

Surname	Centre Number	Candidate Number
First name(s)		4



LEVEL 3 DIPLOMA

4463U60-1



S25-4463U60-1

MONDAY, 2 JUNE 2025 – MORNING

MEDICAL SCIENCE

UNIT 6: Medical Case Study

1 hour 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1–3	25	
4–6	25	
7–9	25	
Total	75	

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ADDITIONAL MATERIALS

You will need the Resource Folder.

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The total number of marks for this paper is 75.



JUN254463U60101

Case study 1: Lyme disease

Hari is an elderly gentleman who has recently been on a walking holiday in the New Forest.

About three weeks after returning home, he noticed an unusual bullseye-shaped rash on his leg and he also had flu-like symptoms. He suspected he might have Lyme disease and decided to visit his GP.

The GP took a blood sample for analysis to find out if Hari had *Borrelia* antibodies. Whilst waiting for the results, the GP recommended that Hari use paracetamol to help control his flu-like symptoms.

The blood test confirmed the presence of the antibodies. Before prescribing a course of antibiotics, the GP checked Hari's medical history and noted that he suffers with tinnitus (ringing in the ears) and was taking probenecid for gout.

Within a month of taking the antibiotics, Hari's Lyme disease symptoms had disappeared.



Figure 1: Incidence of animal-associated infections in the UK in 2021

Disease	Causative organism	Mode of transmission	Number of cases
Brucellosis	Gram-negative bacterium <i>Brucella</i>	Drinking unpasteurised milk or eating cheese made from unpasteurised milk.	8
Leptospirosis	Gram-negative bacterium <i>Leptospira</i>	Exposure to water or soil contaminated with infected animal urine.	55
Lyme disease	Gram-negative bacterium <i>Borrelia</i>	Transmitted to humans through a tick bite.	1156
Pasteurellosis	Gram-negative bacterium <i>Pasteurella</i>	Transmitted to humans through a dog or cat bite.	697

Figure 2: Antibiotics used in treatment of Lyme disease

	Doxycycline	Amoxicillin	Azithromycin
Contraindications (do not prescribe to)	pregnant or breast-feeding women children under 12 people with kidney disorders	people with allergy to penicillin people with kidney disorders people with glandular fever	people with liver disorders people with cardiac arrhythmia people with muscle weakness
Possible side effects	anaemia nausea and vomiting photosensitivity (rash in UV light) severe headache tinnitus	skin rash nausea diarrhoea	nausea and vomiting diarrhoea severe headache psychiatric effects, e.g. nervousness, anxiety, delirium
Drug interactions	antacids insulin	warfarin probenecid	antacids hydroxychloroquine statins



1. An investigation was carried out in a clinical laboratory to investigate the effectiveness of various antibiotics on the growth of the bacterium *Borrelia*.

The method followed is outlined below:

- Filter paper discs were soaked in three different antibiotic solutions and placed on the surface of three different Petri dishes containing agar with a culture of the bacterium *Borrelia*.
- The agar plates were incubated for 24 hours at a temperature of 40 °C.
- The agar plates were examined and the size of the clear area around each antibiotic disc was observed. The clear zone is where the bacteria did not grow.

- (a) State the independent variable in this investigation. [1]

.....

- (b) State why it was important that the same type of agar was used in all the Petri dishes. [1]

.....



- (c) The diagram below shows the appearance of the three Petri dishes after they had been incubated.

Plate A: filter
paper disc soaked
with doxycycline

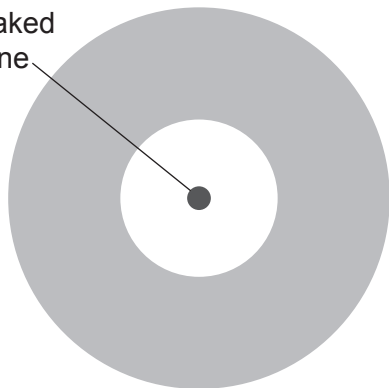
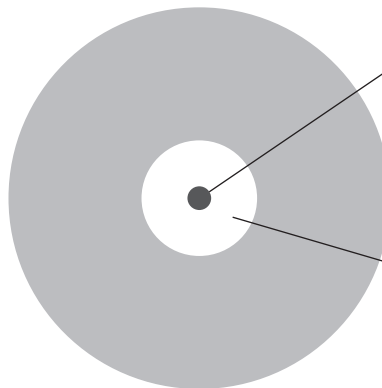
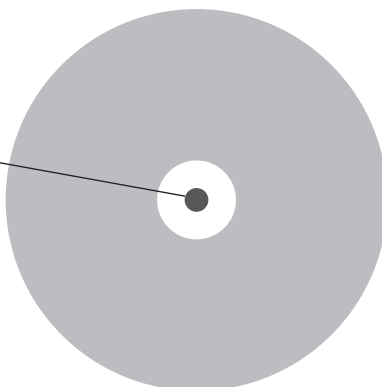


Plate B: filter
paper disc soaked
with amoxicillin



clear zone

Plate C: filter
paper disc soaked
with azithromycin



- (i) State which antibiotic was the best at preventing the growth of the bacterium. [1]

.....

- (ii) Explain your answer to part (i). [1]

.....

.....

- (d) Suggest why the agar used in this investigation contained a source of nitrogen. [1]

.....



- (e) Aseptic techniques have to be used when culturing bacteria on sterile agar plates to prevent contamination of the plates and the environment.

Give **four** methods that you would use to prevent contamination when agar plates are being inoculated. Two examples are already listed. [4]

Disinfect the work surface

Wash hands

1.
2.
3.
4.



2. Use **Figure 1** to answer the following question.

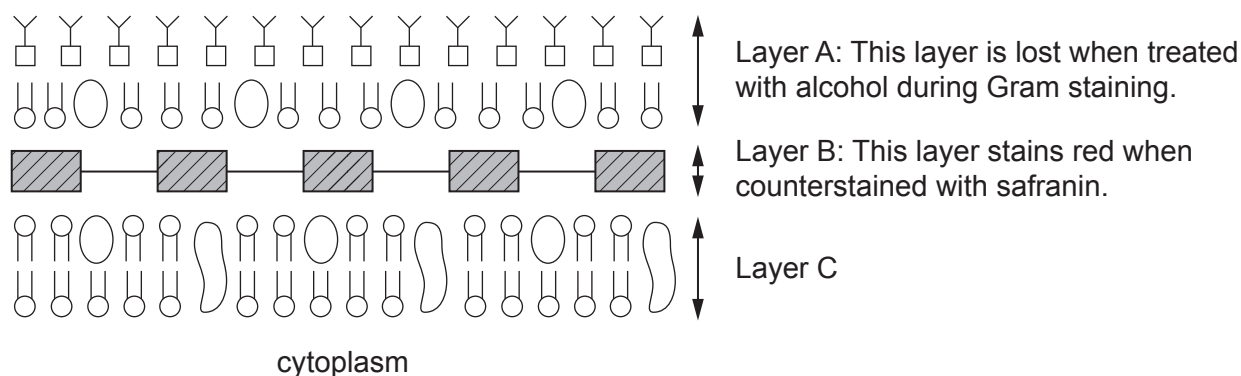
- (a) Calculate the percentage of animal-associated infections that are the result of Lyme disease.

Give your answer to 1 decimal place.

[3]

percentage = ...

- (b) The diagram below shows the structure of the cell wall of a Gram-negative bacterium, along with the effect of Gram staining on two of the layers.



- (i) Name layers A, B and C.

[3]

A:

B:

C:

- (ii) State **two** ways in which the cell wall of a Gram-positive bacterium is different to the cell wall above.

[2]

1.

2.

- (c) Suggest why the Gram stain technique could not be used to identify the specific bacteria in Hari's blood sample.

[1]

.....



3. The GP prescribed the antibiotic azithromycin for Hari.

- (a) Use the information in **Figure 2** to explain why he did **not** prescribe doxycycline or amoxicillin: [2]

Doxycycline:

.....

Amoxicillin:

.....

- (b) Probenecid is a competitive inhibitor of an enzyme in the kidney which helps amoxicillin to be excreted from the body.

- (i) Describe how probenecid acts a competitive inhibitor. [4]

.....

.....

.....

.....

.....

.....

.....

- (ii) Suggest **one** possible effect of this drug interaction on amoxicillin excretion. [1]

.....

.....



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Case study 2: Epidermolysis Bullosa (EB)

Beca is a nine-year-old girl. She was diagnosed shortly after birth with the genetic disorder, Epidermolysis Bullosa (EB). Her condition is monitored by a team of professionals.

Her skin is constantly painful and prone to severe blistering. As a result she finds it difficult to attend school or interact with other children. The nurse who coordinates her care team is concerned that Beca is having increasing difficulty with her breathing and that this might require medical intervention. She has decided to assess Beca's peak expiratory flow readings before making any recommendations.

Despite her difficult circumstances, Beca is always positive and keen to find out as much as she can about her condition and possible new treatments that might be available to her in the future.



Figure 3: Normal values for peak expiratory flow.
(Figures in brackets show normal range of readings.)

Age	Mean peak expiratory flow (Litres/min)	
	Boys	Girls
5	205.5 (+/- 20.5)	197.6 (+/- 19.8)
6	221.6 (+/- 22.2)	206.8 (+/- 20.7)
7	247.8 (+/- 24.8)	238.8 (+/- 23.9)
8	291.9 (+/- 29.2)	269.1 (+/- 26.9)
9	305.3 (+/- 30.5)	288.5 (+/- 28.9)
10	313.4 (+/- 31.3)	307.4 (+/- 30.7)

Figure 4: Beca's peak expiratory flow readings

Day	Peak expiratory flow (Litres/min)
1	220.5
2	231.8
3	217.4
4	219.3
5	221.4
6	206.7
7	215.7



4. EB is an inherited condition in humans. It is caused by a mutant recessive allele.

- (a) Two parents were non-sufferers of the disease. They had a child who had the disease. Using **E** for the dominant allele and **e** for the recessive allele, complete the genetic diagram below. [4]

Parent genotype:

Parent gametes:

Genotypes of all the possible offspring:

Phenotypes of all the possible offspring:

- (b) (i) The parents are expecting their second child. State the probability of this child having EB. [1]

.....

- (ii) EB is caused by a recessive allele.

Suggest why the number of people with EB is low. [2]

.....
.....



5. The apparatus below is used to obtain physiological measurements of lung function.



- (a) (i) Name this apparatus. [1]

.....

- (ii) Describe how this apparatus is used to collect measurements. [4]

.....

.....

.....

.....

.....

.....

- (b) Beca's nurse asked her to record her peak flow readings every day for a week. Use **Figure 3** and **Figure 4** to answer the following questions.

- (i) Calculate the normal range of readings the nurse would use to analyse Beca's results. [2]

range = ... to Litres/min

- (ii) State how Beca's readings compare to the normal range. [1]

.....

.....

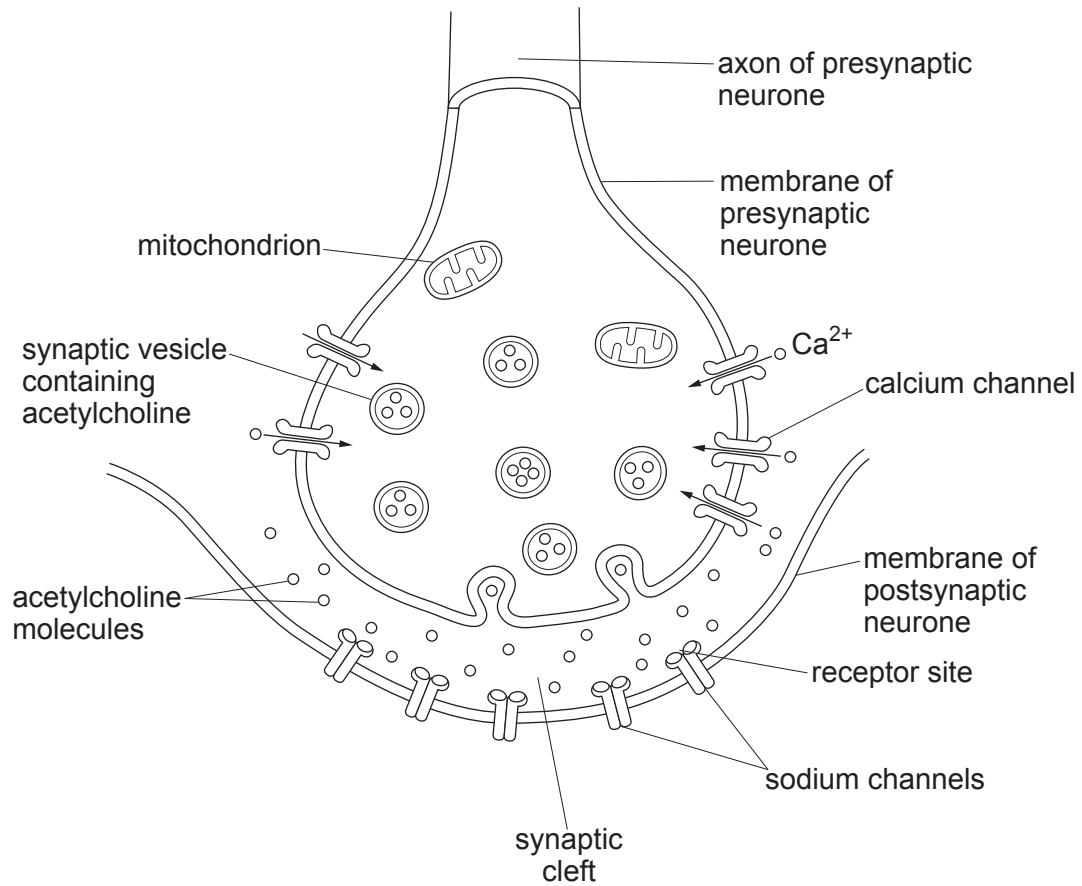
- (iii) Suggest what might be causing this change. [1]

.....

.....



6. EB sufferers often experience pain that is detected by the nervous system. The diagram shows a synapse in the nervous system.



- (a) The sequence of events that takes place at a synapse is given below but the stages are not in the correct order.

A – Acetylcholine molecules fuse with receptor molecules on the postsynaptic membrane. This allows sodium ions to diffuse across the membrane.

B – Calcium channels open and calcium ions enter the synaptic knob.

C – ATP released from mitochondria is used to store recycled acetylcholine into synaptic vesicles.

D – Influx of calcium ions causes synaptic vesicles to fuse with presynaptic membrane.

E – The enzyme acetylcholinesterase hydrolyses acetylcholine.

F – Acetylcholine diffuses across the synaptic cleft.

G – The influx of sodium ions generates a new action potential in the postsynaptic neurone.

Complete the boxes by placing the steps in the correct order.
Two have been done for you.

[4]

B						C
----------	--	--	--	--	--	----------

- (b) Beca will feel pain from her blisters because receptors in her skin send a nerve impulse to her brain which perceives the stimulus as pain.

New research has shown cannabinoids can block this stimulus by acting at a synapse.

Suggest **three** ways in which cannabinoids might affect synaptic transmission. [3]

1.
2.
3.

- (c) State **two** strategies to improve adherence to taking new medication. [2]

1.
2.



Case study 3: Anorexia

Nia's family had become increasingly concerned about her secrecy around eating and her weight loss. They noticed that she was obsessive about exercising and that she was beginning to lose her hair. Her mother noticed that her periods had stopped. They eventually persuaded her to see her GP who referred her to a psychiatrist. Whilst waiting for the psychiatrist's appointment, she suffered chest pains and was admitted to hospital. At this point her condition was taken very seriously and during a five-month stay in hospital, she gradually started the recovery process from anorexia.

Nia was encouraged to keep a diary of her feelings. Her food intake was carefully monitored and she was able to access therapy sessions for both herself and her family. Now, five years after her initial diagnosis, she has made a recovery. Her periods have started again. She has written a book about her experiences hoping that it may encourage others to have a positive self-image.



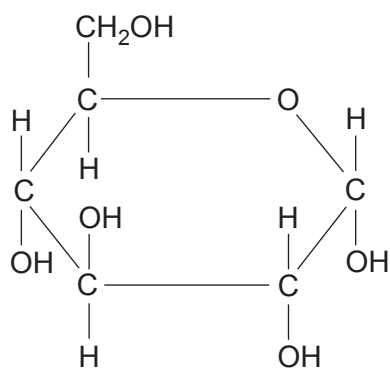
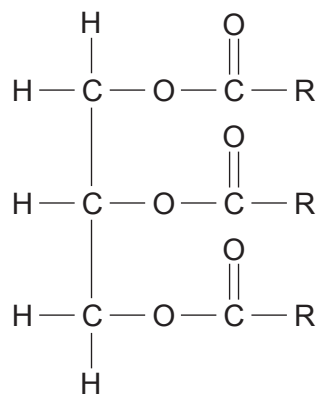
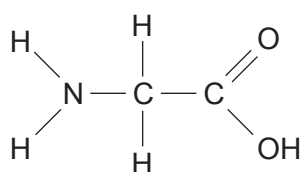
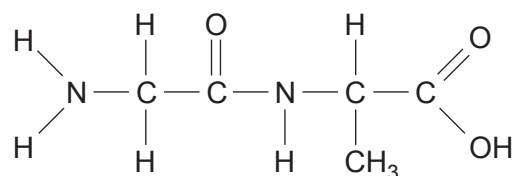
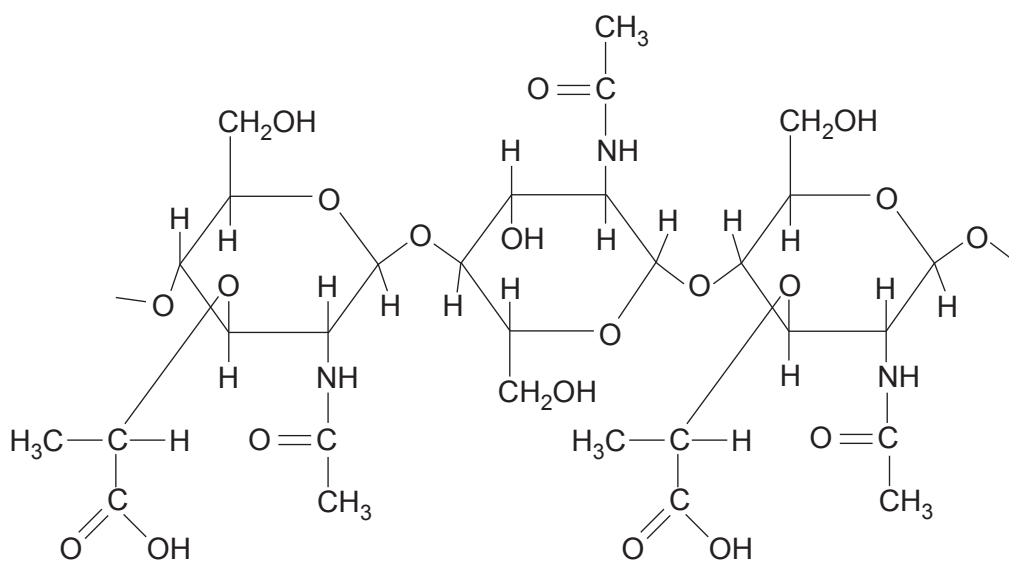
Figure 5: Biochemical molecules**A****B****C****D****E**

Figure 6: Extent to which individuals are likely to use social media to find information about anorexia

(Scale 1 – 10, where 1 is very unlikely and 10 is very likely)

Responses from individuals who have anorexia	Responses from individuals who do not have anorexia
4	7
3	1
5	6
7	3
9	7
8	1
2	2
10	1
6	4
3	6
9	5
1	7
7	6
2	1
2	1
Mean:	Mean: 3.9



7. A balanced diet provides the body with essential nutrients including proteins, carbohydrates, lipids, vitamins and minerals. Many anorexia sufferers try to eliminate lipids from their diet.

(a) State which of the molecules shown in **Figure 5** is a lipid. [1]

.....

(b) When a lipid molecule is broken down, name:

(i) the products formed [2]

.....

(ii) the type of bond broken [1]

.....

(c) Describe how the bond in 7(b)(ii) is broken. [1]

.....

.....

(d) State **three** essential roles of lipids in humans. [3]

1.

2.

3.



Describe the advantages and disadvantages of the following methods of administering medication:

[10]

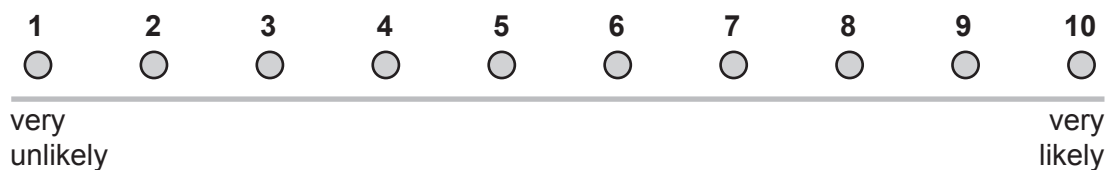
- oral
- intravenous injection
- topical



9. A group of therapists working with individuals with anorexia wanted to find out if social media platforms were influencing their lifestyle choices.

They compared information from two groups of individuals of a similar age. One group had anorexia and the other group did not.

Participants were asked to rate on a scale of 1–10 how likely they were to use social media to find out about anorexia.



Their responses are shown in **Figure 6**.

- (a) Calculate the mean value for the individuals with anorexia.

[1]

mean = ...

- (b) The data was analysed using a t-test and the value of t was 0.85.

Probability values for t-test

Degrees of freedom (df)	P values
	0.05
22	2.82
24	2.81
26	2.78
28	2.76
30	2.75

- (i) State the null hypothesis for this test.

[2]

.....

.....



- (ii) Using the calculated t value of 0.85 and the table of probability values, explain whether the null hypothesis is accepted or rejected for 28 degrees of freedom. [2]

.....

.....

.....

.....

- (iii) Suggest **two** limitations of this conclusion. [2]

1.

.....

2.

.....

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