019	Intercostal nerves
CAI_M_A_0020	Nerves of the abdominal wall including innervation of the inguinal region
CAI_M_A_0021	Lumbar and sacral plexuses; nerves of the lower limb
CAI_M_A_0022	Anatomical organisation of the autonomic nervous system.
CAI_M_A_0023	Sympathetic innervation, sympathetic chain, ganglia and plexuses
CAI_M_A_0024	Parasympathetic innervation; cranial and sacral outflow

CAI_M_A_0025	Stellate ganglion
CAI_M_A_0026	Cranial nerves
CAI_M_A_0027	Innervation of the pharynx and larynx
CAI_M_A_0028	Eye and orbit

Code	Endocrine System
CAI_M_A_0029	Functional anatomy of the hypothalamic/pituitary system
CAI_M_A_0030	Functional anatomy of the adrenal gland
CAI_M_A_0031	Functional anatomy of the thyroid and parathyroid glands
CAI_M_A_0032	Anatomical organisation of the endocrine pancreas

Code	Vertebral Column
CAI_M_A_0033	Cervical, thoracic and lumbar vertebrae
CAI_M_A_0034	Sacrum, sacral hiatus
CAI_M_A_0035	Ligaments of vertebral column
CAI_M_A_0036	Surface anatomy of vertebral spaces; length of spinal cord and subarachnoid space; age-related differences from the neonate to the adult

Code	Surface Anatomy
CAI_M_A_0037	Neck: Cricothyroid Membrane, Internal and External Jugular Veins, Thoracic Duct, Carotid and Vertebral Arteries, Stellate Ganglion, Cervical Spine Landmarks (Vertebra Prominens, Chassaignac's Tubercle), Hyoid Bone, Superficial Cervical Plexus
CAI_M_A_0038	Structures in the axilla: landmarks for identifying the brachial plexus in the neck and axilla
CAI_M_A_0039	Large veins of the neck and the anterior triangle of the neck; surface anatomy and ultrasound demonstrated anatomy relevant to insertion of central venous cannulae
CAI_M_A_0040	Large veins of the leg and femoral triangle
CAI_M_A_0041	Arteries of the upper and lower limbs
CAI_M_A_0042	Landmarks for insertion of intercostal drainage catheters
CAI_M_A_0043	Dermatome anatomy: Sensory and Motor
CAI_M_A_0044	Chest: pulmonary Lobes, cardiac landmarks, subclavian vein

Code	Radiological and Ultrasound Anatomy
CAI_M_A_0045	Brain and skull: CT and basic MRI
CAI_M_A_0046	Chest: CT and CT pulmonary angiography
CAI_M_A_0047	Spine (Cervical, Thoracic, Lumbar), Including CT and MRI
CAI_M_A_0048	Neck (Including Doppler ultrasound for central venous access)
CAI_M_A_0049	Abdominal wall
CAI_M_A_0050	Extremities: vasculature and nervous innervation

Section 2: Pharmacology

Description:

Candidates should have knowledge of the principles of general pharmacology, detailed knowledge of the pharmacology of drugs used in the practice of anaesthesiology, intensive care medicine, resuscitation and pain management; therapeutic substances interacting and complicating anaesthesia; particular attention should be paid to the principles of pharmacokinetics.

Pre-requisites:

Knowledge of pharmacology (as per medical degree).

Code	Pharmacokinetics, pharmacodynamics and medicinal chemistry
CAI_M_P_0001	***Organic chemistry:*** drugs as organic molecules: interactions between molecules; organic compared with inorganic compounds; bond strength; important atomic constituents: C, N, O, P, S and halides
CAI_M_P_0002	***Organic chemistry:*** ionization of molecules: type of groups that ionize, amides, hydroxyl, carboxyl. Permanently charged [quaternary ammonium] drugs
CAI_M_P_0003	***Drug chemistry:*** solubility, partition coefficients and movement of drugs through membranes: Lipid solubility; influence of pKa and pH; partition coefficients. Passive and active transport mechanisms
CAI_M_P_0004	***Isomers:*** structural and stereoisomers: classification systems; clinical relevance
CAI_M_P_0005	***Mechanisms of drug action:*** physicochemical; pharmacodynamic; pharmacokinetic: drug-receptor interactions; dose-response and log[dose]-response curves; agonists, partial agonists, antagonists. Reversible and irreversible antagonism. Potency and efficacy
CAI_M_P_0006	***Non-specific drug actions:*** Physicochemical mechanisms: e.g. adsorption; chelation; neutralization
CAI_M_P_0007	Voltage-gated ion channels; membrane-bound transport pumps. Sodium, potassium and calcium channels as targets for drug action
CAI_M_P_0008	Receptors as proteins; ion channels; transmembrane transduction and intermediate messenger systems; intracellular/nuclear receptors. Receptor regulation and tachyphylaxis
CAI_M_P_0009	***Transduction systems as receptors:*** G-protein coupled receptors [GPCRs] and non-GPCR systems.
CAI_M_P_0010	***Nuclear receptors:*** Intracellular hormone receptors. e.g. cytoplasmic receptors for steroids; corticosteroids vs. mineralocorticoid receptors
CAI_M_P_0011	***Enzymes as drug targets:*** Michaelis-Menten kinetics. Direct and allosteric mechanisms. e.g., acetylcholinesterase; cyclo-oxygenase; phosphodiesterase
CAI_M_P_0012	***Predictable side effects of drugs:*** non-selective actions of drugs; action at multiple receptors; multiple anatomical locations; predictable enzyme induction-inhibition

CAI_M_P_0013	***Idiosyncratic side effects of drugs:*** e.g. blood and bone-marrow dyscrasias; pulmonary fibrosis; anti-platelet effects. Anaphylactic and anaphylactoid reactions: comparison; treatment; identification of responsible drug; risks with polypharmacy
CAI_M_P_0014	***Tachyphylaxis and tolerance:*** Examples of drugs demonstrating tachyphylaxis; proposed mechanisms. Opioid dependence and tolerance
CAI_M_P_0015	***Drug interactions:*** Types of interaction: synergism, additivity, antagonism; isobolograms. Classification of mechanisms of drug interaction
CAI_M_P_0016	***Pharmacokinetics:*** general principles: absorption, distribution, and redistribution; elimination, excretion. Chemical properties of drugs and their pharmacokinetics: blood-brain-barrier and placental barrier. Protein binding: plasma and tissue. Body compartments; adipose and vessel-poor tissue. Bioavailability; clearance
CAI_M_P_0017	***Administration and absorption:*** routes of administration; first-pass metabolism and bioavailability. Selection of appropriate route. Drug delivery systems: e.g. sustained release, enteric coated, transdermal patch and iontophoretic systems
CAI_M_P_0018	***Oral administration:*** Time-course for systemic appearance; factors e.g. pKa, lipid solubility, active transport. Bioavailability of drugs given orally and its measurement
CAI_M_P_0019	***Drug elimination from plasma.*** Mechanisms: distribution; metabolism; excretion: exhalation; renal; biliary; sweat; breast milk. Factors affecting e.g.: pathological state: renal and hepatic failure; age, including extremes of age; gender; drug interactions. Active and inactive metabolites; pro-drugs. Enzyme induction and inhibition
CAI_M_P_0020	Non-enzymatic drug elimination: Hofmann degradation
CAI_M_P_0021	***Pharmacokinetic modelling:*** types of models available: one, two and three-compartment models; non-compartmental; physiological. Pharmacokinetic parameters: volume of distribution, half-life and time constant, clearance
CAI_M_P_0022	***Context-sensitive half-time:*** comparison of drugs e.g. propofol, fentanyl and remifentanil. Target-controlled infusions [TCI]
CAI_M_P_0023	***TCI in practice:*** accuracy, applicability, cost. Variations due to patient differences: predictable and unpredictable
CAI_M_P_0024	Differences in patient response to therapy: age; gender; pathology; polypharmacy
CAI_M_P_0025	***Pharmacogenetics:*** pharmacokinetic variation e.g. pseudocholinesterase; acetylation; CYP450 variants. Poor and fast metabolizers; racial and geographic distribution of common abnormal genes

Code	Anaesthesiology Pharmacology
CAI_M_P_0026	***Volatile and gaseous anaesthetic agents:*** Structure of available agents. MAC. Clinical effects: CNS [including ICP], CVS, RS. Unwanted effects of individual agents. Malignant hyperpyrexia susceptibility; hepatitis risks. Factors affecting onset and offset time. Oil/gas partition coefficient
CAI_M_P_0027	***Intravenous anaesthetic agents:*** Chemical classes. Properties of an ideal induction agent. Adverse effects on CNS [including effects on ICP], CVS, RS; pharmacokinetics including metabolism
CAI_M_P_0028	Mechanisms of general anaesthetic action
CAI_M_P_0029	***Benzodiazepines:*** classification of action. Clinical actions. Synergism with anaesthetic agents. Antidote in overdose
CAI_M_P_0030	***Local anaesthetic agents.*** Additional effects, including antiarrhythmic effects. Mechanism of action. Clinical factors influencing choice: operative site, patient, available agents. Toxicity syndrome; safe clinical and maximum clinical doses; treatment of overdose
CAI_M_P_0031	***Analgesics.*** Simple analgesics, NSAIDs and opioids. Available routes of administration; peri-operative prescribing; chronic compared with acute pain prescribing
CAI_M_P_0032	***Aspirin and paracetamol.*** Comparison of structures; indications and contraindications; mechanisms of action. Bioavailability; metabolism; toxicity
CAI_M_P_0033	***Non-steroidal anti-inflammatory analgesics:*** Classification. Mechanism of action. Clinical effects and uses; unwanted effects, contraindications
CAI_M_P_0034	***Opioid analgesics:*** Receptor classification. Mechanism of action. Inhibitory effects, sites of action on pain pathways. Unwanted effects. Full and partial agonists and partial agonists. Routes of administration
CAI_M_P_0035	***Non-opioid adjuncts:*** mechanism of action, clinical uses and side effects of gabapentinoids, clonidine, magnesium
CAI_M_P_0036	***Muscle relaxants.*** Classification. Sites of action. Properties of an ideal muscle relaxant. Dantrolene and management of MH
CAI_M_P_0037	***Depolarizing muscle relaxants:*** Structure, mechanism of action. Organophosphate poisoning. Adverse effects and contraindications
CAI_M_P_0038	***Non-depolarizing muscle relaxants:*** Structural classification; subclassification according to onset-time and duration of action. General comparison of aminosteroids and benzylisoquinoliniums. Comparison of individual agents; metabolism and active metabolites. Unwanted effects.
CAI_M_P_0039	***Reversal of neuromuscular blockade:*** Indications for use; mechanisms of action; clinically unwanted effects of reversal of neuromuscular blockade

Code	General and Systemic Pharmacology
CAI_M_P_0040	***Drugs and the autonomic nervous system***: anatomy; myelinated and unmyelinated nerves; ganglia and rami communicantes. Neurotransmitters. Sites at which drugs can interfere with autonomic transmission
CAI_M_P_0041	***Drugs and the sympathetic nervous system***: adrenergic receptors and molecular mechanisms of action: Indications for pharmacological use of naturally occurring catecholamines and synthetic analogues. Other classes of drugs active in the sympathetic system: e.g. MAOIs
CAI_M_P_0042	***Drugs and the parasympathetic nervous system:*** nicotinic and muscarinic receptors with subgroups. Mechanism of action. Agonists, antagonists. Comparison of available drugs. Hyoscine and antiemesis
CAI_M_P_0043	***Anticholinesterases:*** Classification of drugs that inhibit acetylcholinesterase and plasma cholinesterase including organophosphates
CAI_M_P_0044	***Cardiovascular system:*** general: drug effects on the heart [inotropy and chronotropy] and on the circulation: arterial and venous effects; systemic and pulmonary effects
CAI_M_P_0045	***Inotropes and vasopressors:*** Classification; site of action. Synthetic inotropes compared with adrenaline
CAI_M_P_0046	***Drugs used in ischaemic heart disease:*** Classification of drugs used. Mechanisms of drug action. Unstable angina
CAI_M_P_0047	***Antiarrhythmics:*** Classification. Indications for use, including use in resuscitation
CAI_M_P_0048	***Hypotensive agents:*** Classes of drugs to produce acute hypotension in theatre. Therapeutic antihypertensive agents: classification according to mechanism of action. Adverse effects of drugs in each class
CAI_M_P_0049	***Anticoagulants:*** oral and parenteral. Sites of action; indications use; monitoring effect. Comparison of heparins: unfractionated and fractionated.
CAI_M_P_0050	***Direct oral anticoagulants*** e.g. apixaban, mechanism of action, indications for use and reversal agents (idarucizumab and andexanet alfa (recombinant factor Xa))
CAI_M_P_0051	***Antiplatelet agents.*** Perioperative management of antiplatelet medication
CAI_M_P_0052	***Pro-coagulants:*** Drugs. Individual factor concentrates; multi-factor preparations including FFP; vitamin K
CAI_M_P_0053	Colloids, including blood and blood products: Composition of preparations; safe use and avoidance of errors
CAI_M_P_0054	***Crystalloid fluids:*** Composition; suitable fluids for maintenance and replacement of losses. Comparison with colloids; unwanted effects
CAI_M_P_0055	***Respiratory system:*** general: Classes of drugs acting on the respiratory tract including bronchodilators; oxygen; surfactant; mucolytics; pulmonary vasodilators. Methods of administration; indications for use; mechanisms of action; adverse effects
CAI_M_P_0056	***Respiratory system:*** drugs used in acute severe asthma and chronic asthma; volatile agents. Mechanisms of action

CAI_M_P_0057	***Gastrointestinal system:*** general: antisialogogues; drugs reducing gastric acidity; drug effects on the GI tract including gastric and bowel motility
CAI_M_P_0058	***Antiemetics:*** Anatomical sites for antiemetic action; central and peripheral inputs to vomiting centre; use of dexamethasone
CAI_M_P_0059	***Renal system:*** diuretics: Classification of diuretics. Unwanted effects; indications for use
CAI_M_P_0060	***CNS:*** antiepileptic agents: Mechanisms of action; unwanted side effects
CAI_M_P_0061	***Therapy for diabetes mellitus***: Drugs used in type 1 and type 2 diabetes: Insulins: classification of types available; routes of administration; perioperative management. Unwanted effects and risks and therapy of hypo- or hyperglycaemia.
CAI_M_P_0062	***Non-insulin glucose lowering drugs*** including: sulphonylureas, meglitinides, intestinal alpha-glucosidase inhibitors, SGLT2inhibitors, biguanides, thiazolidinediones, incretin mimetics/GLP-1 analogues, the gliptins/DPP4 inhibitors; their mechanism of action, effects, perioperative management and side-effects
CAI_M_P_0063	***Hormones:*** corticosteroids: Indications for use; clinical effects; longterm complications of glucocorticoid use
CAI_M_P_0064	***Hormones:*** treatment of thyroid disorders: Synthesis and release of thyroid hormones. Preparations used in hyper- and hypo-thyroidism
CAI_M_P_0065	***CNS stimulants***: classes, mechanisms of action, uses in anaesthesia
CAI_M_P_0066	***Respiratory system stimulants*** including theophylline's and doxapram
CAI_M_P_0067	***Antimicrobial agents:*** general classification: Types of antimicrobial agents: antiviral; antibacterial; antifungal; bacteriostatic and bactericidal. Mechanism of action. Indications for use of different classes of antibiotics. Bacterial resistance
CAI_M_P_0068	Effects of drugs on the ***eye*** and vision; includes intra-ocular pressure
CAI_M_P_0069	***Social drugs*** including tobacco, alcohol and non-legal drugs: anaesthetic relevance
CAI_M_P_0070	***Basic toxicology:*** including agents, effects and antidotes
CAI_M_P_0071	***Alternative and Herbal Medicines***: Perioperative Implications
CAI_M_P_0072	Immunosuppressive and Anti-Rejection Drugs
CAI_M_P_0073	***Transfusion of blood and blood products*** (packed red cell, fresh frozen plasma, cryoprecipitate/fibrinogen complex concentrate, synthetic and recombinant clotting factors). Indications, blood and blood product preservation and storage. Preparation for transfusion: group and cross, group and screen, un-crossmatched blood, autologous Blood.

Section 3: Physiology and Biochemistry

Description:

Anaesthesiologists are expected to have a detailed knowledge of physiology and biochemistry along with the disturbances that may arise in anaesthesia and/or intensive care practice.

Pre-requisites:

Knowledge of Physiology and biochemistry (as per medical degree).

Code	General Physiology and Concepts
CAI_M_PB_0001	Organization of the human body and control of internal environment
CAI_M_PB_0002	Changes at birth and variations with age
CAI_M_PB_0003	Cells; components and organelles
CAI_M_PB_0004	Function of cells; genes and their expression
CAI_M_PB_0005	Cell membrane characteristics; cell junctions, receptors
CAI_M_PB_0006	Protective mechanisms of the body

Code	Biochemistry
CAI_M_PB_0007	Definition of pH. Strong and weak acids.
CAI_M_PB_0008	Acid base balance. Includes buffers, Henderson-Hasselbalch equation and anion gap
CAI_M_PB_0009	Ions e.g. Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, HCO_3^-
CAI_M_PB_0010	Cellular metabolism; aerobic vs anaerobic
CAI_M_PB_0011	Enzymes
CAI_M_PB_0012	Effects of stress

Code	Body fluids, functions and constituents
CAI_M_PB_0013	Capillary dynamics and interstitial fluid; osmosis, filtration and convection
CAI_M_PB_0014	Osmolarity: osmolality, partition of fluids across membranes, tonicity
CAI_M_PB_0015	Lymphatic system
CAI_M_PB_0016	Special fluids especially cerebrospinal fluid. Also – pleural, pericardial and peritoneal fluids
CAI_M_PB_0017	Active cellular transport mechanisms

Code	Haematology and Immunology
CAI_M_PB_0018	Blood: physical properties, components, functions
CAI_M_PB_0019	Red blood cells: production and turnover, haematinics, haemoglobin and its variants including abnormal haemoglobins e.g. thalassaemia, HbS
CAI_M_PB_0020	Anaemia: acute and chronic adaptations – Iron absorption, transportation, metabolism
CAI_M_PB_0021	Polycythaemia: causes and implications
CAI_M_PB_0022	Blood groups: ABO, Rhesus, others
CAI_M_PB_0023	Transfusion reactions; rhesus incompatibility
CAI_M_PB_0024	Haemostasis and coagulation, fibrinolysis – including abnormalities, congenital and acquired
CAI_M_PB_0025	Alternative oxygen carrying solutions
CAI_M_PB_0026	White blood cells: types, origins, characteristics, turnover
CAI_M_PB_0027	The inflammatory response, systemic inflammatory responses, hypersensitivity reactions
CAI_M_PB_0028	Immunity and allergy; innate vs acquired; non-specific vs specific, humoral vs cellular
CAI_M_PB_0029	Immunodeficiency – congenital and acquired

Code	Muscle Physiology
CAI_M_PB_0030	Action potential generation and its transmission
CAI_M_PB_0031	Neuromuscular junction and transmission, motor endplate
CAI_M_PB_0032	Disturbances of neuromuscular transmission
CAI_M_PB_0033	Myopathies – congenital and acquired
CAI_M_PB_0034	Muscle contracture – malignant hyperthermia, myoclonus, burns
CAI_M_PB_0035	Muscle types; skeletal, smooth, cardiac
CAI_M_PB_0036	Skeletal muscle excitation-contraction coupling
CAI_M_PB_0037	Smooth muscle contraction: sphincters
CAI_M_PB_0038	Motor unit concept

Code	Heart / Circulation
CAI_M_PB_0039	Cardiac muscle contraction
CAI_M_PB_0040	The cardiac cycle: pressure volume relationships, work and power
CAI_M_PB_0041	Rhythmicity of the heart; cardiac impulse generation
CAI_M_PB_0042	Regulation of cardiac function; general and cellular
CAI_M_PB_0043	Control of cardiac output [including Starling relationship]
CAI_M_PB_0044	Fluid challenge and heart failure, types of shock
CAI_M_PB_0045	Electrocardiogram and arrhythmias, origin of ECG, effects of temperature, ischaemia, infarction and electrolyte imbalance
CAI_M_PB_0046	Neurological and humoral control of systemic blood pressures, blood volume and blood flow [at rest and during physiological disturbances e.g. exercise, haemorrhage and Valsalva manoeuvre]
CAI_M_PB_0047	Peripheral circulation: capillaries, vascular endothelium and arteriolar smooth muscle
CAI_M_PB_0048	Functions of endothelium
CAI_M_PB_0049	Characteristics of special circulations including pulmonary, coronary, cerebral, renal, portal, transitional and fetal

Code	Renal Physiology
CAI_M_PB_0050	Structure and function, renal circulation
CAI_M_PB_0051	Blood flow and glomerular filtration, plasma clearance and tubuloglomerular feedback
CAI_M_PB_0052	Tubular function and urine formation; transport processes
CAI_M_PB_0053	Assessment of renal function
CAI_M_PB_0054	Regulation of water and electrolyte [Na^+, K^+, Ca^{2+}, Mg^{2+}, PO_4^{3-},] balance; response to fluid loss /hypovolaemia. Role of urea and creatinine measurement.
CAI_M_PB_0055	Regulation of acid-base balance
CAI_M_PB_0056	Micturition
CAI_M_PB_0057	Pathophysiology of acute kidney injury

Code	Respiration
CAI_M_PB_0058	Gaseous exchange: O_2 and CO_2 transport, hypoxia and hyper- and hypocapnia, hyper- and hypobaric pressures
CAI_M_PB_0059	Function of haemoglobin in oxygen carriage and acid-base equilibrium
CAI_M_PB_0060	Pulmonary ventilation: volumes, capacities, flows, dead space, compliance, work of breathing
CAI_M_PB_0061	Effect of IPPV on lungs
CAI_M_PB_0062	Mechanics of ventilation: ventilation/perfusion abnormalities, regional V/Q, surfactant
CAI_M_PB_0063	Control of breathing, acute and chronic ventilatory failure, effect of oxygen therapy
CAI_M_PB_0064	Effects of altitude
CAI_M_PB_0065	Non-respiratory functions of the lungs

Code	Nervous System
CAI_M_PB_0066	Neuronal structure and function
CAI_M_PB_0067	Resting membrane potential, action potentials, conduction, synaptic mechanisms, actions of neurotransmitters
CAI_M_PB_0068	The brain: functional divisions
CAI_M_PB_0069	Brain stem; organization, interconnections
CAI_M_PB_0070	Intracranial pressure: cerebrospinal fluid, blood flow
CAI_M_PB_0071	Maintenance of posture
CAI_M_PB_0072	Autonomic nervous system; organization, ganglia, adrenergic vs cholinergic
CAI_M_PB_0073	Neurological reflexes: monosynaptic, polysynaptic, stretch, inhibition
CAI_M_PB_0074	Motor function: basal ganglia, spinal and peripheral
CAI_M_PB_0075	Sense: receptors, nociception, proprioception, sight, taste, smell, hearing, balance, touch, temperature
CAI_M_PB_0076	Pain: afferent nociceptive pathways, dorsal horn, peripheral and central mechanisms, neuromodulatory systems, supraspinal mechanisms, visceral pain, neuropathic pain, influence of therapy on nociceptive mechanisms
CAI_M_PB_0077	Spinal cord: anatomy and blood supply, effects of spinal cord section

CAI_M_PB_0078	Nausea and vomiting

Code	Liver
CAI_M_PB_0079	Functional anatomy and blood supply, immunological functions
CAI_M_PB_0080	Metabolic, digestive and synthetic functions

Code	Gastrointestinal Physiology
CAI_M_PB_0081	Gastric function; secretions, nausea and vomiting
CAI_M_PB_0082	Gut motility, sphincters and reflex control – neurohumoral integration
CAI_M_PB_0083	Digestive functions; composition of secretions; digestion of carbohydrates, lipids, proteins, vitamins, minerals
CAI_M_PB_0084	Immune functions

Code	Metabolism
CAI_M_PB_0085	Energy homeostasis. Energy balance and nutritional status. Body mass/composition: body mass index, body fat estimation. Functional measurements: e.g. handgrip strength, work/exercise capacity. Biochemical measurements. Immune function.
CAI_M_PB_0086	Principles of nutrition: carbohydrates, fats, proteins, vitamins and minerals. Energy requirements/expenditure and measurement
CAI_M_PB_0087	Metabolic pathways, energy production and enzymes; metabolic rate
CAI_M_PB_0088	Hormonal control of metabolism: regulation of plasma glucose, response to trauma
CAI_M_PB_0089	Hormonal control of metabolism: regulation of plasma glucose, response to trauma
CAI_M_PB_0090	Physiological alterations in starvation, obesity [including normal and abnormal BMI ranges], exercise and the stress response.
CAI_M_PB_0091	Body temperature and its regulation, [including differences at extremes of age]

Code	Endocrine Physiology
CAI_M_PB_0092	Hormones; types, receptors, hierarchy, extracellular signalling
CAI_M_PB_0093	Mechanisms of hormonal control; feedback mechanisms, effects on membrane and intracellular receptors
CAI_M_PB_0094	Hypothalamic and pituitary function
CAI_M_PB_0095	Adrenocortical hormones
CAI_M_PB_0096	Adrenal medulla; adrenaline and noradrenaline
CAI_M_PB_0097	Pancreas; insulin, glucagon and exocrine function
CAI_M_PB_0098	Thyroid and parathyroid hormones and calcium homeostasis

Code	Pregnancy Physiology
CAI_M_PB_0099	Physiological changes associated with pregnancy
CAI_M_PB_0100	Maternofetal, fetal and neonatal circulation
CAI_M_PB_0101	Function of placenta; placental transfer
CAI_M_PB_0102	Fetus; physiological changes at birth
CAI_M_PB_0103	Lactation

Section 4: Physics, Equipment and Clinical Measurement

Description:

Anaesthesiologists are expected to have a detailed knowledge of the equipment and monitoring devices they use in clinical practice. They also need to have a very good foundation on the physical principles behind these items for safe and effective clinical practice.

Pre-requisites:

Knowledge of Physics, Equipment and Clinical Measurement (as per medical degree).

Code	Basic Mathematics and Mechanics
CAI_M_CM_0001	Mathematical concepts: relationships and graphs
CAI_M_CM_0002	Exponential functions including wash-in, wash-out, tear-away
CAI_M_CM_0003	Logarithms
CAI_M_CM_0004	Area under the curve [integration] and rate of change [differentiation]
CAI_M_CM_0005	Basic measurement concepts relevant to understanding of monitoring in anaesthesia: • linearity • drift • hysteresis • signal to noise ratio • static and dynamic response
CAI_M_CM_0006	Electrolyte solutions [also drug doses]: conversion between units e.g. molar, mg/ml, %
CAI_M_CM_0007	SI Units: fundamental units and derived units
CAI_M_CM_0008	Other non-SI units relevant to anaesthesia: including mmHg, bar, atmospheres, cm H_2O, psi

Code	Physical Principles, Equipment and Clinical Measurement
CAI_M_CM_0009	Heat: including temperature, absolute zero
CAI_M_CM_0010	Heat transfer and loss: conduction, convection, radiation, evaporation
CAI_M_CM_0011	Temperature measurement: including Hg, alcohol, infrared, thermistor, thermocouple, Bourdon gauge, liquid crystal. Anatomical sites used for measurement

CAI_M_CM_0012	Latent heats, triple point of water
CAI_M_CM_0013	Patient warming systems: principles
CAI_M_CM_0014	Warming equipment for intravenous fluids: principles
CAI_M_CM_0015	Laws of thermodynamics; mechanical equivalent of heat
CAI_M_CM_0016	Humidity, absolute and relative; including measurement
CAI_M_CM_0017	Colligative properties: osmolarity, osmolality, osmometry, diffusion
CAI_M_CM_0018	Physics of gases. Gas Laws: kinetic theory of gases, Boyles, Henry's, Dalton, Charles, Gay-Lussac
CAI_M_CM_0019	Critical temperature, critical pressure
CAI_M_CM_0020	Physics of vapours
CAI_M_CM_0021	Pressure: absolute and relative pressure; gauge pressure
CAI_M_CM_0022	Manufacture and storage of gases and vapours, safety
CAI_M_CM_0023	Cylinders and pipelines, Bourdon gauge
CAI_M_CM_0024	Suction devices mechanisms, visceral pain, neuropathic pain, influence of therapy on nociceptive mechanisms

CAI_M_CM_0025	Scavenging devices
CAI_M_CM_0026	Measurement of lung volumes and diffusion
CAI_M_CM_0027	Density and viscosity of gases
CAI_M_CM_0028	Laminar and turbulent flow: Hagen-Poiseuille equation, Reynold's number, examples including helium
CAI_M_CM_0029	Measurement of volume and flow in gases and liquids, including pneumotachograph and other respirometers
CAI_M_CM_0030	Bernoulli principle
CAI_M_CM_0031	Venturi effect and entrainment devices
CAI_M_CM_0032	Vapour pressure: saturated vapour pressure
CAI_M_CM_0033	Vaporisation: process of vaporisation
CAI_M_CM_0034	Vaporisers: principles, including plenum and draw-over, temperature compensation, concentration
CAI_M_CM_0035	Principles of surface tension
CAI_M_CM_0036	Basic concepts of electricity and magnetism
CAI_M_CM_0037	Electrical voltage, AC and DC current, resistance, impedance
CAI_M_CM_0038	Electrical circuits: series and parallel
CAI_M_CM_0039	Symbols of basic components of electrical circuits
CAI_M_CM_0040	Capacitance, inductance
CAI_M_CM_0041	Wheatstone bridge: principles, uses
CAI_M_CM_0042	Electrical hazards: causes and prevention
CAI_M_CM_0043	Electrocution: including microshock, earth faults, leakage
CAI_M_CM_0044	Electrical equipment safety: domestic and medical, classification/types of equipment, symbols
CAI_M_CM_0045	Circuit breakers, fuses
CAI_M_CM_0046	Transformers, inductance
CAI_M_CM_0047	Transistors, diodes
CAI_M_CM_0048	Amplifiers: band width, low pass, high pass, band pass filters
CAI_M_CM_0049	ECG: principles including electrodes and electrode placement
CAI_M_CM_0050	Fourier analysis

CAI_M_CM_0051	Amplification of biological signals: including ECG, EMG, EEG, BIS, CFM, CFAM
CAI_M_CM_0052	Piezo-electric devices
CAI_M_CM_0053	Electrical interference: sources, methods of reduction
CAI_M_CM_0054	Processing, storage, display of physiological measurements
CAI_M_CM_0055	Transducers and strain gauges
CAI_M_CM_0056	Lasers: basic principles and safety
CAI_M_CM_0057	Ultrasound: basic principles of ultrasound
CAI_M_CM_0058	Demonstrates knowledge of the physics relevant to optical fibres
CAI_M_CM_0059	Doppler effect, principle, and clinical application
CAI_M_CM_0060	Cardiac pacemakers: principles and classification
CAI_M_CM_0061	Defibrillators and defibrillation: principles, including thoracic impedance, monophasic, multiphasic, implantable devices
CAI_M_CM_0062	Diathermy: monopolar, bipolar; safety and uses
CAI_M_CM_0063	Pressure transducers
CAI_M_CM_0064	Resonance, damping, frequency response
CAI_M_CM_0065	Plenum systems: warming blankets, theatre and anaesthetic room ventilation
CAI_M_CM_0066	Breathing systems: Maplesons' classification, coaxial systems, circle systems, T-piece; resuscitation breathing devices
CAI_M_CM_0067	Ventilators: principles, including pressure and flow generators, cycling, minute volume dividers, jet and oscillator ventilators
CAI_M_CM_0068	Disconnection: monitoring of patient ventilatory disconnection
CAI_M_CM_0069	CO_2 absorption: chemistry, complications
CAI_M_CM_0070	Capnography
CAI_M_CM_0071	Pulse oximetry
CAI_M_CM_0072	Fires and explosions: risks and prevention
CAI_M_CM_0073	Measurement of gas pressures
CAI_M_CM_0074	Blood pressure: direct and indirect measurement
CAI_M_CM_0075	Pulmonary artery pressure measurement
CAI_M_CM_0076	Cardiac output: principles of measurement
CAI_M_CM_0077	Measurement of gas and vapour concentrations: e.g. infra-red, paramagnetic, fuel cell, oxygen electrode, mass spectrometry
CAI_M_CM_0078	Measurement of pH, PCO_2, PO_2, electrolytes
CAI_M_CM_0079	Derived blood gas variables, e.g. HCO_3a, HCO_3s, BE. Siggaard-Andersen nomogram
CAI_M_CM_0080	Measurement of CO_2 production, oxygen consumption, respiratory quotient
CAI_M_CM_0081	Simple tests of pulmonary function: peak flow rate, spirometry
CAI_M_CM_0082	Measurement of perfusion: coronary, cerebral, splanchnic, renal
CAI_M_CM_0083	Assessment of neuromuscular blockade
CAI_M_CM_0084	Infusion pumps and syringe drivers; including PCA drivers and epidural infusion devices: principles, use, safety, and relevant drug infusion calculations
CAI_M_CM_0085	Environmental monitoring: contamination by anaesthetic gases and vapours
CAI_M_CM_0086	Minimum monitoring standards
CAI_M_CM_0087	Understanding the limits of monitoring equipment

CAI_M_CM_0088	Principles of calibration of monitoring equipment
CAI_M_CM_0089	Principles of hygiene, including cleaning and sterilisation of equipment
CAI_M_CM_0090	Magnetic resonance imaging; principles and safety issues
CAI_M_CM_0091	Ionising radiation and safety
CAI_M_CM_0092	Point of care testing

Section 5: Statistical Methods

Description:

Anaesthesiologists are expected to have a detailed knowledge of statistical principles sufficient to allow the understanding of trial or investigation design, sampling and selection, size of sample, power of a test, confidence limits and statistical significance consistent with usage in current medical literature.

Pre-requisites:

Knowledge of Statistics (as per medical degree).

Code	Data Collection
CAI_M_S_0001	Recalls the simple aspects of study design
CAI_M_S_0002	Explains the outcomes measures and the uncertainty in their definition
CAI_M_S_0003	Explains the basis of meta-analysis and evidence-based medicine

Code	Descriptive Statistics
CAI_M_S_0004	Recalls the types of data and their representation
CAI_M_S_0005	Explains the normal distribution as an example of parametric distribution
CAI_M_S_0006	Explains indices of central tendency and variability

Code	Deductive and inferential statistics
CAI_M_S_0007	Recalls simple probability theory and the relationship to confidence values
CAI_M_S_0008	Explains the null hypothesis
CAI_M_S_0009	Explains the choices for simple statistical tests for different types of data
CAI_M_S_0010	Recalls type I and type II errors