

Semester II Biomedicine Exam

TIME ALLOWED: 120 minutes

Please read each question carefully.

If you do not understand a term or a question please ask your supervisor.

Always keep exam papers and clinic sheets in your file.

All marks are provisional until ratified by the CNM Exam Board

Student name:	
Campus location:	
Date:	
Student signature:	

Grade awarded:	/ 100
Comments:	
Marker (1):	
Marker (2):	

1) a) List FOUR functions of the kidneys (2 marks)

1. Excretion of unwanted substances.
 2. Maintenance of water & electrolyte balance.
 3. pH regulation of body fluids (especially the blood).
 4. Production of hormones (erythropoietin & calcitriol)
 5. Regulation of red blood cell (erythrocyte) production.
 6. Regulation of blood glucose levels.
 7. Regulation of blood pressure, volume & osmolarity.
- (1/2 mark for each)

b) Explain what is meant by the 'renal hilum' (1 mark)

The region where structures enter/exit the kidneys (eg. blood vessels, lymph vessels, nerves and ureters)

2) a) Describe the function of the 'renal corpuscle' (1 mark)

Filtration

b) In the space below, draw a simple diagram of a nephron (1 mark). You should then label the: Collecting duct (1/2 mark), glomerulus (1/2 mark), proximal convoluted tubule (1/2 mark)

As appropriate

c) Through what investigation procedure would the GFR be calculated? (1/2 mark). What would be considered an average GFR in females? (1/2 mark)

½ mark – blood test

½ mark – accept either over 90 OR approx. 105 (no higher)

3) Explain how ‘Angiotensin II’ elevates blood pressure (1 mark)

Vasoconstricts OR

Triggers the release of aldosterone which increases blood volume

4) A 50 year old female patient presents to you complaining of recurrent cystitis.

a) Explain why cystitis is more common in women (1 mark)

Shorter urethra (no not accept shorter ureter) OR urethra closer to anus

b) List FOUR symptoms of cystitis (2 marks)

Pain in lower back/abdomen

Dysuria & frequent/urgent need to urinate
but only passing small amounts (oliguria)

Dark, smelly/cloudy urine

Systemic signs - malaise, nausea, fever (award up to 1 mark max here for only general systemic symptoms – for 2 marks must mention urinary changes/pain etc.)

c) List TWO substances that might be elevated on a urine dipstick analysis in cystitis (1 mark)

Nitrates
Leukocytes
Erythrocytes
Specific gravity
(do not accept bacteria)

5) a) Name the THREE main layers of the uterine wall (1.5 marks)

Endometrium / myometrium / perimetrium

b) Explain the hormonal changes that occur to induce ovulation (1 mark)

Surge of LH

c) Describe the role of the corpus luteum (2 marks)

½ mark - To release predominantly progesterone
½ mark - This maintains the endometrial lining – sustains potential implantation/pregnancy

d) Name the structure in the testes that act as the site of spermatogenesis (1 mark)

Seminiferous tubules

6) a) One hormone produced by the placenta is 'progesterone'. Name TWO other hormones produced by the placenta and briefly explain their functions during pregnancy (2 marks)

Any of: (1/2 mark for each hormone and ½ mark for 1 description of each)

Oestrogen	<ul style="list-style-type: none"> Promotes growth of breast tissue and myometrium. Produced by corpus luteum until 8 weeks.
human Chorionic Gonadotropin (hCG)	<ul style="list-style-type: none"> Only produced during pregnancy (= pregnancy test) Maintains corpus luteum for 8 weeks and increases transfer of nutrients to foetus (initially produced by chorionic sac) Related to morning sickness.
human Placental Lactogen (hPL)	<ul style="list-style-type: none"> Increase the amount of glucose & lipids in maternal blood.
Relaxin	<ul style="list-style-type: none"> Targets ligaments and relaxes them. Produced by the corpus luteum and placenta.
Corticotropin releasing hormone (CRH)	<ul style="list-style-type: none"> Triggers release of cortisol from the adrenal cortex Prevents rejection of foetus/placenta.

b) Explain what is meant by a 'placenta praevia' (1 mark)

When the placenta attaches to the lower part of the uterine wall (potentially covering the cervix)

8) A 26 year old female patient presents to you complaining of heavy menstrual bleeding and dyspareunia. The patient reports that her sister suffers from polycystic ovarian syndrome (PCOS).

a) Explain what is meant by 'dyspareunia' (1 mark)

Pain on sexual intercourse

b) You consider endometriosis in your differential diagnosis. Explain why women experience symptoms in endometriosis (1 mark)

The endometrial tissue responds to normal hormonal changes (i.e. drop in progesterone), which triggers shedding and bleeding....

c) List TWO symptoms of PCOS (1 mark)

- Amenorrhoea / Oligomenorrhoea.
- Lack of ovulation
- Infertility
- Hirsutism
- Acne & oily skin
- Acanthosis nigricans (*or description*)
- Alopecia/baldness
- Weight gain & difficulty losing weight
- Increased risk of miscarriage.
- Anxiety & depression

d) List TWO findings on a blood test that would indicate PCOS (1 mark)

- Increased androgens (testosterone, androstenedione & DHEA-S).
- Low sex hormone binding globulin (SHBG).
- High LH: normal or low FSH.
- High oestrogen (oestradiol).
- Hyperinsulinemia & blood glucose levels

9) a) Explain what is meant by the Central Nervous System (1 mark)

The brain and spinal cord

b) Complete the following table describing the effects of sympathetic nervous system stimulation on different anatomical structures (1.5 marks)

Structure	Sympathetic Nervous System activity
Adrenal glands	Releases adrenaline & Noradrenaline
Bronchioles	BRONCHODILATION
Pupils	DILATION OF PUPILS
Digestive tract	REDUCED PERISTALSIS/SECRETIONS – REDUCES BLOOD TO GIT

10) a) In the space below, draw a 'neuron' and label FOUR key components (2 marks)

Accept adequate drawing and any of the following labelled for ½ mark each: Cell body, dendrites, nucleus, nodes of ranvier, axon, terminal endings, myelin sheath

b) Explain what is meant by the 'resting potential'. You should consider any relevant ions and charges in your response (2 marks)

At Rest, neurons maintain a electrochemical gradient. This is created by a build up on negative ions/charge inside the cell and positive ions outside the cell. Sodium ions are outside the cell, whilst potassium and negative protein ions are inside the cell. The charge is -70Mv

c) Describe the movement of ions that occurs in 'depolarisation' (1 mark)

Sodium ions move into neuron

11) A 40 year old female patient presents to you in the CNM clinic. She reveals that she is undergoing investigations by a neurologist for suspected multiple sclerosis (MS). The patients grandfather suffers from Parkinson's disease.

a) Describe what happens pathologically in MS (1 mark)

De-myelination of axons (due to AI induced inflammation) leading to plaque formation

b) List FOUR symptoms of MS (2 marks)

- Visual symptoms are common: Blindness, loss of vision of one eye and occasional pain (neuritis). Double vision and nystagmus (jerking of eyeball).
- Deafness and loss of balance.
- Burning, pulling sensations.
- Tingling and loss of sensation.
- Bladder urgency and incontinence.
- Cognitive changes and depression.
- Impotence in men.

c) Name the region of the brain affected by Parkinson's disease (1 mark)

Substantia nigra (midbrain = ½ mark)

d) Compare the common distribution (*location and progression*) of weakness and paralysis as seen in Motor Neuron Disease (MND) and Guillain-Barre Syndrome (1 mark)

MND: weakness typically starts in upper limbs and later affects the legs (and progressive)

G.B: Ascending (starts in legs) progressive

12) a) Name the THREE layers of the meninges (1.5 marks)

Dura mater / arachnoid mater / pia mater (accept just dura etc.)

b) List TWO functions of cerebrospinal fluid (2 marks)

- Supports & protects the brain and spinal cord, acting as a shock absorber.
- Maintains uniform pressure around the brain - in case of brain enlargement compensation occurs by reduction of CSF.
- Keeps brain and spinal cord moist.
- Circulates nutrients and waste.
- Optimal chemical environment for nerve signalling ie. Ions.

13) a) Describe the main function of the 'thalamus' (1 mark)

- Major relay centre – relays sensory information to the cerebrum.
- Integrates sensory and motor information

b) Describe what information is carried by the 'spinothalamic tract' (1 mark)

Pain / temperature (1 mark for either)

c) Explain what you might observe about a patient with cerebellar disease (1 mark)

Ataxic gait – stumbling / unsteady

Tremor (intention)

Slurred speech

14) For each cranial nerve, state ONE function (2 marks)

Cranial Nerve	Function
Optic Nerve	vision
Hypoglossal Nerve	Tongue movements
Trigeminal Nerve	Facial sensation / muscles of mastication
Oculomotor Nerve	Eye movement

15) A 46 year old male patient presents to you complaining of a headache that is gradually worsening. The patient has suffered from associated vomiting over the last couple of days. You are initially concerned about the possibility of raised intracranial pressure.

a) List TWO possible causes of raised intracranial pressure (2 marks)

Tumours, haemorrhage, hydrocephalus, meningitis/encephalitis (causing brain swelling), abscesses, cerebral venous thrombosis.

b) State ONE question you could ask the patient about the headaches aggravating factors, to determine the likelihood of raised intracranial pressure. Explain what response you would be looking to receive if this was the case (1 mark)

Is the headache worse: on awakening? lying down? Coughing?

c) You decide to perform a plantar (cutaneous) response on the patient. Describe the response you might observe if the patient has raised intracranial pressure (1 mark)

Upgoing plantar response (toes go up/extend)

16) a) List FOUR features of the first line of immune defence (2 marks)

Skin, mucous membranes, sweat, saliva, tears, vomiting, diarrhoea, sebum, nasal hairs, mucociliary escalator, gastric acid, microflora, vaginal acidity

b) Explain the general difference between the second and third line of defence (1 mark)

Second line: Targets any foreign antigen (and is innate/natural)

Third line: Targets only specific antigens (immune memory) and is learnt ("specific immunity")

c) Describe the function of the following: (3 marks)

Defence	Function
Interferons	Prevent viral replication (anti-viral)
Transferrin's	Prevent bacteria using iron from RBCs
Fever	Makes interferons more effective. Inhibits growth of some microbes. Speeds up the reactions that aid repair

17) 'Heat' and 'pain' are common signs of inflammation. List TWO other cardinal signs of inflammation (1 mark)

Swelling, redness, loss of function

18) Explain how 'antigen presentation' leads to the formation of immunological memory. You should consider all relevant physiology (3 marks)

Phagocytosis often occurs by macrophages → foreign cell digested → foreign antigen bound to APC HLA/MHC →

Enters lymphatic system and presents foreign antigen to T-Helper cell → releases interleukin-2 →

This triggers **clonal selection** (produces memory T and memory B cells etc.)

19) A 39 year old female patient presents to you at the CNM clinic complaining of fatigue, malaise and joint pains. You consider systemic lupus erythematosus in your differential diagnosis.

a) List TWO other signs and/or symptoms of systemic lupus erythematosus (1 mark)

- Butterfly rash, photosensitivity, vasculitis, Raynaud's syndrome
- Pleurisy, pericarditis, hypertension
- Nephritis (*nephrotic syndrome*) – and subsequent symptoms i.e. back pain/oedema
- Lymphadenopathy (i.e. abdominal swelling), splenomegaly

b) Compare the joint involvement as seen in systemic lupus erythematosus and rheumatoid arthritis (1 mark)

SLE: mostly peripheral joints (1/2)

RA: Bilateral joint involvement (wrists, ankles, elbows, hips etc.) (1/2)

c) Name the gene that is present in 95% of patients with ankylosing spondylitis (1 mark)

HLA – B27

20) a) Explain what is meant by a ‘commensal’ microbial relationship (1 mark)

One benefits and the other is unaffected (do not accept both benefit)

b) “All microbes are pathogenic” – discuss whether you agree with this statement and explain your reasons why (1 mark)

NO – microbes provide vital functions for our body e.g. gut flora – accept examples

c) Explain what is meant by a ‘nosocomial infection’ (1 mark)

An infection acquired in a medical setting i.e. hospital

21) Describe how viruses replicate themselves (1 mark)

They inject their DNA/RNA into living host cell apparatus

b) Explain why viruses are difficult for our bodies to identify and destroy (2 marks)

They do not have many structures of their own

They do not have a metabolism of their own

Are able to mutate

Can remain latent

c) State the cell/s that are targeted by the Human Immunodeficiency Virus (HIV) (1 mark)

CD4 cells

22) A 45 year old male patient presents to you complaining of white plaques around the oral cavity. The patients father has previously suffered from diphtheria.

a) You suspect the patient might have oral candidiasis. Name the microbe that frequently causes oral candidiasis (1 mark)

Candida albicans

b) Explain TWO reasons a patient might develop a candida infection (1 mark)

Broad spectrum antibiotics / immune compromised patient (i.e. very stressed / HIV positive / immunosuppressive therapy) / high sugar diet and diabetics / pregnancy

c) What might you observe when looking inside a patients oral cavity who has diphtheria (1 mark)

Grey membrane across the pharynx/tonsils

23) Explain the difference between chicken pox and shingles. You should consider the cause and presentation in your response (2 marks)

Both are viral diseases caused by varicella zoster

Chicken pox – first exposure to varicella zoster virus causes widespread itchy vesicular eruptions on the skin (all over body)

Shingles – a reactivation of the virus that produces a dermatomal rash e.g. in thorax

24) a) Describe FOUR features of a malignant tumour (2 marks)

Undifferentiated / varied shapes and sizes / reproduce much quicker than normal / can metastasise / often systemic / can be life threatening

b) Explain why a malignancy with a TNM score of T1 N1 M0 will likely have a better prognosis than a TNM score of T1 N1 M1 (1 mark)

The tumour has metastasised → leading to a poorer prognosis

25) Name one tumour marker that might be useful in diagnosing the following pathologies:

a) Ovarian cancer (1 mark): CA-125_____

b) Prostate cancer (1 mark): PSA_____

26) Describe the appearance of each of the following skin cancer lesions (2 marks)

Type of skin cancer	Appearance of lesion
Basal cell carcinoma	Raised, smooth, pearly bump on the sun-exposed skin of the head, neck or shoulders.
Melanoma	Often brown/black lesions, occasionally pink or red in colour

27) A 68 year old male patient presents to you complaining of a worsening cough that has not yet been medically investigated. The patient has smoked heavily for 40 years. You initially consider the possibility of lung cancer.

a) State FOUR other signs and/or symptoms of lung cancer (2 marks)

Dyspnoea & chest pain
 Weight loss
 Haemoptysis (bloody/raspberry sputum)
 Hoarseness of voice
 Wasting of muscles in hand (if apical tumour)
 Clubbing of nails.

b) Lung cancer is often treated in conventional medicine with chemotherapy. Explain why these patients undergoing chemotherapy might experience recurrent infections and suffer with fatigue (1 mark)

The chemotherapy targets rapidly dividing cells and so can target the bone marrow, causing bone marrow suppression (hence anaemia etc.)

c) Name ONE malignancy that often presents as painless haematuria and has a prominent association with cigarette smoking (1 mark)

Bladder Ca

28) a) Indicate the age group most commonly affected by primary osteosarcomas (1 mark)

Teenagers

b) Describe the character/nature of symptoms that patients may experience with an osteosarcoma (1 mark)

Unremitting/constant pain that is deep and focal to the bone. Often worse at night.

29) a) Describe the function of the tympanic membrane (1 mark)

Converts sound waves into mechanical vibration

b) Name the cranial nerve involved in providing information about hearing and balance (1 mark)

Vestibulocochlear

c) Name the bones of the inner ear that play a role in balance (1 mark)

Vestibule (utricle/sacculle)

Semi-circular canals

d) List TWO causes of otitis externa (1 mark)

Swimmers. Also more prevalent in humid climates, diabetes mellitus, HIV, narrow auditory canal. Low ear wax. Ex cess ear plug use, hearing aids, acne, eczema, SLE, post antibiotic fungal infection.

30) a) The eyeball is formed of three layers. The outer layer of the eyeball is formed of the 'sclera' and 'cornea'. Name the inner TWO layers (1 mark)

Uvea / Retina

b) Briefly describe the function of the 'lacrimal gland' (1 mark)

To produce tears (immune function etc.)

c) Name TWO structures of the eye that assist in refraction of light (1 mark)

Cornea and lens

d) Explain what the 'optic disc' is formed of (1 mark)

Optic nerve (nerve tissue)

e) Name the location where most cone cells are located (1 mark)

Macula lutea / fovea centralis

31) A patient presents to you and reports that they are currently undergoing investigations for glaucoma. The patient has been experiencing worsening eye pain. The patient is particularly concerned about her eye symptoms after her husband suffered a retinal detachment last year.

a) Explain what is meant by 'glaucoma' (1 mark)

Raised intraocular pressure

b) List TWO other symptoms of glaucoma (1 mark)

Pain in the eyes and haloes around lights, relieved by sleep.

Rapid deterioration of vision, intense eye pain, redness and watering of the eye, sensitivity to bright light, nausea and vomiting.

Late symptoms: loss of peripheral vision, blurring of objects directly in front of the person.

Loss of night vision.

c) Describe the symptoms associated with a retinal detachment (1 mark)

Floaters in vision, flashing lights, curtains descending over vision.

THE END
Total 100 marks