The Exam
MCQ Paper – 60 questions, 90 minutes

Marking
MCQ Paper:
Type A format – choose the one most correct response from 4 options

Expectations as per the ACEM Training and Examination Handbook:
A thorough knowledge of cardiovascular, respiratory and renal physiology and of fluid and electrolyte balance is required.
A working knowledge of the physiology of the nervous system, muscles, digestion and absorption and the gastrointestinal tract is also required.

Biochemistry will not be examined separately, but candidates will be expected to be familiar with those aspects of metabolism and endocrine function that are relevant to emergency medicine.

Recommended Texts


Respiratory Physiology - The Essentials J B West (Lippincott Williams and Wilkins) 8th, 2008

Other Resources

Filing Cabinet in the Trainee Room contains MCQ and previous viva exams.

ACEM website has many useful resources:
In 'Training Program Information' – 'Primary Exam' – there are the viva questions from the last 2 years; practice MCQs; past papers; and a viva training video.
In 'Trainees Home' – 'Resources' – 'Non-ACEM Resources' – Primary Exam there are practice MCQ from the NZ Primary Course
Please also note there are Primary Pre-Exam Courses that operate in Victoria. Whilst these have not routinely been attended by QLD Trainees, it may suit some people. We would also hope that our own preparation program is more than adequate.

Talk to trainees that have recently undertaken the exam – they will have acquired numerous useful resources that they would be happy to share.

**Multiple Choice Matrix:**

The more important the topic – the more questions:

- Principles of Cellular Function: 4
- Nerves & Muscles: 4
- Nervous System: 4
- Metabolism: 3
- Endocrinology: 4
- Digestion & Absorption: 3
- Gastrointestinal System: 3
- Blood: 1
- Heart: 3
- The Circulation: 10
- Cardiovascular Homeostasis: 2
- Respiratory Physiology: 10
- Renal System: 5
- Acid/Base Balance: 4
PHYSIOLOGY

1. The General & Cellular Basis of Medical Physiology
   1.1 General principles 1
   1.2 Functional morphology of the cell path. (Covered & examined in
      Pathology, not Physiology)
   1.3 Transport across cell membranes 1
   1.4 The capillary wall 1
   1.5 Intercellular communication 2

2. Excitable Tissue: Nerve
   2.1 Introduction 3
   2.2 Nerve cells 3
   2.3 Excitation & conduction 1
   2.4 Ionic basis of excitation & conduction 1
   2.5 Properties of mixed nerves 2
   2.6 Nerve fibre types & function 1
   2.7 Neuroglia 3

3. Excitable Tissue: Muscle
   3.1 Skeletal muscle
      3.1.1 Morphology 2
      3.1.2 Electrical phenomena & ionic fluxes 2
      3.1.3 Contractile responses 1
      3.1.4 Energy sources & metabolism 1
      3.1.5 Properties of skeletal muscles in the intact organism 1
   3.2 Cardiac muscle
      3.2.1 Morphology 2
      3.2.2 Electrical properties 1
      3.2.3 Mechanical properties 1
      3.2.4 Metabolism 1
      3.2.5 Pacemaker tissue 1
   3.3 Smooth muscle
      3.3.1 Morphology 3
      3.3.2 Visceral smooth muscle 2

4. Synaptic & Junctional Transmission
   4.1 Synaptic transmission 1
      4.1.1 Functional anatomy 1
      4.1.2 Electrical events in postsynaptic neurons 1
      4.1.3 Inhibition & facilitation at synapses 1
      4.1.4 Chemical transmission of synaptic activity
      4.1.5 Principal neurotransmitter systems 1
      4.1.6 Synaptic plasticity & learning 3
   4.2 Neuromuscular transmission
      4.2.1 Neuromuscular junction 1
      4.2.2 Nerve endings in smooth & cardiac muscle 1
      4.2.3 Denervation hypersensitivity 1
5. Reflexes
   5.1 Monosynaptic reflexes: the stretch reflex 2
   5.2 Polysynaptic reflexes: the withdrawal reflex 2
   5.3 General properties of reflexes 2

6. Cutaneous, Deep & Visceral Sensation
   6.1 Pathways 1
   6.2 Touch 1
   6.3 Proprioception 1
   6.4 Temperature 1
   6.5 Pain 1
   6.6 Other sensations 1

7. Vision
   7.1 Anatomic considerations 1
   7.2 The image-forming mechanism 1
   7.3 Responses in the visual pathways & cortex 1
   7.4 Other aspects of visual function 1
   7.5 Eye movements 2

8. Hearing & Equilibrium
   8.1 Anatomic considerations 2
   8.2 Hair cells 3
   8.3 Hearing 2
   8.4 Vestibular function 2

9. Alert Behaviour, Sleep & the Electrical Activity of the Brain
   9.1 The thalamus & the cerebral cortex 3
   9.2 The reticular formation & the reticular 3
   9.3 Activating system 3
   9.4 Evoked cortical potentials 3
   9.5 The electroencephalogram 3
   9.6 Physiologic basis of the EEG, consciousness, & sleep 3

10. Control of Posture & Movement
    10.1 General principles 1
    10.2 Corticospinal & corticobulbar system 1
    10.2.1 Anatomy & function 1
    10.2.2 Posture-regulating systems 1
    10.2.3 Spinal integration 1
    10.2.4 Medullary components 1
    10.2.5 Midbrain components 3
    10.2.6 Cortical components 1
    10.2.7 Basal ganglia 3
    10.3 Cerebellum 1
11. The Autonomic Nervous System (Covered & examined in Pharmacology, not Physiology)
   11.1 Anatomic organization of autonomic outflow
   11.2 Chemical transmission at autonomic junctions
   11.3 Responses of effector organs to autonomic nerve impulses

12. Central Regulation of Visceral Function
   12.1 Medulla oblongata 2
   12.2 Hypothalamus
     12.2.1 Anatomic considerations 3
     12.2.2 Hypothalamic function 1
   12.3 Relation to cyclic phenomena 3
   12.4 Thirst 2
   12.5 Control of posterior pituitary secretion vasopressin 1, oxytocin 3
   12.6 Control of anterior pituitary secretion 2
   12.7 Temperature regulation 1

13. Higher Functions of the Nervous System: Conditioned Reflexes, Learning & Related Phenomena
   13.1 Functions of the neocortex 2

14. Energy Balance, Metabolism & Nutrition
   14.1 Energy metabolism 2
   14.2 Intermediary metabolism 2
   14.3 Carbohydrate metabolism 2
   14.4 Protein metabolism 2
   14.5 Fat metabolism 2
   14.6 Nutrition 2

15. The Thyroid Gland
   15.1 Formation & secretion of thyroid hormones 2
   15.2 Transport & metabolism of thyroid hormones 2
   15.3 Effects of thyroid hormones 2
   15.4 Regulation of thyroid secretion 2
   15.5 Clinical correlates 2

16. Endocrine Functions of the Pancreas & Regulation of Carbohydrate Metabolism
   16.1 Islet cell structure 3
   16.2 Structure, biosynthesis, & secretion of insulin 1
   16.3 Insulin excess 1
   16.4 Regulation of insulin secretion 2
   16.5 Glucagon 2
   16.6 Other islet cell hormones 3
   16.7 Fate of secreted insulin 1
   16.8 Effects of insulin 1
   16.9 Mechanism of action 2
16.10 Consequences of insulin deficiency 1
16.11 Effects of other hormones & exercise on carbohydrate metabolism 2
16.12 Hypoglycemia & diabetes mellitus in humans 1

17. The Adrenal Medulla & Adrenal Cortex
17.1 Adrenal morphology 2
17.2 Adrenal medulla
17.2.1 Structure & function of medullary hormones 1
17.2.2 Regulation of adrenal medullary secretion 1
17.3 Adrenal cortex
17.3.1 Structure & biosynthesis of adrenocortical hormones 3
17.3.2 Transport, metabolism, & excretion of adrenocortical hormones 3
17.4 Effects of adrenal androgens & estrogens 3
17.5 Physiologic effects of glucocorticoids 1
17.6 Pharmacologic & pathologic effects of glucocorticoids 1
17.7 Regulation of glucocorticoid secretion 2
17.7.1 Effects of mineralocorticoids 2
17.7.2 Regulation of aldosterone secretion 1
17.7.3 Role of mineralocorticoids in the regulation of salt balance 1
17.7.4 Summary of the effects of adrenocortical hypofunction in humans 1

18. Hormonal Control of Calcium Metabolism & the Physiology of Bone
18.1 Calcium & phosphorus metabolism 1
18.2 Bone physiology 2
18.3 Vitamin D & the hydroxycholecalciferols 3
18.4 The parathyroid glands 2
18.5 Calcitonin 3
18.6 Effects of other hormones & humoral agents on calcium metabolism 2

19. The Pituitary Gland
19.1 Introduction 1
19.2 Morphology 2
19.3 Intermediate-lobe hormones 3
19.4 Growth hormone 2
19.5 Physiology of growth 3
19.6 Pituitary insufficiency 1
19.7 Pituitary hyperfunction in humans 2

20. The Gonads: Development & Function of the Reproductive System
20.1 Sex differentiation & development 3
20.1.1 Chromosomal sex
20.1.2 Embryology of the human reproductive system
20.1.3 Aberrant sexual differentiation
20.1.4 Puberty
20.1.5 Precocious & delayed puberty
20.1.6 Menopause
20.2 Pituitary gonadotropins & prolactin 3
24.2.8 Haemostasis
24.3 Lymph 3

25. Origin of the Heartbeat & the Electrical Activity of the Heart
   25.1 Origin & spread of cardiac excitation 1
   25.2 The electrocardiogram 1
   25.3 Cardiac arrhythmias 1
   25.4 Electrocardiographic findings in other cardiac & systemic diseases 1

26. The Heart as a Pump
   26.1 Mechanical events of the cardiac cycle 1
   26.2 Cardiac output 1

27. Dynamics of Blood & Lymph Flow
   27.1 Functional morphology 1
   27.2 Biophysical considerations 1
   27.3 Arterial & arteriolar circulation 1
   27.4 Capillary circulation 1
   27.5 Lymphatic circulation & interstitial fluid volume 1
   27.6 Venous circulation 1

28. Cardiovascular Regulatory Mechanisms
   28.1 Local regulation 1
   28.2 Substances secreted by the endothelium 1
   28.3 Systemic regulation by hormones 1
   28.4 Systemic regulation by the nervous system 1

29. Circulation through Special Regions
   29.1 Introduction 2
   29.2 Cerebral circulation 1
   29.2.1 Anatomic considerations
   29.2.2 Cerebrospinal fluid
   29.2.3 The blood-brain barrier
   29.2.4 Cerebral blood flow & its regulation
   29.2.5 Brain metabolism & oxygen requirements
   29.3 Coronary circulation 1
   29.4 Splanchnic circulation 2
   29.5 Cutaneous circulation 2
   29.6 Placental & foetal circulation 2

30. Cardiovascular Homeostasis in Health & Disease
   30.1 Introduction 2
   30.2 Compensations for gravitational effects 1
   30.3 Exercise 1
   30.4 Inflammation & wound healing 1
   30.5 Shock 1
   30.6 Hypertension 1
   30.7 Heart failure 1
31. Respiration: Structure & Function 1
   31.1 Blood-gas interface
   31.2 Airways and airflow
   31.3 Blood vessels and flow
   31.4 Stability of alveoli
   31.5 Removal of inhaled particles

32. Ventilation 1
   32.1 Lung volumes
   32.2 Ventilation
   32.3 Anatomic dead space
   32.4 Physiologic dead space
   32.5 Regional differences in ventilation

33. Diffusion 1
   33.1 Laws of diffusion
   33.2 Diffusion and perfusion limitations
   33.3 Oxygen uptake along the pulmonary capillary
   33.4 Measurement of diffusing capacity
   33.5 Reaction rates with haemoglobin
   33.6 Interpretation of diffusing capacity for CO
   33.7 CO2 transfer across the pulmonary capillary

34. Blood Flow & Metabolism 1
   34.1 Pressures within pulmonary blood vessels
   34.2 Pressures around pulmonary blood vessels
   34.3 Pulmonary vascular resistance
   34.4 Measurement of pulmonary blood flow
   34.5 Distribution of blood flow
   34.6 Active control of the circulation
   34.7 Water balance in the lung
   34.8 Other functions of the pulmonary circulation
   34.9 Metabolic functions of the lung

35. Ventilation – Perfusion Relationships 1
   35.1 Oxygen transport from air to tissues
   35.2 Hypoventilation
   35.3 Diffusion
   35.4 Shunt
   35.5 The ventilation-perfusion ratio
   35.6 Effect of altering the ventilation-perfusion ratio of a lung unit
   35.7 Regional gas exchange in the lung
   35.8 Effect of ventilation-perfusion Inequality on overall gas exchange
   35.9 Distributions of ventilation-perfusion ratios
   35.10 Ventilation-perfusion inequality as a cause of CO2 retention
   35.11 Measurement of ventilation-perfusion inequality
36. Gas Transport by the Blood

36.1 Oxygen
36.1.1 Dissolved O2
36.1.3 Haemoglobin
36.1.3 O2 Dissociation curve
36.2 Carbon dioxide
36.2.1 CO2 Carriage
36.2.2 CO2 Dissociation curve
36.3 Acid-base status
36.3.1 Respiratory acidosis
36.3.2 Respiratory alkalosis
36.3.3 Metabolic acidosis
36.3.4 Metabolic alkalosis
36.4 Blood-tissue gas exchange

37. Mechanics of Breathing

37.1 Muscles of respiration
37.1.1 Inspiration
37.1.2 Expiration
37.2 Elastic properties of the lung
37.2.1 Pressure-volume curve
37.2.2 Compliance
37.2.3 Surface tension
37.3 Causes of regional differences in ventilation
37.3.1 Airway closure
37.3.2 Measurement of airway resistance
37.3.3 Pressures during the breathing cycle
37.3.4 Chief site of airway resistance
37.3.5 Factors determining airway resistance
37.3.6 Dynamic compression of airways
37.4 Cause of uneven ventilation
37.5 Tissue resistance
37.6 Work of breathing
37.6.1 Work done on the lung
37.6.2 Total work of breathing

38. Control of Ventilation

38.1 Central controller
38.1.1 Brainstem
38.1.2 Cortex
38.1.3 Other parts of the brain
38.2 Effectors
38.3 Sensors
38.3.1 Central chemoreceptors
38.3.2 Peripheral chemoreceptors
38.3.3 Lung receptors
38.3.4 Other receptors
38.4 Integrated responses
38.4.1 Response to carbon dioxide
38.4.2 Response to oxygen
38.4.3 Response to pH
38.4.4 Response to exercise
38.5 Abnormal patterns of breathing

39. Respiratory Systems under Stress
  39.1 Exercise
  39.2 High altitude
  39.2.1 Hyperventilation
  39.2.2 Polycythemia
  39.2.3 Other features of acclimatization
  39.3 O2 Toxicity
  39.4 Space flight
  39.5 Increased pressure
  39.5.1 Decompression sickness
  39.5.2 Inert gas narcosis
  39.5.3 O2 toxicity
  39.5.4 Hyperbaric O2 therapy
  39.6 Polluted atmosphere
  39.7 Liquid breathing
  39.8 Perinatal respiration
  39.8.1 Placental gas exchange
  39.8.2 The first breath
  39.8.3 Circulatory changes

40. Tests of Pulmonary Function
  40.1 Ventilation
  40.1.1 Forced expiration
  40.1.2 Lung volumes
  40.2 Diffusion
  40.3 Blood flow
  40.4 Ventilation-perfusion relationships
  40.4.1 Topographical distribution of ventilation and perfusion
  40.4.2 Inequality of ventilation
  40.4.3 Inequality of ventilation-perfusion ratios
  40.5 Blood gases and pH
  40.6 Mechanics of breathing
  40.6.1 Lung compliance
  40.6.2 Airway resistance
  40.6.3 Closing volume
  40.7 Control of ventilation
  40.8 Exercise

41. Renal Function & Micturition
  41.1 Introduction
  41.2 Functional anatomy
  41.3 Renal circulation
  41.4 Glomerular filtration
  41.5 Regulation of Na+ & Cl- excretion
41.6 Regulation of K+ excretion 1
41.7 Diuretics 1
41.8 Tubular function 1
41.9 Water excretion 1
41.10 Acidification of the urine & bicarbonate excretion 1
41.11 Effects of disordered renal function 1
41.12 The bladder 2

42. Regulation of Extracellular Fluid Composition & Volume
   42.1 Introduction 1
   42.2 Defense of tonicity 1
   42.3 Defense of volume 1
   42.4 Defense of specific ionic composition 1
   42.5 Defense of H+ concentration 1
Study Aid

Make sure you ‘pick and stick’. With respect to sitting this exam, make a commitment and stick to it. Avoid taking a ‘toe in the water’ approach, where you just see how your study goes for a few months before deciding whether to sit or not. If you go in ‘half-hearted’ you will be wasting your time. Once you have made your decision to sit, you can set about planning your intensive preparation.

This study aid suggests that you undertake to study the more important topics first (i.e. those from which many of the exam questions come from). In the following, I have not reproduced the curriculum in its entirety but tried to limit it to the most important topics. Note the college ranking system to define which topics should be understood in the most detail.

LOA 1 Candidates should demonstrate a detailed knowledge
LOA 2 Candidates should demonstrate a general knowledge
LOA 3 Candidates should demonstrate a basic knowledge

The suggested time frames are suggestions only. Feel free to cover more territory at a faster rate. Regardless you should have completed your run through of the curriculum by 17 weeks (earlier if possible); allowing 5 weeks for revision and focused exam practice.

As you study each topic have an understanding of how this topic is examined. Practice MCQ questions on the topic as you go, to check and consolidate knowledge. Similarly look to work in a study group and test each other with viva questions.

You should pay careful attention to the weighting of each topic class when it comes to your study time. The big 3 topics, cardiovascular, respiratory and renal together cover almost 60% of the MCQ matrix and feature heavily in the vivas. You should know these topics inside out.
Program Summary

Week 1
Principles of Cellular Function

Week 2 - 3
Nerves & Muscles and the Nervous System

Weeks 4-6
Circulation & Blood

Weeks 7
The Heart & Cardiovascular System Homeostasis

Week 8-10
Respiratory

Week 11-13
Renal & Acid Base

Week 14-15
Digestion & Gastrointestinal

Week 16
Metabolism

Week 17
Endocrine

Week 18
MCQ Paper

Week 19–23
VIVA practice
Week 1  Principles of Cellular Function

This is your week to ease into it. Make the most of it. Bold denotes the more important topics.

General principles
Transport across cell membranes
The capillary wall
Intercellular communication

PAST VIVA QUESTIONS

2011.1
- What is the difference between diffusion and osmosis?
- Define “tonicity”.
- What is the genesis of the membrane potential?
- Please outline the ways in which a substance can cross a cell membrane.
- Can you please explain the process of secondary active transport?
- Give a clinical example.
Week 2 - 3  Nerves & Muscles and the Nervous System

There is a lot more to cover this fortnight. Concentrate on the bold topics which you are expected to have detailed knowledge. Don’t get bogged down in fine details. This topic often pops up in a viva.

Excitable Tissue: Nerve
Excitable Tissue: Muscle
Skeletal muscle
Cardiac muscle
Smooth muscle
Synaptic & Junctional Transmission
Synaptic transmission
Neuromuscular junction
Reflexes
Monosynaptic reflexes: the stretch reflex
Polysynaptic reflexes: the withdrawal reflex
Sensation
Touch
Proprioception
Temperature
Pain
Vision
Hearing & Equilibrium
Control of Posture & Movement
Corticospinal & corticobulbar system
Cerebellum
Central Regulation of Visceral Function
Medulla oblongata
Hypothalamus
Thirst
Temperature regulation
Alert Behaviour, Sleep & the Electrical Activity of the Brain
Higher Functions of the Nervous System

PAST VIVA QUESTIONS

2013.1
- Please draw and explain the action potential in a cardiac pacemaker cell.
- Describe the major differences between a ventricular muscle AP and a pacemaker AP.
- What are the two major mechanisms of deafness?
- Explain these causes in physiological terms and give examples.
- How can one differentiate between the two forms using a tuning fork?

2012.2
- Describe the neural connections of the visual pathways.
- Describe the visual field defects of nerve sectioning at optic chiasm and optic tract on the right.
- Describe the withdrawal reflex.
- Describe or draw the components of a muscle spindle.
- Describe the sequence of events involved in producing a stretch reflex.
- Describe how pain is transmitted from the periphery to the brain.
- How can acute pain be modulated?
- What sites do opioid peptides act on?

2012.1
- What is clonus?
- Why does ankle clonus occur with upper motor neuron lesions?
- What are the components of the stretch reflex?
- What is the sequence of events in skeletal muscle excitation contraction coupling?
- Describe the micturition reflex.

2011.2
- Describe the resting membrane potential of a cell.
- What conditions are required to create a resting membrane potential?
- In a neuron what ions are involved and how is the concentration gradient produced?
- What happens to acetylcholine when released into a synapse?
- Describe the differences between the two types of acetylcholine receptors.

2011.1
- What are the different types of nerve fibres?
  - Prompt- What classifications are there?
- What is the clinical relevance to emergency medicine?
- Describe the normal sequence of electrical excitation of the cardiac conduction system and cardiac muscle.
- What are the common mechanisms which cause abnormalities of cardiac conduction?
- What are the possible clinical consequences of these conduction abnormalities?

2010.2
- Please describe a monosynaptic stretch reflex.
- Describe the physiological process of micturition.
- What factors are responsible for heat production and heat loss?
- Describe the body's adaptive response to a cold environment.

2010.1
- Outline the steps in the synthesis of catecholamines.
- What happens to noradrenaline after it is released into the synaptic cleft?
- What is the basis of the resting membrane potential?
- Describe the ionic fluxes during the action potential.
- In the synapse, where can inhibition occur?

2009.2
- What are the sequence of events in contraction and relaxation of skeletal muscle?

2009.1
- How does the body generate heat?
- How does the body lose heat?
• What is the thermoregulatory response to cold?
• What are the functions of serotonin?
• What are the steps in synthesis and catabolism of serotonin?
• Describe the route followed by pain pathways from the periphery to the brain.
• What are the characteristics of different pain fibres?
• Please describe the withdrawal reflex.
• What are the important characteristics of the polysynaptic reflex?
• What is meant by the term pre-potency of the withdrawal reflex?

2008.2
• Describe the physiologic process of Micturition.
• List other factors that stimulate and inhibit micturition.
• Describe the sequence of events in contraction and relaxation of skeletal muscle.
• What is summation of contractions?
• Describe the biosynthesis and storage of norepinephrine at the synaptic junction.
• How is Norepinephrine removed from the synaptic junction?

2007.1
• What is the function of the reticular activating system?
• Describe its location and structure.
• Describe the sequence of events in contraction and relaxation of visceral smooth muscle.
• What factors influence intestinal smooth muscle contraction?
Weeks 4-6  Blood, Circulation & Cardiovascular Homeostasis

The cardiovascular system is a core topic – which is why most of these subtopics are bold. You have 3 weeks because this is important. More than 20% of the paper will have questions from this topic. Know it back to front.

Circulating Body Fluids
Blood
Lymph
Dynamics of Blood & Lymph Flow
Arterial & venous circulation
Capillaries
Lymphatics
Cardiovascular Regulatory Mechanisms
Local regulation
Systemic regulation by hormones & the nervous system
Circulation through Special Regions
Cerebral circulation
Coronary circulation
Splanchnic, cutaneous, placental & foetal circulation
Cardiovascular Homeostasis in Health & Disease
Compensations for gravitational effects
Exercise
Inflammation & wound healing
Shock
Hypertension
Heart failure

PAST VIVA QUESTIONS

2013.1
• Describe the autoregulation of tissue blood flow.
• How would this apply to autoregulation of cerebral blood flow?
• What are the proposed mechanisms involved in autoregulation?

2012.2
• How is blood pressure maintained in the setting of acute blood loss?
• What other factors influence the vasomotor centre?

2012.1
• What local factors can cause vasoconstriction or vasodilatation?
• What is autoregulation in relation to blood flow?
• What is normal serum osmolality?
• What substances contribute to serum osmolality?
• How does plasma differ in composition to intracellular fluid?

2011.2
• What factors determine cerebral blood flow?
• What is the Monro-Kellie Doctrine?
2011.1
- Describe the factors influencing Angiotensin 2 production.
- What are the physiological effects of Angiotensin 2?

2010.1
- Please draw a diagram of the changes in systolic and diastolic pressure as blood flows through the systemic circulation.
- How does the total cross-sectional area of vessels change through the systemic circulation?
- Describe how tissues regulate their own blood flow.
- What chemical factors regulate coronary blood flow?
- Describe the neural regulation of coronary blood flow.

2009.2
- What are the physiological changes that allow survival at high altitude?

2009.1
- What factors determine cerebral blood flow?
- Describe the process of autoregulation.

2008.2
- Where are Baroreceptors found in the body?
- What is the effect of vessel wall distension on a baroreceptor?

2008.1
- What are the basic factors which determine the rate of flow of blood through a vessel?
- What factors cause turbulent blood flow through a vessel?
- What factors determine cerebral blood flow?
- What substances are important for brain metabolism?

2007.1
- What is the normal value for venous return in the healthy human adult?
- What are the major factors that influence venous return to the heart?
- What is the relationship between right atrial pressure and venous return?
- What are the major factors affecting the regulation of arterial pressure?
- How is water distributed through the body compartments?
- How do age and gender affect total body water?
Weeks 7  The Heart

Another important topic which complements the last 3 weeks of learning. A viva question is guaranteed from the cardiovascular topic.

The Heart as a Pump
Cardiac cycle & cardiac output
Origin of the Heartbeat & the Electrical Activity of the Heart
Cardiac excitation
Normal ECG
Cardiac arrhythmias
Abnormal ECG

PAST VIVA QUESTIONS

2013.1
- Describe the coronary arterial blood flow during the cardiac cycle.
- What factors can decrease coronary artery blood flow?

2012.2
- Draw or describe the Frank-Starling law as it applies to human cardiac muscle.
- What factors influence the F-S curve?
- Please draw and label the intervals and segments of a normal ECG including times.
- What electrophysiological event occurs during these periods?
- Please draw a pressure-volume loop for the left ventricle.
- Please relate the phases of the cardiac cycle to this pressure-volume loop.

2012.1
- Describe the factors affecting Cardiac Output
- What are the physiological responses to moderate blood loss?
- Describe what happens to Cardiac Output during exercise.
  - Prompt: By what mechanisms?
- What are the local mechanisms that maintain a high blood flow in exercising muscles?

2011.2
- Describe the factors that control blood flow to the myocardium.
- What factors influence myocardial oxygen consumption?
- How does decreasing a patient’s heart rate improve symptoms of angina?

2011.1
- What factors may reduce myocardial contractility?
- How do changes in myocardial contractility alter the relationship between end diastolic volume and stroke volume?
- How are cardiac stroke volume and cardiac output related?
- What is cardiac preload?
- What factors affect preload?
  - Prompt - What are the causes of reduced end diastolic volume?
2010.2
- List in order, the mechanical phases of the cardiac cycle.
- Please draw the pressure changes in the ventricle that occur during the cardiac cycle.
- Please draw the Starling Curve.
- What factors influence myocardial contractility.
- Please draw a normal ECG tracing.
- Describe the cardiac events that relate to each of the intervals.
- What is the electrophysiological basis for ST elevation in acute MI.
- What are the parameters that define cardiac output?
- What are the factors that influence stroke volume?
- How can cardiac output be measured?

2009.2
- Draw and explain the action potential in a cardiac pacemaker cell.
- Describe the major difference between a cardiac myocyte action potential and the pacemaker.
- Draw the Frank Starling curve.
- List the factors that alter contractility.
- Please draw an ECG trace and below this identify the 5 phases of the cardiac (contractile) cycle.
- Please draw an ECG trace and below this demonstrate the left ventricular volume trace. Please give approximate volume values on the y axis.

2009.1
- Describe the pressure and the volume changes in the ventricles at the onset of systole.
- Describe the pressure and the volume changes in the ventricles at the onset of diastole.
- Can you draw the pressure-volume loop of the left ventricle?
- What factors determine myocardial oxygen demand?
- What effects do the increase in preload and afterload have on myocardial O2 demand?

2008.2
- Draw the action potential in a cardiac pacemaker cell and explain the ionic fluxes.
- How do sympathetic and parasympathetic stimulation change the prepotential?
- Please draw a normal ECG tracing, showing the durations of the major intervals.
- How does the ECG change with hyperkalaemia?
- How does it change with hypokalaemia?

2008.1
- What factors control cardiac output?
- What are the major factors which determine myocardial oxygen consumption?

2007.1
- Describe the features of the action potential in cardiac pacemaker tissue.
- How do autonomic factors alter the slope of the prepotential?
Week 8-10  

Respiratory

You finally get a break from cardiovascular – but this is another high MCQ yielding topic. A bit over 15% of MCQs are taken from respiratory and there is usually 1 viva question. West is your new best friend... fortunately it is also pocket sized. Read it cover to cover. Then keep reading it until you know it intimately.

Respiration: Structure & Function
Ventilation
Diffusion
Pulmonary Blood Flow & Metabolism
Ventilation – Perfusion Relationships
Gas Transport by the Blood
Oxygen
Carbon dioxide
Acid-base status
Mechanics of Breathing
Control of Ventilation
Respiratory Systems under Stress
Tests of Pulmonary Function

PAST VIVA QUESTIONS

2013.1

• Please describe the components of total lung capacity.
• Name a method to measure each of these.
• Describe how oxygen is carried in the blood.
• Please draw the oxygen-haemoglobin dissociation curve.
• Describe factors that can affect the curve.
• Describe the factors that determine the airway resistance in the lung.
• With regard to lung compliance, give examples of diseases that reduce compliance.
• Define compliance.

2012.2

• What happens to normal ventilation, perfusion and the ventilation-perfusion ratio from top to bottom of the upright lung?
• Explain the reasons for the alveolar-arterial oxygen difference.
• What two mechanisms allow pulmonary vascular resistance to fall, such as during exercise?
• What other influences are there on pulmonary vascular resistance?
• Please draw and label a diagram showing a spirometer tracing of static lung volumes.
• What is residual volume and state a method or methods of measuring this volume.
• What factors influence the rate of oxygen transfer from the alveolus in to the pulmonary capillary?
How do we measure diffusion capacity?

2012.1

- What are the effects of exercise on the respiratory system?
  - Prompt(s): “What are the effects on: gas exchange; OR ventilation; OR pulmonary blood flow.”
- What changes occur in blood gases during exercise?
- What factors determine the work of breathing?
- What variables affect elastic workload?
- What variables affect viscous resistance?
- In what forms is carbon dioxide transported in the blood?
- Please draw the carbon dioxide dissociation curve for normal arterial blood.
  - Prompt: "Draw a graph showing the relationship between the pressure of carbon dioxide and the total carbon dioxide content in arterial blood."
- Where will the curve lie for venous blood and why??

2011.2

- Describe the function of the central chemoreceptors in the regulation of ventilation.
- Describe the function of the peripheral chemoreceptors in the regulation of ventilation.
- Outline the metabolic functions of the lung.
- Describe the ventilatory response that occurs as you acclimatize to high altitudes.
- Outline other compensatory responses to high altitudes.

2011.1

- What sensors are involved in the control of ventilation?
- Describe the ventilatory response to metabolic acidosis.
- Please draw and describe the features of the haemoglobin-oxygen dissociation curve.
- What factors cause shift in the curve?
- What are the effects of carbon monoxide on haemoglobin oxygen transport capacity?
- Describe the normal distribution of pulmonary blood flow.
- How is the distribution of pulmonary blood flow actively controlled?
- Please explain how cardiogenic pulmonary oedema occurs.

2010.2

- Please explain the concept of compliance as it relates to the lung.
- What factors affect compliance?
- What are the metabolic functions of the lung?
- What factors influence the rate of transfer of oxygen from the alveolus into a pulmonary capillary?
- Could you give some clinical examples of when these may be affected?
- Please draw a diagram showing static lung volumes.
- How does physiological dead space differ from anatomical dead space?

2010.1

- What are the factors which keep fluid out of the alveoli?
- What are the causes of hypoxaemia in a person breathing room air?
- Explain why ventilation-perfusion inequality causes a reduced arterial pO2 while arterial pCO2 remains relatively normal.
- What is pulmonary compliance?
- What are the factors that decrease and increase pulmonary compliance?
- What are the physiological effects of surfactant on the lung?

2009.2
- What are the major factors that affect pulmonary vascular resistance in the normal lung?
- Why is pulmonary flow so sensitive to pulmonary vascular pressures?
- Please draw the curve demonstrating the relationship between O2 concentration and pO2.
- How does this change in anaemic and polycythaemic individuals.
- What is the effect of carbon monoxide on these curves?

2009.1
- In the lung, what is surfactant and how does it work?
- What are the physiological advantages of surfactant?
- How is carbon dioxide transported in the blood?
- How does venous blood carry more CO2 than arterial blood?
- What is the alveolar gas equation?
- How do you calculate the alveolar-arterial gradient?
- What is the physiological significance of the A-a gradient?

2008.2
- Describe the distribution of blood flow in the lung of an upright subject at rest.
- What are the main determinants of flow in these three zones?
- How does the distribution of blood change when the subject becomes supine?
- How is carbon dioxide transported from the tissues to the lungs?
- What is meant by the term ‘chloride shift’?
- What is the role of central chemoreceptors in control of ventilation?

2008.1
- Describe the relationship between ventilation and perfusion of the lung while a person is standing.
- What are the effects of V/Q inequality on gas exchange?
- What effect does increasing ventilation to the lungs have on arterial pO2 and pCO2?
- What factors impact on resistance in the airway?
- What factors cause turbulent flow in the airway?
- Define lung compliance.
- What factors influence lung compliance?
- What else does surfactant do?
- What is the role of the peripheral chemoreceptors?

2007.1
- What is thoracic compliance?
- What are the main determinants of compliance of the thorax?
- How does compliance vary throughout the upright lung?
• Explain the difference between alveolar and arterial oxygen concentrations in the healthy adult.
• What sensors are involved in the control of ventilation?
Week 11-13  Renal & Acid Base

This is the last of the big 3 topics with cardiovascular and respiratory. It is difficult. Make sure you give it the time it deserves. About 15% of the MCQ paper will be renal and there is usually 1 question in the viva.

Functional anatomy & the renal circulation
- Glomerular filtration
- Regulation of Na+, Cl- and K+ excretion
- Diuretics
- Tubular function
- Water excretion
- Acidification of the urine & bicarbonate excretion
- Effects of disordered renal function
- The bladder
- Regulation of Extracellular Fluid Composition & Volume

PAST VIVA QUESTIONS

2013.1
- What are the actions of the renin-angiotensin system?
- What factors affect renin secretion?
- How do the ascending and descending limbs of the loop of Henle differ in function?
- Describe the process of tubuloglomerular feedback in the nephron.
- Describe the renal response to metabolic acidosis.
  - Prompts - What prevents H+ secretion stopping when a pH of 4.5 is reached? What substances act as buffers in the urine?

2012.2
- Describe how the renal tubule cells respond to metabolic academia?
- In metabolic acidosis, describe which buffer systems in the urine are involved that allow excretion of large amounts of H+.
- What happens to glutamine synthesis in the liver in chronic metabolic acidosis.
- What is the normal glomerular filtration rate?
- What factors affect GFR?
- What physiological factors are involved in regulating rennin secretion?
- What conditions increase rennin secretion?
- What is the normal renal blood flow?
- Describe the mechanisms which determine renal blood flow.

2012.1
- What are the essential features of the loop of Henle countercurrent multiplier?
- What is the role of urea in the countercurrent mechanism?
- How does urea reach the interstitium?
- By what mechanism is H+ secreted in the distal tubules and collecting ducts of the kidney?
In H+ secretion, what is the limiting urine pH?
- Describe the principal urinary buffers and; what is their role?

2011.2
- How does the kidney handle potassium?
- Describe the differences between the ascending and descending loops of Henle.
- Describe the changes in the tonicity of tubular fluid as it moves along the loop of Henle.
- How does vasopressin act on the kidney?
- What hormonal changes occur after drinking a large amount of water?

2011.1
- Describe how Na+ is handled by the kidney.
- How does aldosterone influence renal sodium handling?
- What are the principal buffering systems in the body?
- Outline how the body responds to a metabolic acid load.

2010.2
- What is normal GFR
- What factors affect GFR?
- As well as filtration, by what other means does the kidneys regulate the composition of urine
- What stimuli influence ADH secretion?
- How does ADH exert its antidiuretic effect?
- What is the normal renal blood flow?
- How is renal blood flow regulated?
- Can you draw a nephron and describe the functions of each part

2010.1
- Describe the renal response to metabolic acidosis.
- What is the normal range of osmolality of ECF?
- How is this maintained?
- What other stimuli affect vasopressin secretion?
- What general mechanisms are involved in renal tubular reabsorption and secretion?
- How is sodium reabsorbed in the various parts of the nephron?

2009.2
- Discuss how and where H+ ion is secreted in the kidney.
- What is the limiting pH of the urine and how is this limitation dealt with?
- Describe how sodium is handled in the glomerulus and the PCT.
- List the mechanisms that affect Na+ reabsorption.

2009.1
- How is H+ ion secreted in the proximal tubule in the kidney?
- Outline the buffer systems that act to bind H+ ion in the tubular fluid?
- What is the importance of H+ ion buffering systems in the urine?
- Describe the counter-current mechanism in the kidney.
- Where does sodium reabsorption occur in the nephron?
- What are the mechanisms of sodium reabsorption in the nephron?
- What mechanisms in the kidney reduce sodium excretion?
2008.2
- Describe the structure and function of the sodium potassium ATPase pump.
- Describe how the nephron handles potassium.
- What factors influence this?
- What is normal renal blood flow and how can it be measured?
- How do blood flow and oxygen extraction vary in different parts of the kidney?

2008.1
- How does the kidney handle potassium?
- How do other ions affect K+ transport across the membranes in the nephron?
- What is a typical value for renal blood flow in an adult at rest?
- What factors regulate renal blood flow?
- Please outline the structure of the Loop of Henle
- What happens to electrolytes in the Loop?
- Explain the counter-current concentrating mechanism.

2007.1
- Describe the cell types in the glomerulus and their functions?
- What properties of substances in the blood prevent free passage across the glomerular membrane?
- What factors influence clearance of substances by the kidney?
- Explain the mechanism of tubuloglomerular feedback.
- What are the buffer systems in blood?
- Explain how carbonic acid / bicarbonate system works.
Week 14-15 Digestion & Gastrointestinal

Digestion & Absorption
Carbohydrates
Proteins
Lipids
Absorption of water & electrolytes
Absorption of vitamins & minerals
Regulation of Gastrointestinal Function
Gastrointestinal hormones
Mouth & oesophagus
Stomach
Exocrine portion of the pancreas
Liver & biliary system
Small intestine
Colon

PAST VIVA QUESTIONS

2013.1
• Explain the mechanisms of absorption of water and electrolytes in the gastrointestinal tract.
• Explain the mechanisms of water and electrolyte secretion in the gastrointestinal tract.

2010.1
• Name the principal pancreatic enzymes and the substances upon which they act.
• Describe the regulation of pancreatic juice secretion

2009.2
• What are the principal functions of the liver?
• Describe bilirubin’s path from production to excretion.

2008.1
• Please describe how ingested iron is absorbed.
• What are the mechanisms that regulate iron absorption?
Week 16  Metabolism

Energy Balance, Metabolism & Nutrition
Carbohydrate metabolism
Protein metabolism
Fat metabolism

PAST VIVA QUESTIONS

2012.2
- Describe the metabolism and excretion of bilirubin.
- What are the causes of jaundice?
- What factors determine blood glucose level?
- How does exercise affect glucose levels?

2011.2
- What factors determine the plasma glucose level?
- Explain how the blood glucose is maintained during fasting.

2011.1
- Please name the principal ketone bodies.
- How are the ketone bodies produced and how are they metabolized?
- In which clinical situation do they accumulate in the body?
- What are the physiological and clinical consequences of excess ketones?

2009.2
- What are the major factors determining the plasma glucose level?
- List the hormones which affect plasma glucose levels?

2007.1
- What factors control blood glucose levels?
- What are the potential pathways for glucose metabolism in the body?
Week 17  Endocrine

It is the home stretch. Endocrine seems to be a viva favourite as the topic is quite meaty. It accounts for 6% of MCQs. A lot of it is covered in other topics, particularly cardiovascular and digestion. It should be all making sense.

The Thyroid Gland
Endocrine Pancreas
Insulin
Glucagon
Adrenal medulla & cortex
glucocorticoids
mineralocorticoids
Calcium Metabolism & the Physiology of Bone
The Pituitary Gland
The Gonads: Development & Function of the Reproductive System
Pregnancy
The renin-angiotensin system
Erythropoietin
Hormones of the heart

PAST VIVA QUESTIONS

2013.1
- List the enzymes secreted from the exocrine pancreas.
- Give at least 3 examples of substrates that these enzymes work on.
- Describe the feedback loop that ensures homeostasis of blood osmolality.
- Name the stimuli that affect vasopressin secretion.
- What hormones are secreted by the anterior pituitary?
- What are the clinical effects of anterior pituitary insufficiency?
- What are the physiological effects of glucocorticoids?
- How is glucocorticoid secretion regulated?

2012.1
- What factors stimulate glucagon release?
- What are the physiological effects of glucagon?
- Describe the body's response to cold?
- Outline the pathogenesis of fever.
- What is the main hormonal factor that stimulates the release of cortisol from the adrenal cortex?
- What factors determine the rate of ACTH secretion?
- What happens to ACTH levels after prolonged treatment with high doses of glucocorticoids is stopped abruptly?
- How can this be avoided?

2011.2
- What factors are involved in regulating thyroid hormone secretion?
- What else affects TSH secretion?
- Describe the role of parathyroid hormone in calcium metabolism.
• How is parathyroid hormone secretion regulated?
• Outline the biosynthesis of adrenaline.
• How is the action of noradrenaline terminated?

2011.1
• What are the effects of insulin deficiency?
  o Prompts- What are the effects on the liver? What are the effects on other tissues?
• What mechanisms does the body use to regulate temperature?
• What mechanisms are activated by cold?
• Are any voluntary?
• How are these temperature regulating mechanisms controlled?

2010.2
• Outline the physiological effects of thyroid hormones.
• Describe the mechanism regulating thyroid hormone.
• What are the physiologic actions of glucagon?
• What factors affect glucagon’s secretion?
• What metabolic effects does insulin have on the liver?
• What are the effects of insulin deficiency on the body?
• What is the physiological role of aldosterone?
• What conditions increase aldosterone secretion?
• What hormones are involved in serum calcium regulation?
• Outline the effects of parathyroid hormone.

2010.1
• What are the principle actions of insulin?
• What happens when insulin binds to its receptor?
• What are the physiologic effects of glucocorticoids?

2009.2
• Describe the typical serum/urine effects in hyperaldosteronism
• How does aldosterone exert its effects in the kidney?
• What are the actions of parathyroid hormone on calcium?
• What are the other effects of parathyroid hormone?
• Describe how ADH acts on the kidney.
• What factors influence ADH secretion?
• What are the effects of thyroid hormones on nervous and vascular systems?
• What other physiological effects does thyroid hormone have on the body?

2009.1
• Describe the steps in the synthesis of thyroid hormone.
• What are the physiological effects of T4.
• How are plasma calcium levels regulated?
• Describe the regulation of parathyroid hormone levels.

2008.2
• Describe the effects of Vasopressin.
• How does vasopressin cause retention of water?
• What stimuli affect vasopressin secretion?
• What happens when insulin binds to an insulin receptor?
• What are the principal actions of insulin?
- Describe the actions of Aldosterone.
- List the stimuli that increase aldosterone secretion.
- Describe the feedback regulation of aldosterone secretion.

2008.1
- What are the effects of thyroid hormones?
- What is the mechanism of action?
- What are the actions of vitamin D?
- How is the synthesis of vitamin D regulated?
- What are the physiological effects of glucocorticoids?
- How is glucocorticoid secretion regulated?
- Describe the effects of insulin on various tissues.
- What is the time frame for these effects?
- What factors influence the level of free calcium in the plasma?
- How does bone resorption occur?

2007.1
- What are the effects of thyroid hormones on different body tissues?
- Describe the effects of increased aldosterone
- List factors that increase aldosterone secretion?
- How is aldosterone secretion regulated?