

University of London

**EXAMINATION FOR INTERNAL STUDENTS**

For The Following Qualification:--

*M.B.,B.S.*

**MBBS: Written Paper (year 1)**

**COURSE CODE : MBBS1003**

**DATE : 16-MAY-05**

**TIME : 10.00**

**TIME ALLOWED : 3 Hours**

## **Phase 1, Year 1: May 2005**

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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.**

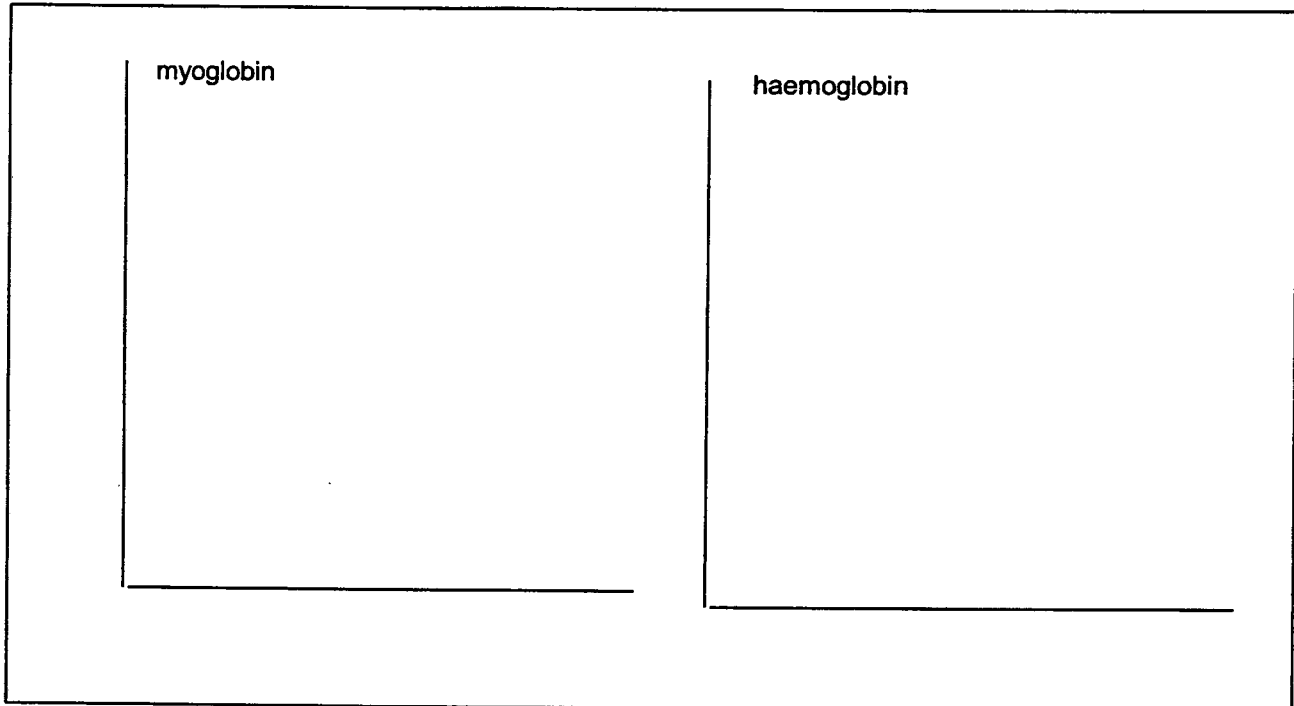
**TURN OVER**

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**Question 1**

*This question does not concern a particular patient*

Draw the oxygen dissociation curves for haemoglobin and myoglobin in the box below. You must label the axes. (8 marks)



Explain briefly how the structures of haemoglobin and myoglobin account for the difference in the curves you have drawn.

(8 marks)

After even moderate exercise (eg climbing a flight of stairs), there is a considerable increase in the plasma concentration of lactate, resulting in lowering of plasma pH. What is the effect of this fall in plasma pH on oxygen binding to haemoglobin?

(4 marks)

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**Question 2**

***This question does not concern a particular patient***

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

a) DNA replication

b) tRNA

c) mRNA

d) Transcription

e) Translation

f) Ribosome

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

h) Polysome

i) TATA box

j) Intron

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**Question 3**

Ms PJ is a 19 year old office worker. She is referred to her GP by the Practice Nurse, who has been dressing a burn Ms PJ apparently received when cooking late one night. The nurse is concerned that this and other recent injuries may be associated with excessive alcohol use.

a) Describe the Department of Health (1995) guidelines on safe alcohol consumption. (4 marks).

b) Outline the types of information that the GP should collect from Ms PJ in order to obtain a detailed alcohol history. (10 marks)

c) Describe three public health measures that can be implemented to control harmful patterns of alcohol consumption amongst young people. (6 marks).

**Question 4**

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At an office party, Ms PJ consumes a litre of red wine; according to the label, the wine is 14% alcohol by volume.

a) What volume of alcohol has she consumed? (2 marks)

b) The density of alcohol is 0.79 g /mL. What weight of alcohol has she consumed? (2 marks)

You can assume that alcohol distributes equally in intracellular and extracellular water. Intracellular water = 40% of body weight, extracellular water = 20% of body weight. Ms PJ weighs 60 kg.

c) What is her total body water content? (2 marks)

d) Ignoring the alcohol that is excreted in urine, exhaled on her breath and metabolised, what will be her blood alcohol concentration at the end of the evening? (4 marks)

Show your working then enter your answer in the box

The legal limit of blood alcohol for driving is 80 mg /100 mL (800 mg /L).

e) What is the total amount of alcohol that she must metabolise before she is legally fit to drive? (6 marks)

Show your working then enter your answer in the box

f) Assuming that Ms PJ can metabolise 8 g of alcohol per hour, and ignoring the alcohol that is lost on her breath and in her urine, how long will it be before she is legally fit to drive? (4 marks)

Show your working then enter your answer in the box

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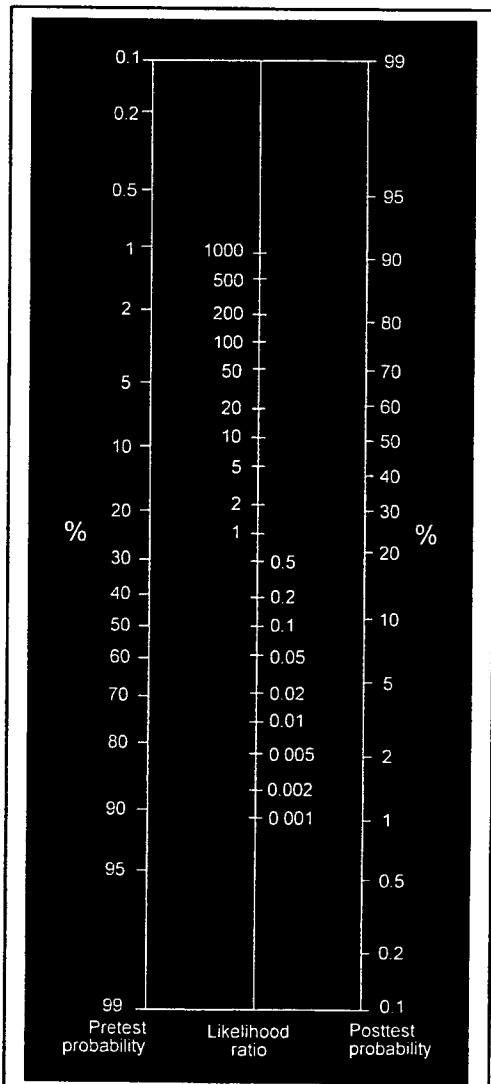
**Question 5**

The following table presents the results of study evaluating the effectiveness of the CAGE questionnaire for diagnosing alcohol dependency.

	True alcohol dependency status			Total
	Yes	No		
CAGE Questionnaire Score: 4	4	20	15	35
CAGE Questionnaire Score: 3	3	30	15	45
CAGE Questionnaire Score: 2	2	25	10	35
CAGE Questionnaire Score: 1	1	10	20	30
CAGE Questionnaire Score: 0	0	15	240	255
<b>Total</b>	<b>100</b>	<b>300</b>	<b>400</b>	<b>400</b>

a) Using criteria of a score of 3 or more on the CAGE to define a positive test result, show how you would calculate the sensitivity and specificity. (6 marks)

b) Using the same criteria as in (a), if an individual has a negative test result show how you would evaluate the probability that they truly don't have a problem with alcohol dependency. What name is given to this quantity? (4 marks)



c) Explain in words what the likelihood ratio for a positive test result is. Show how you would calculate this using the sensitivities and specificities from part (a). (6 marks)

d) If a doctor judges that a patient has a 40% probability of having alcohol dependency before using the CAGE questionnaire, and the patient then scores 3, evaluate the post-test probability of alcohol dependency using the likelihood ratio you obtained in part (c) on the nomogram on the left. (4 marks)

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**Question 6**

A male immigrant is found to have HIV and TB. His doctor starts to talk about the risk to others, but he interrupts, insisting that he can be trusted not to harm others, and that he has a right to confidentiality.

Explain, as briefly as possible, what the doctor should say to him.  
Your answer should show your understanding of rights and duties in general, as well of current legal and professional requirements. (20 marks)



**Question 7**

Mrs X is an elderly woman who has come along to the GP as she has been losing weight recently and is concerned at what might be the cause of this. The GP asks you to speak to her about her diet.

a) List four types of information you will need to gather about her diet.

(8 marks)

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b) For each type of information you have listed, formulate a question you might ask and say whether it is an open or a closed question.

(8 marks)

c) Food and eating can be very sensitive issues for some people to talk about. Give two examples of communication skills you might use to put someone at their ease when talking about their diet.

(4 marks)

**Question 8**

Mrs X is an elderly woman who has come along to the GP as she has been losing weight recently and is concerned at what might be the cause of this. She now weighs 45 kg and is 160 cm tall.

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a) What is her BMI (kg /m<sup>2</sup>)? (1 mark)

Show your working, then enter your answer in the box

b) She is moderately active, with a PAL (physical activity level) of 1.4; what is her total energy expenditure if her BMR is 4.5 MJ /day, which is what we would expect for a woman of her age, height and weight? (1 mark)

Show your working, then enter your answer in the box

Mrs X has lost 4 kg over the last 4 weeks. She has little adipose tissue, so you can assume that 20% of the weight loss was adipose tissue and the remainder lean tissue (muscle).

c) How much weight has she lost from each of adipose tissue and muscle? (1 mark each)

adipose tissue	
muscle	

d) What was her total energy deficit over the last four weeks? (10 marks)

adipose tissue = 80% triacylglycerol, 5% protein, 15% water  
skeletal muscle = 3% triacylglycerol, 17% protein, 1% carbohydrate, 79% water.  
Energy yield of triacylglycerol is 37 kJ /g, protein 17 kJ /g, carbohydrate 16 kJ /g

Show your working, then enter your answer in the box

e) What was her average daily energy deficit over this period? (1 mark)

Show your working, then enter your answer in the box

f) What is her average total daily energy expenditure? (2 marks)

Show your working, then enter your answer in the box

g) What is her actual BMR? (3 marks)

Show your working, then enter your answer in the box

**Question 9**

Mrs X is an elderly woman who has come along to the GP as she has been losing weight recently and is concerned at what might be the cause of this.

Subsequent investigations show that Mrs X has cancer of the pancreas, and it is relatively advanced.

a) What name would you give to the cause of her weight loss? (1 mark)

b) Describe three biochemical mechanisms that explain her hypermetabolism. (9 marks)

c) Give three reasons why her rate of protein synthesis is lower than normal. (6 marks)

d) Give two reasons why her rate of protein catabolism is increased. (4 marks)

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**Question 10**

**This question does not concern any particular patient**

In 1999, 16 per cent of the population of Great Britain was aged 65 and over. Draw a graph representing the 'squaring of the rectangle of survival' ( 8 marks) and use it to explain the nature of the 'demographic transition' in relation to health (12 marks).

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**Question 11**

Mrs H has been suffering from nausea and intense pain in the upper abdomen. She has been diagnosed with gall stones and is being considered for surgery to remove the gall bladder.

- a) What are gall stones made of ? (2 marks)
- b) Why do you find cholesterol in the bile even in a healthy person ? (2 marks)
- c) Where are the bile salts synthesised and what is their function? (3 marks)
- d) What are the three main functions of cholesterol in the body? (6 marks)
- e) Cholesterol can be biosynthesised from acetyl CoA. Which two organs are the main sites of cholesterol biosynthesis in adults and how is cholesterol circulated around the body in the blood? (4 marks)
- f) How is LDL-cholesterol removed from the circulation? What happens if this process is defective for genetic reasons? (3 marks)

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**Question 12**

Mrs H has been suffering from nausea and intense pain in the upper abdomen. She has been diagnosed with gall stones and is being considered for surgery to remove the gall bladder.

- a) What is meant by the term 'critical micellar concentration of bile salts'? Why is this important to intestinal function? (3 marks)
- b) List 3 functions of the gall bladder. (3 marks)
- c) Describe the histology of the gall bladder (3 marks)
- d) Explain the difference between the cephalic and intestinal phases of gall bladder emptying and the stimuli that trigger emptying in each phase? (4 marks)
- e) List three factors that help the sphincter of Oddi to open. (3 marks)
- f) What happens to bile salts after their involvement in the intestinal processing of fat? (4 marks)

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**Question 13**

A medical student receives his routine hepatitis B immunisation from his GP. Two days later he becomes jaundiced and returns to his GP. A fellow student suggests that he must have caught hepatitis B from the vaccine.

- a) Was his friend's suggestion valid? (1 mark)
- a) Give three reasons to justify your answer to (a) above (6 marks)
- b) Describe briefly the immune response that follows immunization (3 marks)
- c) How will the GP assess whether or not the vaccine has produced a protective response? (4 marks)
- d) List three possible causes of jaundice (3 marks)
- e) Name three routes by which hepatitis B virus may be transmitted from one individual to another (3 marks)

**Question 14**

Angela is a sickly infant, and frequently goes into hyperammonaemic coma after a feed.

a) Explain briefly why an increase in blood ammonium concentration from  $< 50 \mu\text{mol/L}$  to about  $150 \mu\text{mol/L}$ , which is too little to affect plasma pH, causes loss of consciousness. (5 marks)

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b) Explain briefly what is meant by the term pH (2 marks)

c) Her parents have been trained to give her a rectal infusion of lactulose when she goes into hyperammonaemic coma. Explain briefly how this lowers her blood ammonium concentration. (5 marks)

Subsequent investigations show that she excretes a large amount of argininosuccinic acid, which is normally undetectable, in her urine. This condition, argininosuccinic aciduria is an autosomal recessive genetic disease, due to a defect in the enzyme argininosuccinase.

If the gene for normal argininosuccinase is *A*, and that for the defective form is *a*:

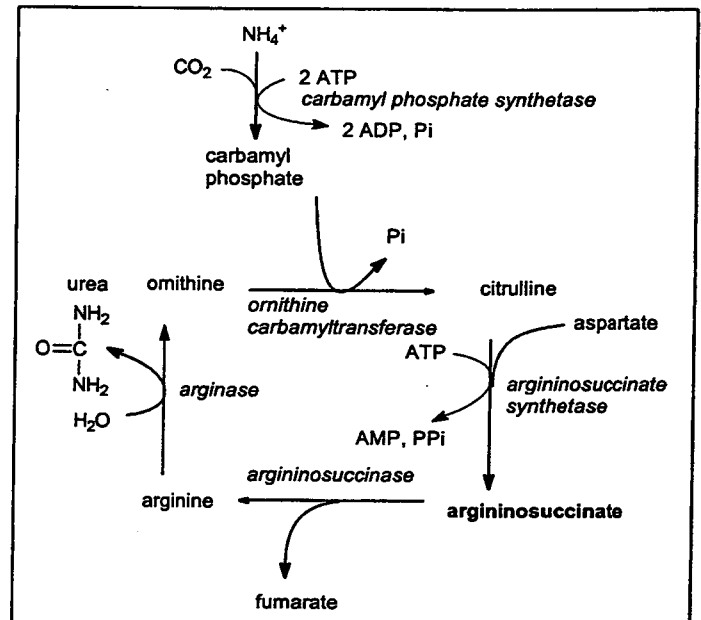
d) How would you describe Angela's genetic make-up at this locus (1 mark)

e) How would you describe the genetic make-up at this locus of her parents? (1 mark)

f) What is the probability that any of her siblings will have the disease? (1 mark)

Angela's paediatrician decides to try giving her supplements of the amino acid arginine, and this results in cessation of the episodes of hyperammonaemic coma, even after a relatively high protein intake.

g) With reference to the metabolic pathway on the right, explain how arginine acts to prevent hyperammonaemia. (5 marks)





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**Question 15**

A young man was involved in a road traffic accident which damaged his spinal cord between the seventh cervical and second thoracic segments. The injury is so severe that all nervous communication between parts of the central nervous system (CNS) above and below the area of damage is severed.

**With the aid of a diagram:**

a) Describe the parasympathetic innervation of the heart; i.e., origin within the CNS, the nerve(s) that its axons project through and the location of ganglia in the periphery. (2 marks)

b) Describe the origin of the sympathetic innervation of the heart, origin within the CNS, the nerves that its axons project through and the location of ganglia in the periphery. (2 marks)

c) Name the branch of the autonomic nervous system that innervates all major blood vessels and is important in the maintenance of arterial blood pressure through its influence on total peripheral resistance. From which levels of the brainstem and/or spinal cord does this innervation arise? (1 mark)

d) In the hours following his spinal cord injury his arterial blood pressure (supine) drops to a mean of ~ 60 mm Hg (his blood volume is normal). Explain why the damage to his spinal cord has led to this low pressure. (5 marks)

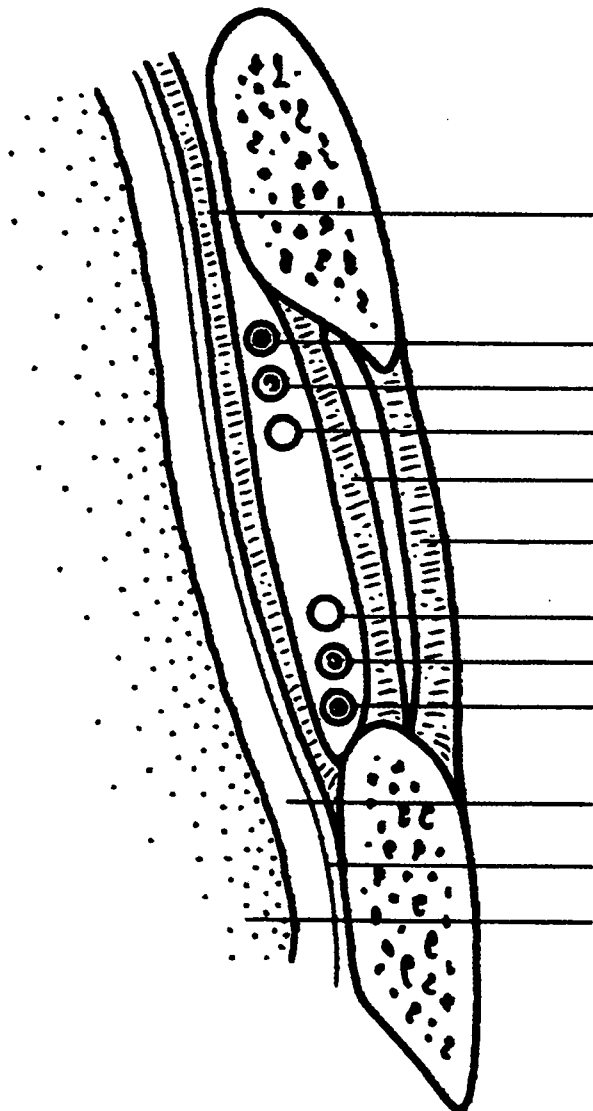
e) During this period of hypotension his heart rate is about 100 beats/min. By reference to the reflex control of arterial blood pressure explain the mechanism(s) behind this increase in heart rate. (10 marks)

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**Question 16**

Mr B aged 25 has a broken right rib that has led to bleeding into his pleural cavity. He is now quite breathless. A needle is inserted in his intercostal space to drain the blood from his chest.

- a) Why is he breathless? (2 marks)
- b) Why doesn't the blood spread into the left side of the thorax? (2 marks)
- c) With reference to the 2<sup>nd</sup> and 3<sup>rd</sup> ribs, where would the needle be inserted? (3 marks)
- d) Label this diagram of a cross section of the ribs and pleura (12 Marks)



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**Question 17**

Ms Melba is a middle aged night club singer who has developed shortness of breath and fatigue over the last few years. She is a non-smoker.

a) In the following Table place a T in the box if the statement about a part of the respiratory tree in a normal subject is **TRUE** and place an F in the box if the statement is **FALSE**.

(½ mark for each correct answer, -½ for each wrong answer)

	bronchioles	respiratory bronchioles	alveoli
Presence of smooth muscle			
Presence of cartilage			
Presence of cilia			
Presence of mucous glands			
Produces surfactant			
Involved in gas exchange			

Ms Melba underwent some pulmonary function tests which showed her FEV<sub>1</sub> of 2.8 litres (87% predicted value) and FVC of 3.1 litres (77% predicted value).

b) What is meant by the term FEV<sub>1</sub> ? (2 marks)

c) What is meant by the term FVC ? (2 marks)

d) Considering the Lung Function data what TYPE of respiratory disease is Ms Melba likely to have? Give reasons for your answer. (3 marks)

e) Would prescribing the use of a salbutamol (β-adrenergic receptor stimulant) inhaler be of use to Ms Melba? Justify your answer. (3 marks)

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**Question 18**

Mr Brown aged 60 develops a swelling in his groin as a result of severe coughing. The swelling can be pushed back but re-appears if he strains

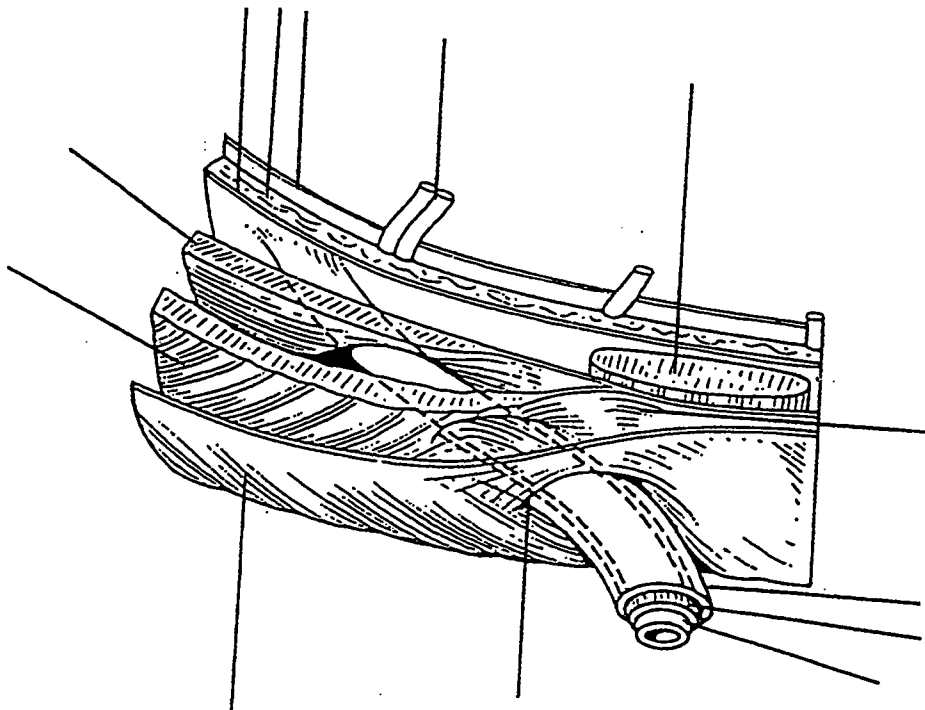
a) Distinguish between a direct and indirect inguinal hernia (4 marks)

b) What other type of hernia would cause a swelling in his groin? (1 mark)

c) Why is an inguinal hernia unlikely in a female? (3 marks)

d) Label this diagram of the inguinal region

(13 marks)



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**Question 19**

**This question does not concern any particular patient.**

Explain how social class impacts upon mortality rates in the UK. In your answer describe the Registrar General's classification of class (6 marks) and relevant arguments linking this to life expectancy (14 marks).

**Question 20**

Barbara is a 76 year old woman who refuses to be immunized against influenza because she has a phobia about injections. In mid-December, during the peak of an outbreak of influenza in her community she experiences a fever, sore throat, headache, rigors, anorexia, malaise and myalgia. A couple of days later she deteriorates and develops a chesty cough, shortness of breath and starts expectorating thick green sputum.

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a) What is the likely diagnosis at the onset of the patient's symptoms? Give your reasons and also describe two well recognised complications of this disease.

(5 marks)

b) What is likely to be the cause of her deterioration and how might this be treated?

(5 marks)

c) If she had been immunised against influenza two years previously would she definitely have avoided being infected during the current outbreak in her community? Give your reasons. (5 marks)

d) Explain the terms 'antigenic shift' and 'antigenic drift' as they apply to the influenza virus. (5 marks)