

UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualification:–

M.B.,B.S.

MBBS: Written Paper (year 1)

COURSE CODE : **MBBS1003**

DATE : **15-MAY-06**

TIME : **10.00**

TIME ALLOWED : **3 Hours**

Phase 1, Year 1: May 2006

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Modified Essay Question paper

3 hours are allowed for this paper.

- **You should attempt all 20 questions, answering each one on the page for that question – if you need more space, continue on the reverse of the page for that question only. Pages will be separated and given to different people to mark.**
- **You are provided with a sheet of bar-code labels. Place one label in the space marked on the page for each question.**
- **You should read through all parts of each question before you begin to answer it – the number of marks for each part question is shown.**
- **Most questions are linked to clinical scenarios. Information about the patient is shown at the top of each question; this may differ from one question to another, as additional information is relevant to the question being asked. Some questions do not refer to any specific patient.**
- **You should allow no more than about 8 minutes for each question.**

This question paper must not be removed from the examination room.

TURN OVER

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Question 1

a) List five communication skills that the doctor can use to help put patients at ease, when they talk to their doctors about sexual matters (10 marks)

b) List five factors that might affect the consultation when you had a discussion with a patient about sexual matters. (10 marks)

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Question 2

Mrs HF, aged 80, has been diagnosed with a serious heart problem and her doctor advises an operation. Her husband, who is anxious and somewhat assertive, is against this treatment and Mrs HF appears to be rather confused. How should the doctor proceed? Explain your answer in terms of legal and professional requirements.

(20 marks)

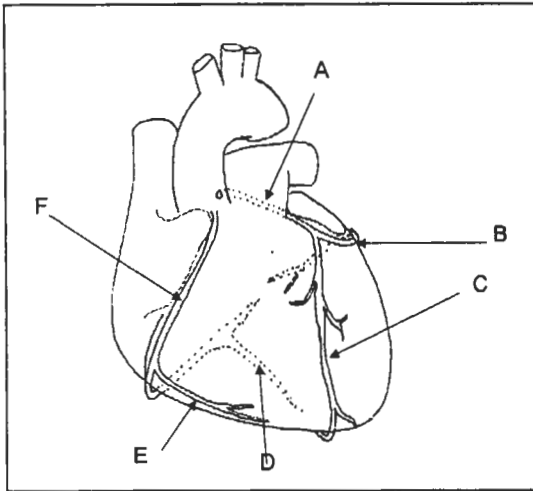
TURN OVER

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Question 3

Mr CB is 50 years old; he is hypertensive, obese and a smoker. He has pain in his left arm that is provoked by exercise but not by shoulder movement. You suspect angina pectoris.

a) Using the table below, name the coronary arteries A-F seen on this anterior view of the heart (6 marks)



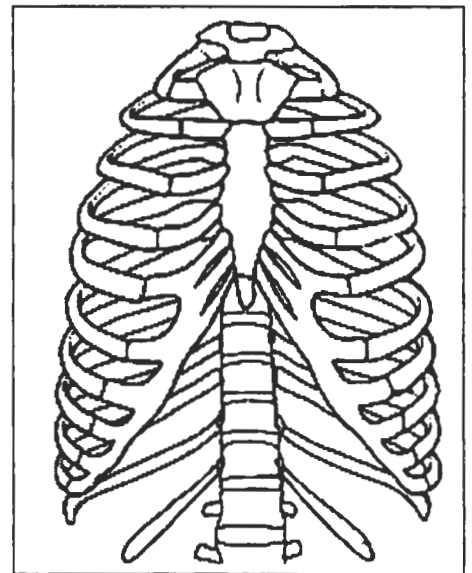
A	
B	
C	
D	
E	
F	

b) Why does he feel pain in his left arm ?

(3 marks)

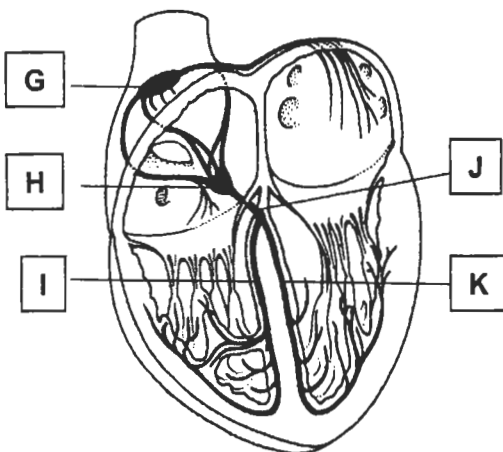
c) Place a cross at four sites on the diagram of the thorax on the right to show the approximate surface markings of the normal heart.

(4 marks)



d) He subsequently has a myocardial infarction that disturbs his heart rhythm. Using the table below, label this diagram of the conducting system of the heart.

(5 marks)



G	
H	
I	
J	
K	

Place your bar
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Question 4

This question concerns the factors that affect blood flow and pressure

a) Which vessels are the main site of resistance in the circulation and describe the relationship between their radius and resistance. (2 marks)

b) The radius of arterioles can be regulated by local control mechanisms. One maintains flow constant when perfusion pressure increases and another influences flow to meet local metabolic needs. What are these 2 type of local control called and to which type of control do they apply. (4 marks)

c) Name four locally produced substances involved in the local regulation of blood flow. (4 marks)

d) Which branch of the autonomic nervous system is most important in regulating vascular resistance, which major transmitter regulates vascular smooth muscle and what effect does it have? (3 marks)

e) What is the immediate effect of increasing total peripheral resistance on arterial blood pressure? Explain your answer with the equation relating arterial blood pressure, cardiac output and total peripheral resistance. (2 marks)

f) Arterial blood pressure is regulated by reflex action. What is the name of the main type of receptor that senses arterial blood pressure and in which two main two locations is this type of receptor found? (3 marks)

g) What are the effects of increasing sympathetic activity to the heart? What effect does vagal nerve activity have on the heart? (2 marks)

TURN OVER

Place your bar
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Question 5

This question does not concern any particular patient.

Most people tolerate their symptoms for quite a while before they see a doctor. Describe the five triggers Zola identifies for a patient's decision to seek help from a medical practitioner. (20 marks)

TURN OVER

Place your bar
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Question 6

This question does not concern any particular patient.

a) Define the terms 'health promotion' and 'health education'. Illustrate your answer with reference to smoking prevention. (4 marks)

b) Outline the role of GPs and their teams in helping patients to successfully quit smoking? (10 marks)

c) What agencies outside of the NHS may have an important role in tobacco control? Select three examples and outline their respective roles. (6 marks)

TURN OVER

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Question 7

Answer the following questions concerning aspects of renal function in a healthy individual.

a) List the forces involved in glomerular filtration and explain how these result in production of glomerular filtrate. (10 marks)

b) How would a 20% decrease in plasma protein concentration affect glomerular filtration rate (GFR)? (2 marks)

c) Explain the effects of the ingestion of 500 mL water on the following, measured 60 mins after drinking (you do not need to give actual values of these parameters):

(i) GFR (2 marks)

(ii) Urine flow rate (2 marks)

(iii) Aldosterone secretion (2 marks)

(iv) Systolic blood pressure (2 marks)

TURN OVER

Question 8

Place your bar
code label here

Answer the following questions concerning aspects of pancreatic exocrine function in a healthy subject.

a) What are the functions of pancreatic exocrine secretions? (2 marks)

b) With the aid of a graph, show the relationship between Na^+ , HCO_3^- and Cl^- levels in pancreatic secretion with its flow rate. (4 marks)

c) Draw a diagram showing the processes involved in pancreatic bicarbonate production. (8 marks)

d) Explain the hormonal mechanisms by which duodenal luminal composition influences the composition of pancreatic exocrine secretion? (6 marks)

TURN OVER

Question 9

Mrs JP is 40 years old. She is on a low protein diet because of renal failure, and she is anaemic. For dinner she has a large bowl of boiled rice together with a glass of water.

a) What is the final product of the digestion of starch and where and how is it absorbed? In your answer explain the role of membrane transporters.

(6 marks)

Place your bar
code label here

b) Explain what is meant by the term 'resistant starch'

(2 marks)

c) What is meant by the glycaemic index of a carbohydrate

(2 marks)

d) Where along the gastrointestinal tract is the majority of water normally absorbed?

(2 marks)

e) What mechanisms are involved at the epithelial level?

(4 marks)

f) How might the products of rice digestion facilitate water absorption?

(2 marks)

g) Rice provides 8% of energy from protein – is this likely to be adequate to meet her protein requirements?

(2 marks)

Place your bar
code label here

Question 10

Mrs JP is 40 years old. She is on a low protein diet because of renal failure, and she is anaemic. She is a strict vegetarian

- a) Why might you suspect that she could be vitamin B₁₂ deficient? (1 mark)
- b) Describe the processes involved in absorption of vitamin B₁₂ (4 marks)
- c) Why might you suspect that she could be iron deficient? (1 mark)
- d) Describe the processes involved in the absorption of iron salts (4 marks)
- e) Explain why the absorption of dietary iron salts is limited (4 marks)
- f) Why are women considerably more likely to suffer from iron deficiency than men are? (1 mark)
- g) Explain why vitamin C supplements are commonly prescribed together with iron for the treatment of iron deficiency anaemia (2 marks)
- A blood film showed she was suffering from microcytic hypochromic anaemia.
- h) Explain what is meant by:
- a) microcytic (1 mark)
- b) hypochromic (1 mark)
- i) Is it more likely that she is deficient in vitamin B₁₂ or iron? (1 mark)

Question 11

This question does not concern any particular person.

Using the example of epilepsy, define Goffman's concept of stigma and explain the distinction between felt and enacted stigma. In your answer explain why epilepsy provides a good example of both felt and enacted stigma. (20 marks)

Place your bar
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Question 12

The following blood data on several patients were returned to you from the Pathology Laboratory at The Royal Free Hospital.

	PaO ₂ mmHg	PaCO ₂ mmHg	pH	CaO ₂ mL/100 mL	[Hb] g/100 mL
A	120	20	7.19	20	15
B	95	38	7.36	5	16
C	52	30	7.34	17	16
D	50	80	7.21	16	15
E	108	34	7.51	10	8
F	120	39	7.41	20	16
G	200	42	7.39	21	15

Which of the blood samples would be likely to relate to the following patients? In a few words explain your reasons. (5 marks each)

- a) A patient with diabetes mellitus who is exhibiting ketosis.

- b) A patient who is recovering from a severe haemorrhage and is likely to be anaemic

- c) A patient who was suspected of having experienced carbon monoxide poisoning

- d) A patient who was hypoventilating due to an overdose of sleeping pills

TURN OVER

Question 13

Place your bar code label here

A 40-year old woman complains of stomach ache that is aggravated by eating fatty meals. She is tender to touch in the right hypochondrium and her conjunctivae are tinged yellow. You suspect jaundice due to gallstones.

a) Adjacent to the tip of which costal cartilage would you expect to find the fundus of the gall bladder? (1 mark)

b) Apart from the gall bladder, name 3 other organs found in the region of the right hypochondrium (3 marks)

c) Briefly explain her jaundice (3 marks)

d) Where precisely does bile enter the gastrointestinal tract? (2 marks)

e) What other major duct commonly joins the common bile duct as it enters the gastrointestinal tract? (1 mark)

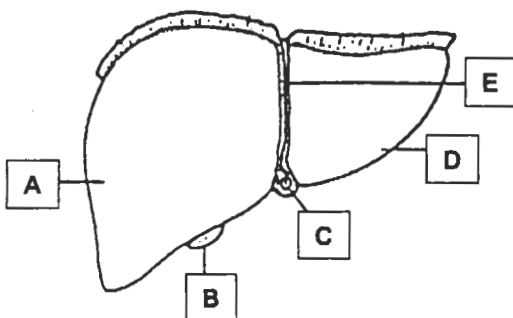
She subsequently has her gall bladder removed surgically.

f) Name two sources of arterial blood to the gall bladder (2 marks)

g) How will gall bladder removal affect bile flow to the gastrointestinal tract? (2 marks)

h) What dietary modifications are usually needed as a result of gall bladder removal? (1 mark)

i) Using the table below, label this diagram of an anterior view of the liver (5 marks)



A	
B	
C	
D	
E	

TURN OVER

Question 14

MG is 18 years old. She has insulin-dependent diabetes mellitus, and was admitted to casualty in a hyperglycaemic ketotic coma.

Place your bar-code label here

- a) Name the ketone bodies. (3 marks)
- b) When are ketone bodies produced in relatively large amounts in a normal individual? (2 marks)
- c) What is the substrate used for synthesis of ketone bodies? (1 mark)
- d) What organ synthesises ketone bodies? (1 mark)
- e) Name three cell types or organs that can use ketone bodies as a metabolic fuel (3 marks)
- f) Name one cell type or organ that cannot ever use ketone bodies as a metabolic fuel (1 mark)
- g) Give two ways in which her ketosis might be easily detected (2 marks)
- h) Explain why her blood concentration of ketone bodies was abnormally high (4 marks)
- i) A urine test showed that she was glucosuric. Explain why. (3 marks)

TURN OVER

Question 15

Place your bar-code label here

Mrs PC is a 60 year old nurse who admits that she is "somewhat overweight", and recently she has been suffering from chest pain, especially after exercise. As part of her occupational health screening her plasma cholesterol was measured, and was found to be 8 mmol /L, compared with a desirable range of under 5 mmol /L.

Cholesterol is carried by plasma lipoproteins. Describe briefly the functions of the three main types of plasma lipoprotein:

- a) Very low density lipoprotein (VLDL) (2 marks)

- b) Low density lipoprotein (LDL) (2 marks)

- c) High density lipoprotein (HDL) (2 marks)

- d) Explain briefly how elevated LDL cholesterol causes her angina (4 marks)

The GP prescribes the use of a 'statin' drug, that inhibits the enzyme 3-hydroxyl methyl glutaryl CoA (HMG CoA) reductase, in order to treat her hypercholesterolaemia.

- e) Explain why HMG CoA reductase is a good drug target in the treatment of hypercholesterolaemia (3 marks)

- f) What other factors regulate the activity of HMG CoA reductase? (3 marks)

- g) What effect would an inhibitor of HMG CoA reductase have on the cellular expression of LDL receptors, and why would this be beneficial? (3 marks)

- h) Which organ is normally responsible for removing most LDL from the circulation? (1 mark)

TURN OVER

Question 16

Place your bar-code label here

Caroline is 60 years old and admits that she is "somewhat overweight", and wants to lose weight.

She is 152 cm tall and weighs 88 kg.

a) What is her BMI (body mass index)? (1 mark)

For the purpose of these calculations, you may assume that all of her weight loss will be adipose tissue: 15% water, 5% protein (with an energy yield of 17 kJ /g) and 80% triacylglycerol (with an energy yield of 37 kJ /g). You should ignore the (probably considerable) loss of muscle tissue to provide amino acids for gluconeogenesis.

b) What is the energy yield in MJ of 1 kg of adipose tissue? (4 marks)
Show your working, then enter your answer in the box

b) Her total energy expenditure is 10 MJ /day. Assuming that she maintains her habitual level of physical activity, how much weight could she expect to lose in a week if she starved completely? (4 marks)
Show your working, then enter your answer in the box

For a woman age 60, and weighing 88 kg, BMR will be about 6.7 MJ /day.

c) What is her PAL (physical activity level)? (2 marks)
Show your working, then enter your answer in the box

Rather than reducing her food intake, she decides that she would prefer to increase her physical activity.

d) How much additional energy will she expend per day by jogging for 2 hours per day at a physical activity ratio (PAR) = 4.5? (4 marks)
Show your working, then enter your answer in the box

e) How much weight would she lose in a week by jogging for 2 hour each day? (4 marks)
Show your working, then enter your answer in the box

TURN OVER

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Question 17

This question does not concern any particular patient

Explain briefly what is meant by each of the following terms in molecular biology:
(2 marks each)

a) DNA replication

b) tRNA

c) mRNA

d) Transcription

e) Translation

f) Ribosome

g) Polysome

h) TATA box

i) intron

j) What is the clinical relevance of the fact that prokaryotes have a 70S ribosome, while eukaryotes have an 80S ribosome?

TURN OVER

Place your barcode label here

Question 18

A 58 year old Circuit Court Judge, His Honour Judge Jefferies, had been feeling under the weather for several weeks. He noted that he had lost weight and suffered sweating attacks at night. He was also complaining of a cough which was streaked with blood. His GP referred him for a chest X ray which showed cavities at the apex of his lungs. A sputum sample was stain with the Zeihl Neelsen (ZN) stain and which is showed in the photograph. A diagnosis of tuberculosis was made and he was started on a combination of rifampicin + isoniazid + pyrazinamide for 2 months with a further 4 months of rifampicin + isoniazid.

- a) Describe the characteristic histology of tuberculosis (3 marks)
- b) Describe the pathogenesis of tuberculosis and explain the judge's symptoms (12 marks)
- c) Describe the bacterial cell wall structure of *M. tuberculosis* and the staining reaction with the ZN stain (2 marks)
- d) How is tuberculosis spread and what preventive measures are available? (3 marks)

TURN OVER

Question 19

Place your bar-code label here

A newborn boy developed a severe pneumococcal infection (*Streptococcus pneumoniae*) at 8 weeks of age. He was investigated and found to have low levels of IgG, increased neutrophils and reduced levels of lymphocytes in his blood. On further examination it was found that no cells with surface antibodies were present in his blood stream.

a) Describe what kind of immunodeficiency is consistent with the clinical and laboratory findings (3 marks)

b) Where are the lymphocytes which are deficient in this patient made in a healthy baby? (3 marks)

c) Why did the baby have IgG but not IgM in his blood stream? (4 marks)

d) Describe the basic structure of an antibody molecule. (5 marks)

e) What forces contribute to the interaction between specific antibody and its antigen? (5 marks)

TURN OVER

Place your bar-code label here

Question 20

DG is a 68 year old man who has become progressively breathless on mild exertion. He has been referred to a chest clinic for routine lung function assessment to determine the progress of his emphysema.

a) Define emphysema (3 marks)

DG was asked to perform a forced vital capacity manoeuvre using a vitalograph. His peak expiratory flow rate was also determined using a peak flow meter.

b) Sketch the vitalograph recording that you might expect to find in a patient with advanced emphysema. On the same graph sketch the recording you would expect to find in a normal healthy individual of comparable age. Take care to label the axes. (5 marks)

c) Comment on the essential features of the vitalograph trace and measurement of peak expiratory flow that would distinguish the patient with emphysema from the normal healthy individual. (4 marks)

d) Is emphysema classified as an 'obstructive' or a 'restrictive' lung disease? (1 mark)

e) Explain your answer. (3 marks)

(f) Name two factors which could be responsible for DG's emphysema. (3 marks)

(g) What effect, if any, would you expect emphysema to have had DG's lung compliance ? (1 mark)

END OF PAPER

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Station 2

The diagram shows the results of blood group testing for two people, Mr and Mrs RH.

- a) What blood group is Mrs RH? (2 marks)
- b) What blood group is Mr RH? (2 marks)
- c) What are the likely blood groups of their children? (½ mark each)
- d) What assumption have you made to arrive at your answer to part (c) above? (2 marks)
- e) What would be the consequences of Mrs RH receiving a blood transfusion from her husband? (2 marks)
- f) Explain briefly your answer to part (e) above (2 marks)
- g) From which blood groups can Mr RH safely receive a transfusion? (3 marks)
- h) To which blood groups can Mr RH's blood safely be used for a transfusion? (3 marks)

Station 3

The diagram shows various compartments of a typical cell.

On lines 1 – 9 of the card choose the one correct name for each compartment from the list A – L below. You will score zero for marking more than one correct answer on lines 1 - 9:

- A) Centriole
- B) Free ribosomes
- C) Lysosome
- D) Mitochondrion
- E) Nuclear pore
- F) Nucleolus
- G) Nucleus
- H) Plasma membrane
- I) Polysome
- J) Rough endoplasmic reticulum
- K) Smooth endoplasmic reticulum
- L) Vacuole

Answer the following section on lines 10 - 15 of the card.

The following metabolic processes occur in one or more of the cell compartments:

- A) ATP formation
- B) ATP hydrolysis / utilisation
- C) Citric acid cycle
- D) DNA replication
- E) Endocytosis
- F) Fatty acid synthesis
- G) Fatty acid β -oxidation
- H) Glycolysis
- I) G-protein activation leading to phospholipase activation
- J) Hydrolysis of proteins (partial or complete)
- K) Post-synthetic modification of proteins for export from the cell
- L) Transamination of amino acids
- M) Transcription
- N) Translation
- O) None of the above

For each of the following named cell compartments mark all processes from the list A-N above that occur in that compartment. If you simply mark all correct you will score zero.

- 10) Cytosol
- 11) Nucleus
- 12) Mitochondrion
- 13) Plasma membrane
- 14) Rough endoplasmic reticulum
- 15) Lysosome

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Place your barcode label here

Station 4

The diagram shows a double reciprocal (Lineweaver-Burk) plot for an enzyme incubated with and without an inhibitor.

a) Which line is the enzyme in the presence of inhibitor? (1 mark)

P	
Q	

b) What type of inhibition is this? (1 mark)

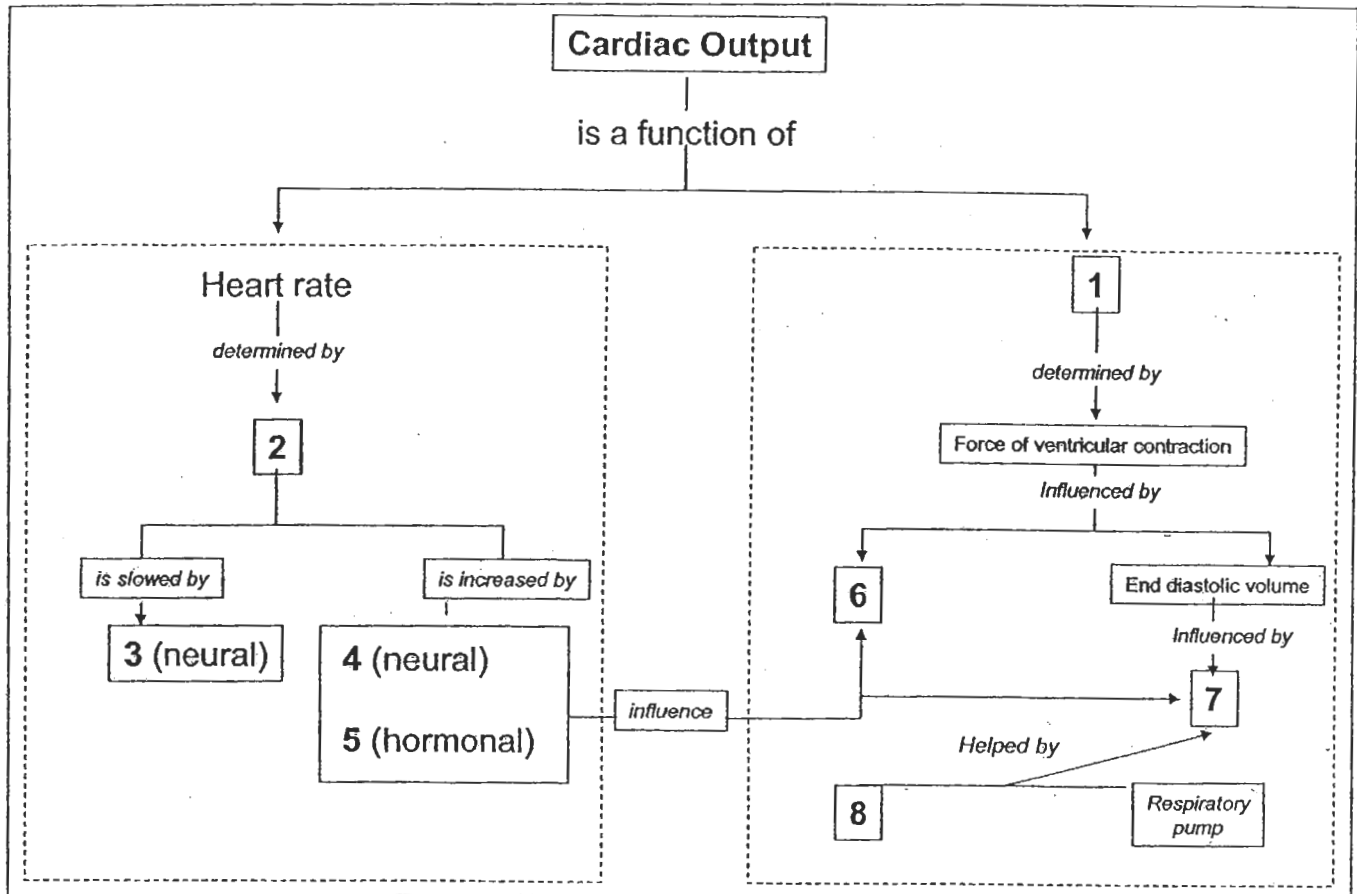
Allosteric	
Competitive reversible	
Irreversible	
Non-competitive reversible	
Uncompetitive reversible	

c) Calculate the values of K_m and V_{max} in the presence and absence of the inhibitor and enter your answers in the table below. You must also show the units of K_m and V_{max} .

	Value (2 marks each)	Units (1 mark each)
K_m without inhibitor		
K_m with inhibitor		
V_{max} without inhibitor		
V_{max} with inhibitor		

d) Over a period of time, would this inhibitor affect the rate of formation of the end-product of the pathway? Explain your answer. (6 marks)

Answer this question on lines 1 – 8 of the computer-readable card provided
 Only one answer is correct for each numbered question at this station.
 You will score zero if you mark more than one answer correct



The flow diagram contains numbered boxes that represent factors that have a bearing on cardiac output.

From the list below choose one word or phrase that best describes each factor

- A) Acetylcholine released from the adrenal medulla
- B) Adrenaline released from adrenal medulla
- C) Sympathetic activity
- D) Chronotropy
- E) Contractility
- F) Noradrenaline
- G) Parasympathetic activity
- H) Rate of action potential generation by sinoatrial node pacemaker cells
- I) Skeletal muscle pump
- J) Stroke volume
- K) Venous return

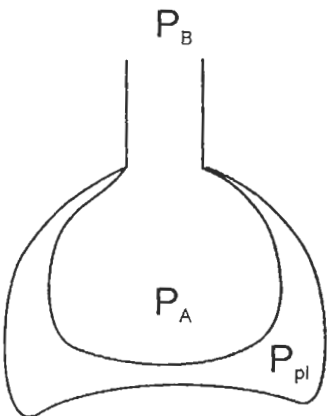
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Station 6

When we look at the relationship between the volume and pressure within the lung

The transpulmonary pressure = alveolar pressure (P_A) – intrapleural pressure (P_{pl})

The relationship between lung volume and intrapleural pressure is shown in the table:



Lung volume (litres)	Intrapleural pressure (cmH ₂ O) [P_{pl}]	Alveolar pressure (cmH ₂ O) [P_A]
1.7	-2.5	0
2.2	-5.0	0
2.7	-7.5	0
3.2	-10.0	0
3.7	-12.5	0
4.1	-15.0	0
4.4	-17.5	0
4.7	-20.0	0
4.8	-25.0	0
4.9	-30.0	0

1) Tick the correct answer. During inspiration intrapleural pressure: (1 mark)

becomes more negative leading to an increase in lung volume	<input type="checkbox"/>
becomes less negative leading to an increase in lung volume	<input type="checkbox"/>
has no effect on lung volume	<input type="checkbox"/>

2) By how much will a change in transpulmonary pressure from 7.5 cm H₂O to 10.0 cm H₂O increase lung volume? You must show all workings and the units of your answer. (2 marks)

3) By how much will a change in transpulmonary pressure from 25.0 cm H₂O to 30.0 cm H₂O increase lung volume? You must show all workings and the units of your answer. (2 marks)

In the following paragraph, **DELETE** the words in brackets that are **INCORRECT**. (8 marks)

Using the data in the table above, the compliance of the lungs is (greater / smaller) at lower lung volumes compared to higher lung volumes. Surface tension in the alveoli tends to act to (increase / reduce) expansion of the alveoli. Surfactant is produced by (Type 1 / Type 2) alveolar cells. It acts to (increase / reduce) surface tension in the alveoli. Its action is (greater / smaller) in small alveoli than in larger ones. In the absence of surfactant, the compliance of the lungs will (increase / decrease). In a disease such as emphysema where some alveolar walls are broken down, lung compliance will be (increased / decreased / unaltered). During an asthma attack, when airways constrict, lung compliance will be (increased / decreased / unaltered).

Place your barcode label here

Station 8

An intravenous infusion of para-aminohippuric acid (PAH) was used to determine the renal plasma flow (RPF) in a healthy subject. When steady peripheral venous levels of PAH had been achieved, a 20 minute collection of urine was made.

1. Calculate the RPF from the following data:

Systemic venous plasma PAH concentration = 0.04 mg/mL

Urine PAH concentration = 16 mg/mL

Urine volume = 20 mL

(3 marks)

2. What is the PAH concentration in the glomerular filtrate?

(2 marks)

3. In the same subject, cells comprise 40% of the blood volume.
Calculate the renal blood flow.

(2 marks)

4. The filtration fraction in this subject is 0.2 and the plasma concentrations of sodium and glucose are found to be:

Sodium: 140mmoles/L (molecular weight = 23)

Glucose: 8 mmoles/L (molecular weight = 180)

Calculate the amounts (in milligrams and mmoles) of sodium and glucose filtered each minute.

(8 marks)

Place your barcode label here

Station 9

The diagram shows the replication cycle of a retrovirus

Label each item marked A – G in the diagram.

(7marks)

A	
B	
C	
D	
E	
F	
G	

Fill in the missing word or term in the following three sentences (the first letter of the word is supplied)

(1 mark each)

Viral DNA when integrated into the host cell chromosome is known as a p _____

The viral attachment protein of HIV is a glycoprotein designated g _____

The principal receptor molecule for HIV on human T cells is C ____

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Place your barcode label here

Station 11

The diagram shows part of the intestinal wall.

a) What are the labels for each of the letters A – D? (4 marks)

What is A?	
What cells are labelled B?	
What specialised blood vessel structures are labelled by C?	
What tissue is D pointing to?	

b) What term do we use for is this kind of lymphoid tissue? (1 mark)

c) What antibody class is transported across the epithelium at this site and what receptors on the epithelial cells are involved? (2 marks)

d) Why is the transported antibody not damaged after entry into A above? (1 mark)

e) How does this antibody work to protect us against infection in A? (2 marks)

Station 12

You have been asked to take a patient's blood pressure using an aneroid sphygmomanometer. Please answer the following questions.

- a) How wide should the blood pressure cuff be? (2 marks)
- b) Why does width matter? (4 marks)
- c) Where should it be placed? (2 marks)
- d) To what pressure should the cuff initially be inflated? (2 marks)
- e) How quickly should it be deflated? (2 marks)
- f) Give two ways in which you can detect the systolic pressure? (4 marks)
- g) What are the Korotkoff sounds? (4 marks)
- h) How will you detect the diastolic pressure? (2 marks)

Place your barcode label here

