Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Thursday 4 June 2020

Morning (Time: 1 hour 45 minutes) | Paper Reference **9BI0/01**

Biology B

Advanced

Paper 1: Advanced Biochemistry, Microbiology and Genetics

You must have:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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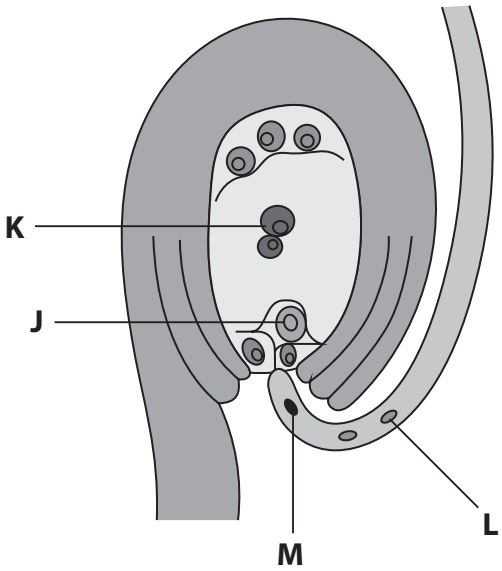
Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The diagram shows a pollen tube entering the embryo sac of a flowering plant.



Complete the table to give the name of each labelled structure and the number of sets of chromosomes that each structure contains.

(4)

Structure	Name of structure	Number of sets of chromosomes
J		
K		
L		
M		

(Total for Question 1 = 4 marks)

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2 The table shows two differences between blood plasma and tissue fluid.

Blood plasma	Tissue fluid
Has a higher protein content	Has a lower protein content
Contains more dissolved oxygen	Contains less dissolved oxygen

(a) State how tissue fluid is formed.

(1)

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(b) Explain the differences between blood plasma and tissue fluids shown in the table.

(2)

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(c) Some of the tissue fluid is not reabsorbed into the blood capillary.

Describe what happens to the tissue fluid that is not reabsorbed into the blood capillary.

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(Total for Question 2 = 5 marks)

3 Mosquitoes transmit a number of diseases, including malaria.

The photograph shows a mosquito, *Anopheles gambiae*.

This mosquito transmits malaria.

Source: © Sinclair Stammers / Science photo library

(a) (i) State the genus of this mosquito.

(1)

.....

(ii) Mosquitoes belong to the class Insecta.

Some of the insects in this class are subdivided into a group called Diptera.

What is the name of the classification group that includes Diptera?

(1)

☒ **A** Family

☒ **B** Genus

☒ **C** Order

☒ **D** Phylum

(iii) Which of the following organisms causes the symptoms of malaria?

(1)

☒ **A** *Anopheles gambiae*

☒ **B** *Plasmodium falciparum*

☒ **C** *Puccinia graminis*

☒ **D** *Salmonella enterica*

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(b) From 2010 to 2015 there was a 29% decrease in the number of deaths from malaria. This was due to prevention and control measures.

(i) Explain **one** implication of a named method of controlling malaria.

(2)

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(ii) In 2015, the number of deaths from malaria was 429 000.

Calculate the number of deaths from malaria in 2010.

(2)

Answer .....

(c) In 2015, the number of cases of malaria was 211 million. This increased to 216 million cases in 2016.

Give the change in the number of cases of malaria in standard form.

(1)

Answer .....

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(d) Scientists are researching new methods of controlling malaria.

One group used a procedure called gene drive.

This procedure resulted in female mosquitoes that could not bite or could not lay eggs.

One of the scientists said:

'It will still be at least 5 to 10 years before we consider testing any mosquitoes with gene drive, but now we have some encouraging proof that we're on the right path.'

Explain why this group are sharing the results of their research.

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(Total for Question 3 = 10 marks)

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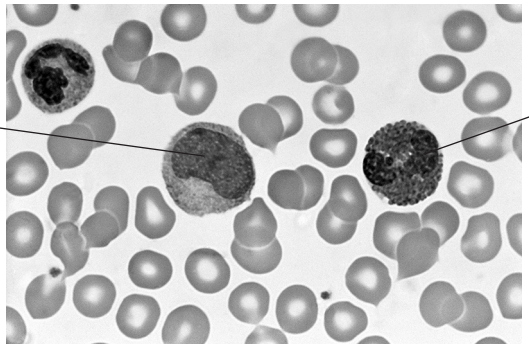
4 The photograph shows a blood smear from a healthy person, as seen using a light microscope.



Source: © biophoto associates/science photo library

(a) (i) Which row of the table identifies the cells labelled **J** and **K**?

(1)

	Cell J	Cell K
☒ **A**	eosinophil	lymphocyte
☒ **B**	lymphocyte	neutrophil
☒ **C**	monocyte	eosinophil
☒ **D**	neutrophil	monocyte

(ii) Which is the approximate ratio of erythrocytes to leucocytes in this blood smear?

(1)

☒ **A** 1 : 50

☒ **B** 3 : 50

☒ **C** 50 : 1

☒ **D** 50 : 3

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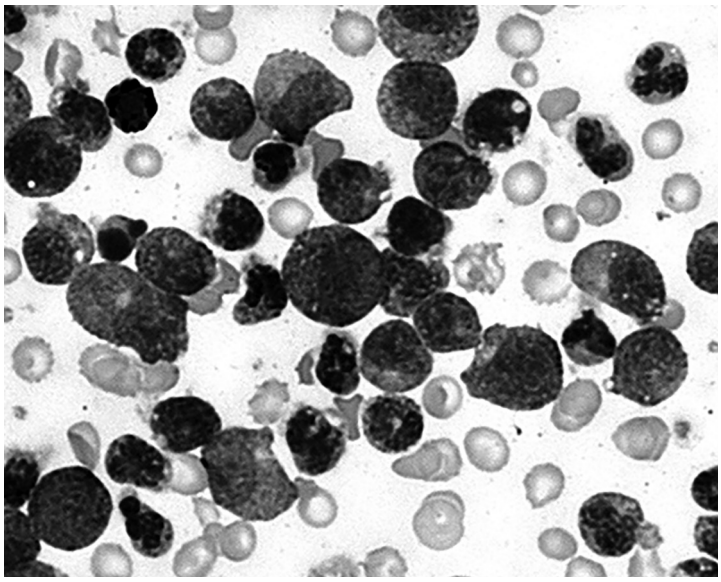
(b) Chronic myelogenous leukaemia (CML) is a blood disorder.

The photograph shows a blood smear from a person with CML, as seen using a light microscope.



Explain why a blood smear can be used to diagnose CML.

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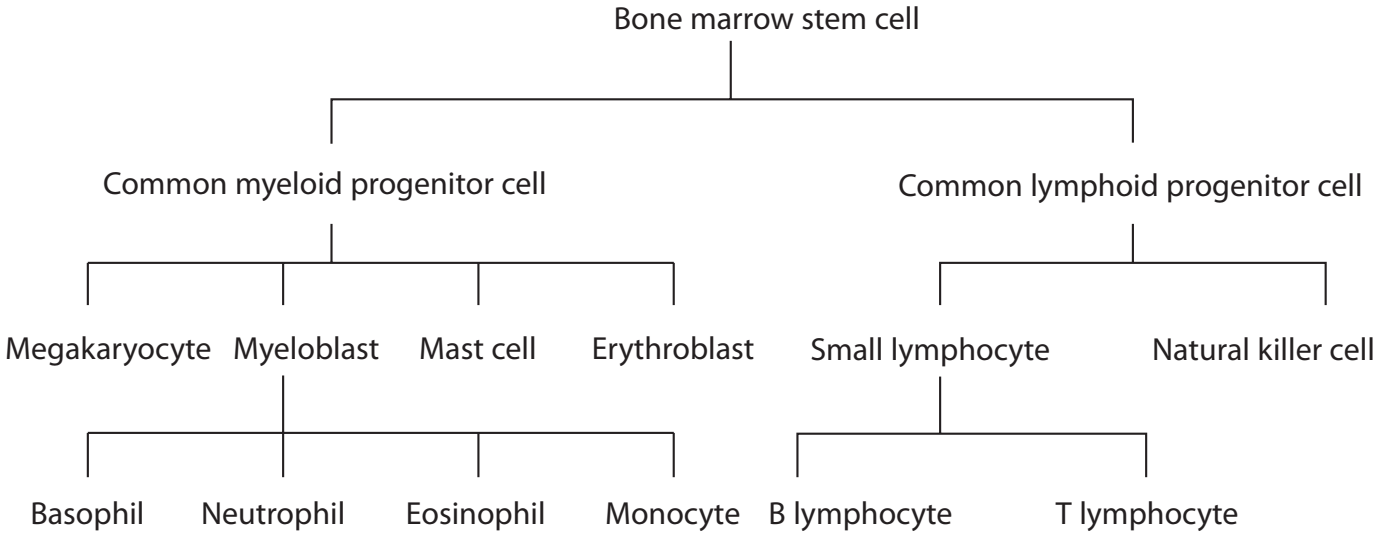
(c) The diagram shows some stages in the production of blood cells from bone marrow stem cells.



Explain how a bone marrow stem cell differentiates into either a common myeloid progenitor cell or a common lymphoid progenitor cell.

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(Total for Question 4 = 8 marks)

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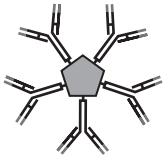
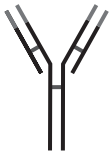
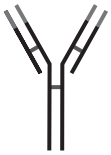
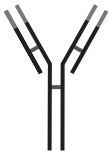
5 The rubella virus stimulates the production of antibodies in humans but usually causes only mild infections.

However, infection of pregnant women can cause serious problems for the developing fetus.

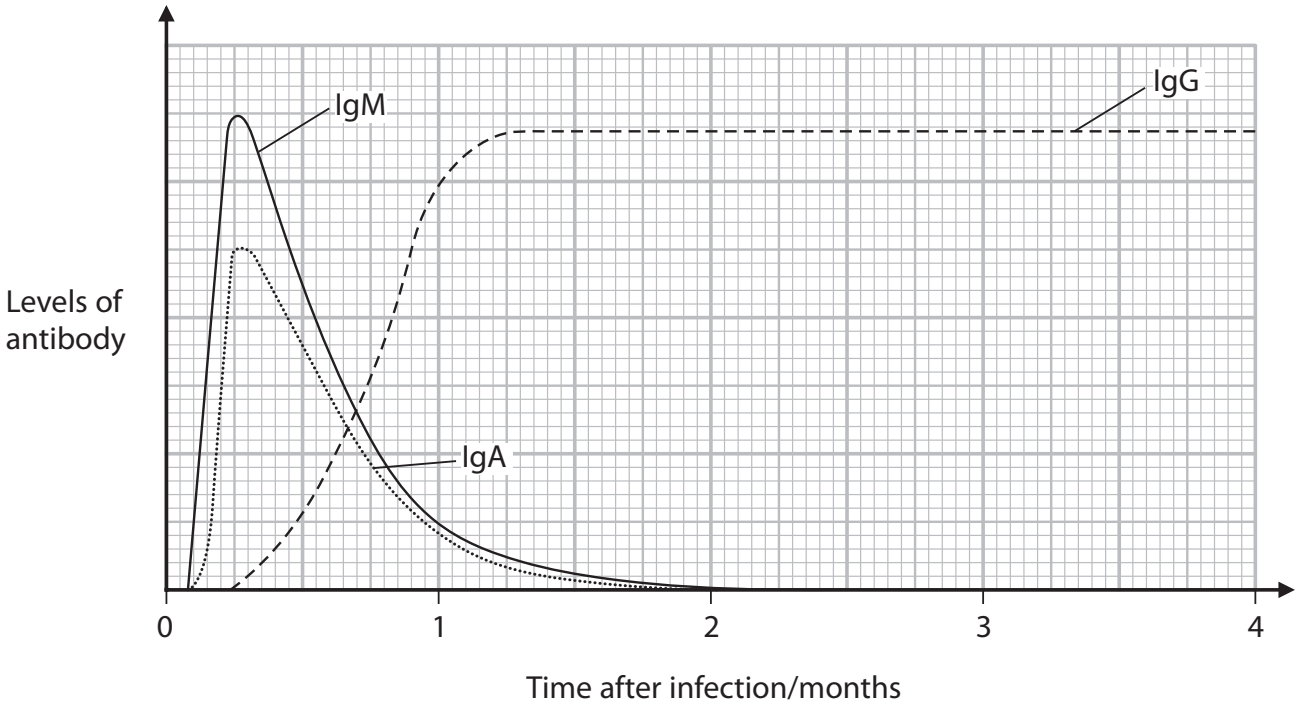
*(a) Antibodies can be divided into five classes.

The table gives some information about these classes of antibody.

Information	Class of antibody				
	IgM	IgA	IgG	IgD	IgE
Shape					
Number of antigen binding sites	10	4	2	2	2
Can cross the placenta	no	no	yes	no	no
Other details	secreted into the blood	secreted into mucus, tears, saliva, colostrum[1]	secreted into the blood	attached to the surface of B cells	involved in allergy and parasitic infections

[1] Colostrum is the first type of milk produced by the mother following birth.

The graph shows the levels of three of these classes of antibody produced in response to infection with the rubella virus.



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Analyse the information in the table and the graph to assess the role of these five classes of antibody in the immune response to the rubella virus.

(6)

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(b) Vaccination against rubella has helped to reduce the incidence of infection.

Explain the importance of vaccinating as many people as possible against rubella.

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(Total for Question 5 = 8 marks)

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6 Norovirus is a single-stranded RNA, non-enveloped virus.

Norovirus is the most common cause of gastroenteritis.

(a) The table shows some features used to classify viruses.

Which box in each row shows how these viruses are classified?

(3)

Virus	Classification of viruses			
	DNA enveloped	**DNA non-enveloped**	**RNA enveloped**	**RNA non-enveloped**
Ebola	☐	☐	☐	☐
λ (lambda) phage	☐	☐	☐	☐
Tobacco mosaic	☐	☐	☐	☐

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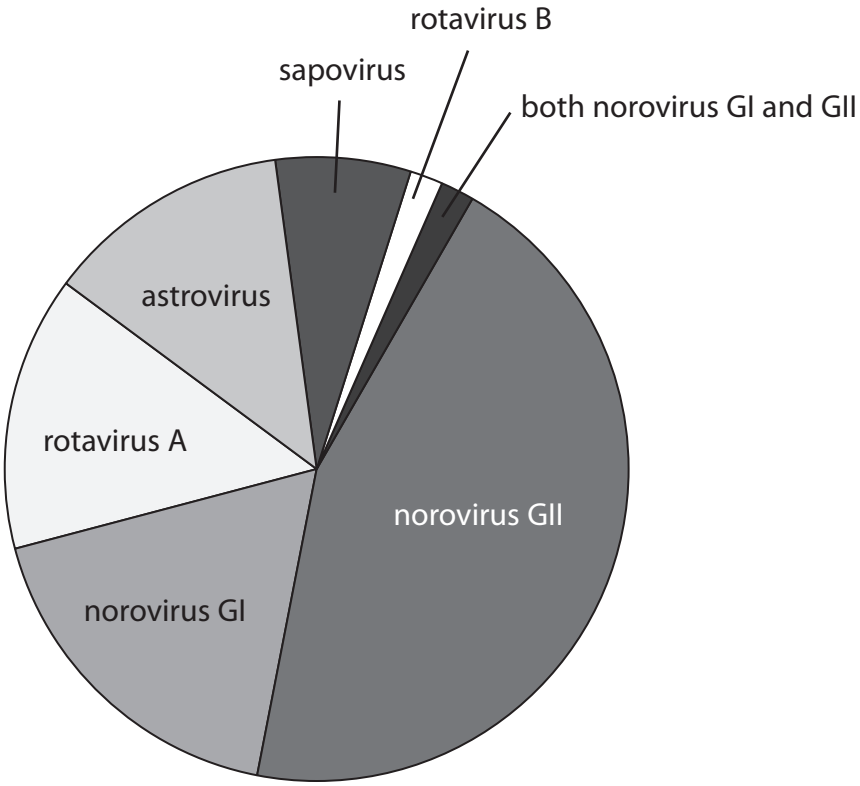
(b) One study into the causes of gastroenteritis involved 162 patients.

This study found that 24.7% of these gastroenteritis cases were caused by viruses.

The pie chart shows the proportion of the different types of virus identified as causing these gastroenteritis cases.



Estimate the total number of gastroenteritis cases caused by noroviruses.

(3)

Answer .....

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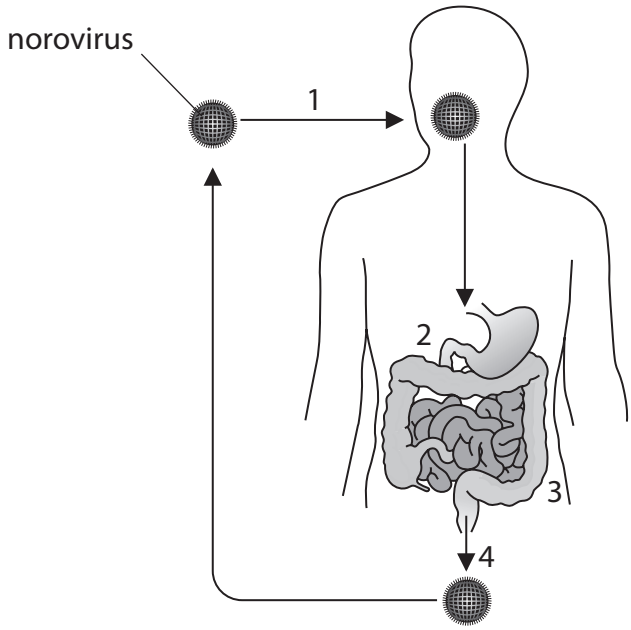
(c) Norovirus is usually spread through the faecal-oral route.

The diagram shows the pathway that norovirus takes through the body.



1 The norovirus is transmitted in contaminated food or water.

2 The norovirus passes through the stomach and into the small intestine.

3 Some noroviruses are taken up by the cells of the small intestine.

4 Some noroviruses pass out of the body in the faeces.

This process only takes a few hours.

Describe what happens inside the cells of the small intestine that have taken up the norovirus.

(3)

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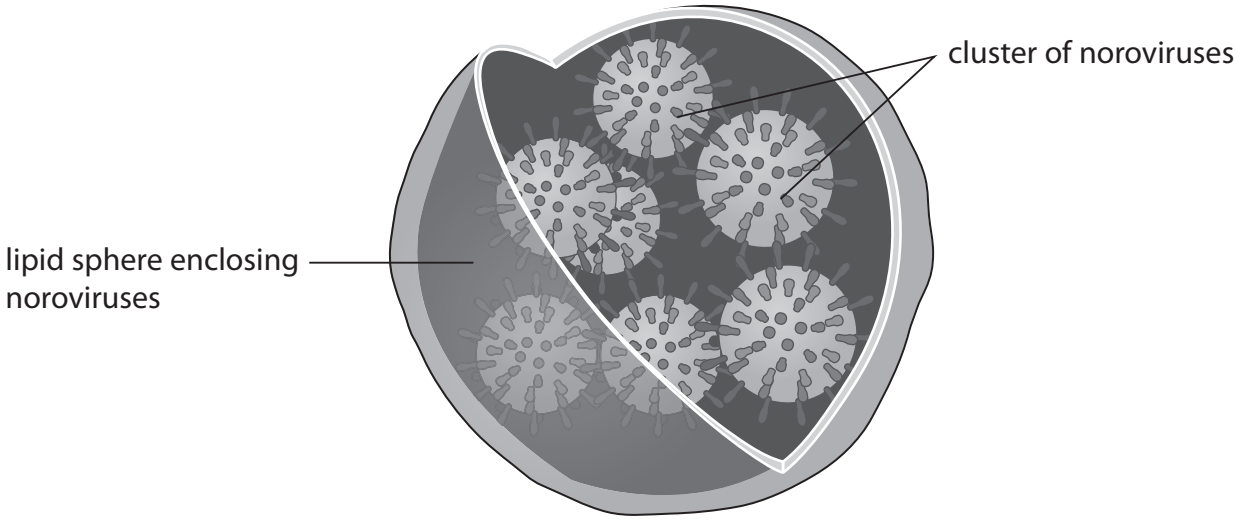
(d) Noroviruses can infect an animal as individual viruses or as a cluster of viruses inside a lipid sphere.

A cluster of viruses inside a lipid sphere is called a stealth sphere.

The diagram shows a stealth sphere.



(i) Animals infected with stealth spheres develop gastroenteritis very quickly and with severe symptoms.

Animals infected with individual noroviruses develop gastroenteritis more slowly and with less severe symptoms.

Analyse the information to explain these findings.

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(ii) Scientists are hoping that new treatments for norovirus infections can be developed to target the stealth sphere.

Analyse the information to explain how targeting the stealth sphere could be used to treat these infections.

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(Total for Question 6 = 14 marks)

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7 Lipids and carbohydrates are used as respiratory substrates.

The respiration of lipids generates more ATP than the respiration of carbohydrates.

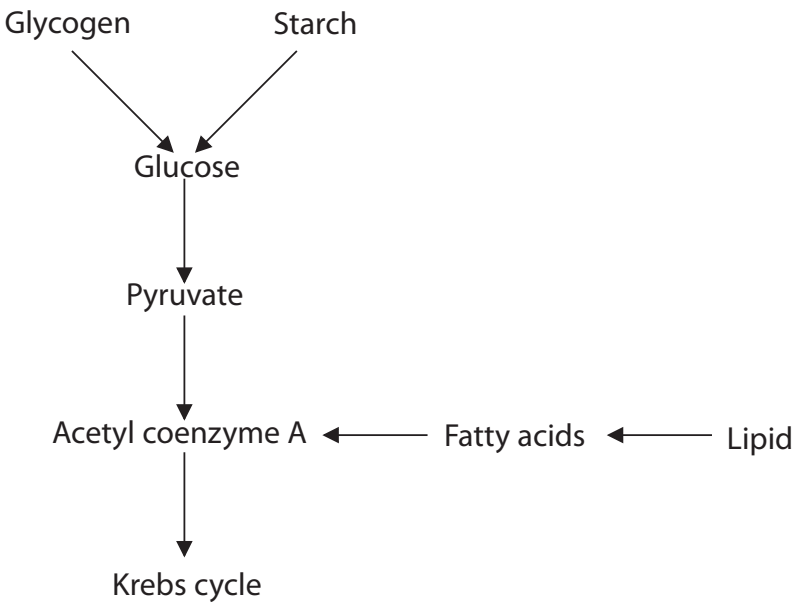
(a) The table shows bonds that may be found in carbohydrates and lipids.

Which box in each row shows whether the bond may be found in these molecules?

(3)

Bond	Molecule that bond may be found in			
	carbohydrate only	**lipid only**	**both carbohydrate and lipid**	**neither carbohydrate nor lipid**
covalent	☒	☒	☒	☒
ester	☒	☒	☒	☒
hydrogen	☒	☒	☒	☒

(b) The diagram shows some steps in the respiration of carbohydrates and lipids.



(i) Where in a cell does the conversion of pyruvate to acetyl coenzyme A take place?

(1)

☒ **A** cytoplasm

☒ **B** matrix

☒ **C** stroma

☒ **D** tonoplast

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(ii) Explain why lipids can be respired only in aerobic conditions.

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(c) The electron transport chain uses hydrogen ions to generate ATP.

Explain why the respiration of lipids generates more ATP than the respiration of carbohydrates.

(2)

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(d) The respiratory quotient (RQ) can indicate which substrate is being used in respiration.

The formula used to calculate RQ is

$$RQ = \frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen used}}$$

(i) State why the RQ for carbohydrate is 1.0.

(1)

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(ii) The table shows the formula for calculating the volume of oxygen used and the volume of carbon dioxide produced in the respiration of lipids.

The number of carbon atoms in the lipid is represented by n.

Volume of oxygen used / a.u.	Volume of carbon dioxide produced / a.u.
4.5n + 3.75	3n + 6

Calculate the RQ for a lipid containing 21 carbon atoms.

(2)

Answer .....

(e) Explain why an insect has an RQ of 1.0 at rest and an RQ of 0.7 during flight.

(3)

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(Total for Question 7 = 15 marks)

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8 Skin flora include bacteria that live on the skin.

Different parts of the body have different types of bacteria present.

Skin flora are beneficial as they inhibit the growth of pathogenic bacteria on the skin.

Skin flora compete for nutrients and space or secrete toxic chemicals.

(a) The following are types of bacteria found in the female genital tract:

- *Escherichia coli*
- *Klebsiella* species
- *Lactobacillus* species
- *Staphylococcus* species.

(i) Describe how these types of bacteria present in the female genital tract could be identified.

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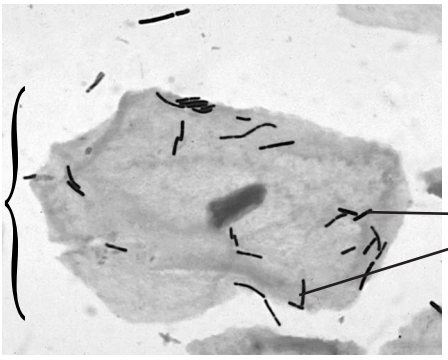
(ii) The photograph shows *Lactobacilli* on a skin cell from the female genital tract.



Source: © Janice Carr Content Providers (s): CDC/Dr. Mike Miller

Lactobacilli metabolise glycogen into lactic acid.

Explain how *Lactobacilli* inhibit the growth of pathogenic bacteria in the female genital tract.

(3)

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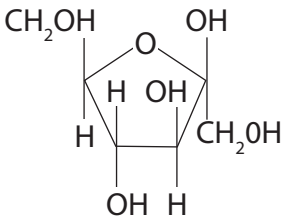
(b) Sperm cells are released into the female genital tract in seminal fluid.

Seminal fluid contains fructose instead of glucose.

The diagram shows the structure of fructose.



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(i) Compare and contrast the structure of fructose with the structure of glucose.

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(ii) Explain the advantages of the presence of fructose in seminal fluid.

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(Total for Question 8 = 13 marks)

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9 The photograph shows a wombat, an animal that lives in dry parts of Australia.

Source: © Blue Gum Pictures/Alamy Stock Photo

Wombats are herbivores, feeding on grasses, leaves and bark. Wombats also dig in the soil for roots.

They have behavioural and physiological adaptations to survive periods of severe drought.

The effect of drought on the health of wild wombats was investigated.

Changes in body mass, body condition and the chemical constituents of stomach contents and faeces were recorded.

These changes were related to the changes in the quality and quantity of the food of wombats.

(a) Explain why drought affects the quality and quantity of the food of wombats.

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(b) The table shows some of the measurements made in this investigation.

Measurement	Before drought	10 months into drought	14 months into drought	2 months after rain
Body condition index	.....	0.86	0.76	0.85
Body mass / kg	26.4	25.1	21.2	25.2
Organic matter in stomach / g kg^{-1} dry matter	946	732	704	822
Mineral ion content in stomach	low	high	high	low
Moisture content of faeces / g kg^{-1} wet mass	815	603	522	748

(i) The body condition was expressed as a body condition index (BCI).

The BCI can be calculated using the formula

$$\text{BCI} = \frac{\text{body mass of wombat}}{\text{mass-for-length of wombat (Y)}}$$

The mass-for-length (Y) of a wombat can be calculated using the formula

$$Y = (\text{body length} \times 0.73) - 34.5$$

A wombat before the drought had a body length of 86.4 cm and a mass of 26.4 kg.

Calculate the BCI of this wombat.

(2)

Answer .....

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*(ii) Analyse the data to explain the results of this investigation.

(6)

(Total for Question 9 = 13 marks)

TOTAL FOR PAPER = 90 MARKS

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