

AQA – Cells – A2 Biology

1. No.1

0	1	.	1
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Give the **three** structural features found in **all** virus particles **and** describe the function of **one** of these features.

[2 marks]

1 _____

2 _____

3 _____

Function of **one** named feature _____

0	1	.	2
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Explain why viruses are described as acellular and non-living.

[2 marks]

0	1	.	3
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Give **one** reason why antibiotics are **not** effective against viruses.

[1 mark]

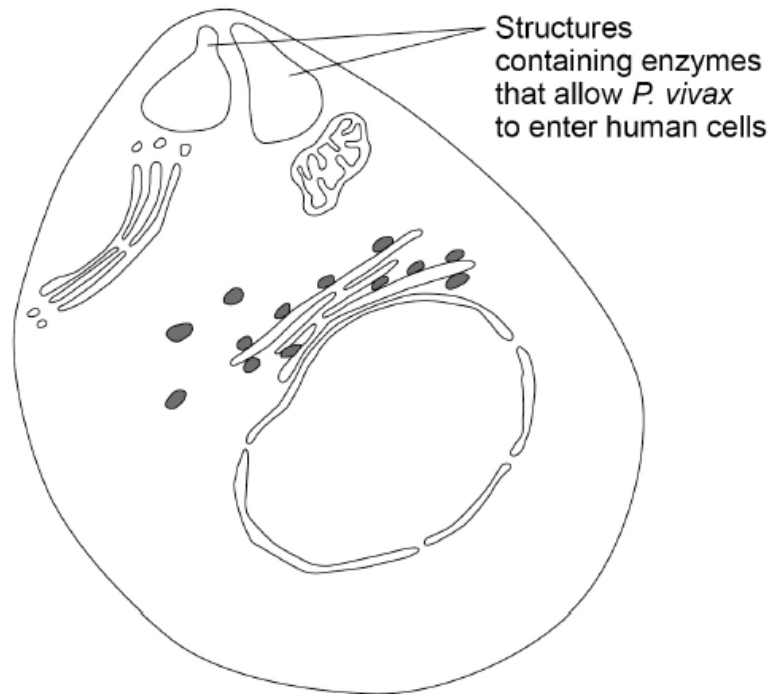
2. No.3

0 3 . 1

The human disease, malaria, is caused by infection with a single-celled eukaryotic organism.

Figure 2 shows a diagram of *Plasmodium vivax*, one of the species that can cause malaria.

Figure 2



Other than the Golgi apparatus, name **one** structure in **Figure 2** which shows that *P. vivax* is a eukaryote.

[1 mark]

0 3 . 2

Describe **two** functions of the Golgi apparatus in a eukaryotic cell.

[2 marks]

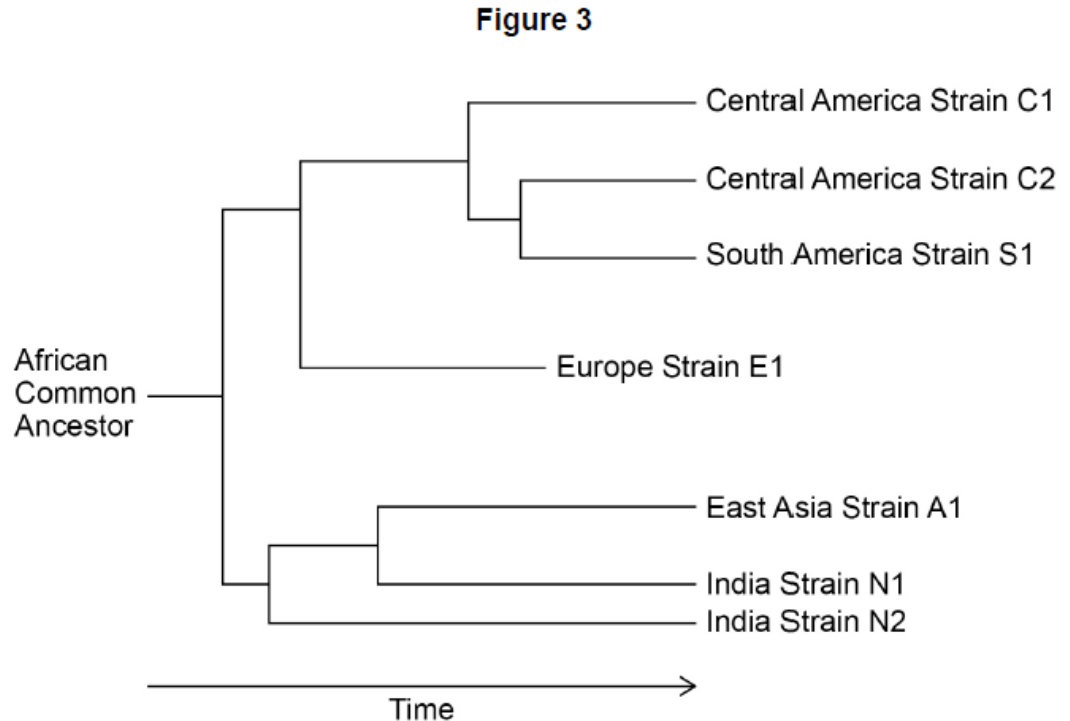
1

2

P. vivax evolved from a common ancestor in Africa. As humans migrated around the world, new strains of *P. vivax* evolved.

P. vivax is now extremely rare in Africa but there are several different strains of *P. vivax* in other parts of the world.

Figure 3 shows a phylogenetic diagram of the evolution of these different strains.



0 3 . 3 What does **Figure 3** suggest is the order of human migration out of Africa?

Tick (✓) **one** box.

[1 mark]

Europe, India, East Asia, Central America, South America

☐

India, East Asia, Europe, South America, Central America

☐

India, Europe, East Asia, Central America, South America

☐

South America, Central America, East Asia, Europe, India

☐

[1 mark]

Answer cases of malaria

0	3	.	5
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[4 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

3. No.9

0 9

Dengue fever is a human disease caused by the dengue virus.

Scientists designed an ELISA test to detect antibodies to the dengue virus in a patient's blood sample.

Figure 10 shows a diagram of this test and some information about how it works.

Figure 10

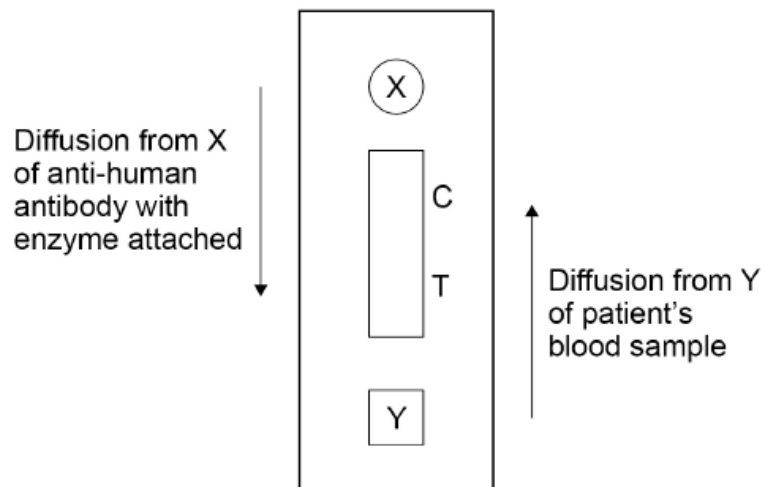
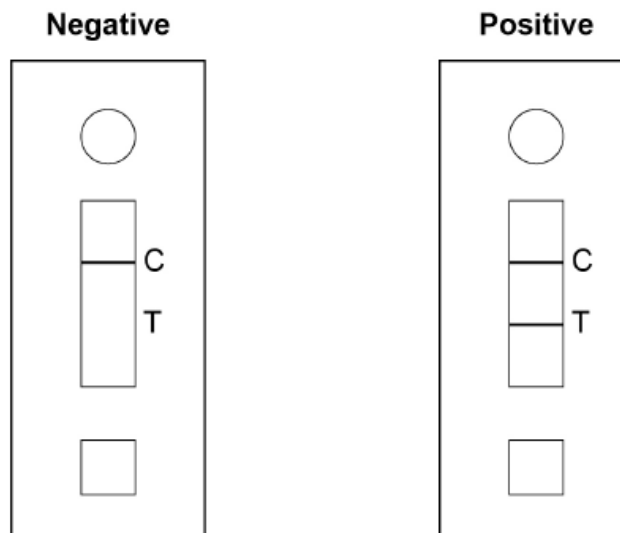


Figure 11 shows the negative and positive results that were produced 20 minutes after the use of the test shown in Figure 10.

Figure 11



09.1

Suggest what is on the test at line **T** and explain what causes the line to appear in a positive test.

[2 marks]

09.2

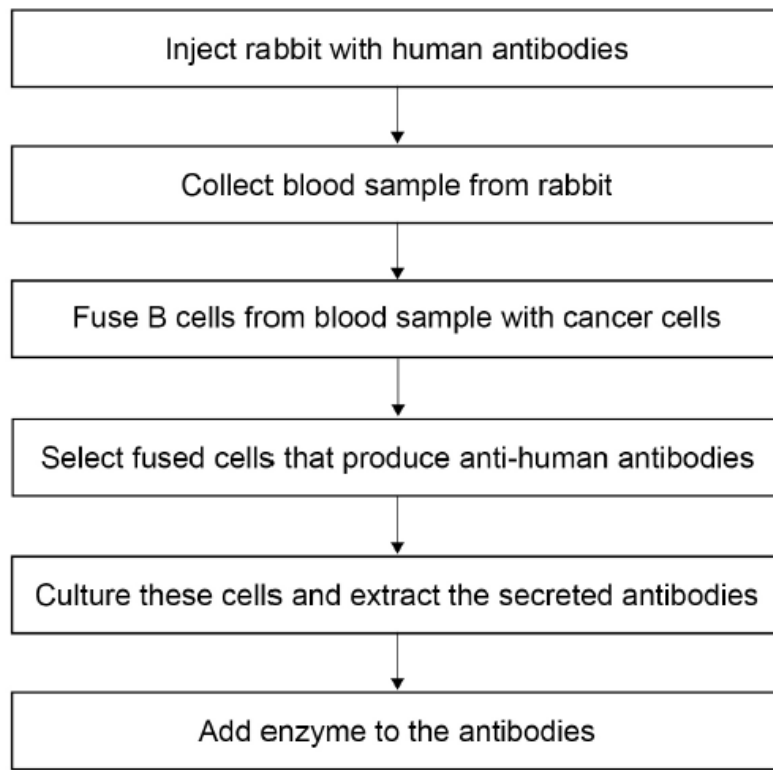
A line at **C** shows that the test has worked.

Suggest **one** reason why a line at **C** shows the test has worked.

[1 mark]

Figure 12 shows a flowchart of how the anti-human antibodies with enzyme attached are produced.

Figure 12



09.3

Suggest why the fused cells allow continuous production of monoclonal antibodies.

[2 marks]

09.4

Evaluate the ethics of the production process shown in **Figure 12**.

[1 mark]

Early identification of dengue fever can be difficult as many other diseases produce the same symptoms. Early identification is important because people suffering with dengue fever can become ill very quickly and may need hospital treatment.

Scientists compared the effectiveness of three diagnostic tests for dengue fever.

- Laboratory-based test – a patient's blood sample is sent from the doctor's clinic to a laboratory for testing.
- Current test used in the doctor's clinic.
- New test to be used in the doctor's clinic – the ELISA test shown in **Figures 10 and 11** (on page 24).

The scientists' results are shown in **Table 3**.

A blood sample from each patient with confirmed dengue fever at each time after onset of symptoms was tested with all three diagnostic tests.

Table 3

Time after onset of symptoms / days	Number of confirmed dengue fever patients tested	Number of positive results		
		Laboratory-based test	Current test	New test
1–2	14	10	0	6
3–4	38	28	6	24
5–7	18	8	14	14

09.5

The scientists recommend that the new test is used for the identification of dengue fever in all countries around the world.

Discuss this recommendation. Use all the information given.

[3 marks]

09.6

The dengue virus causes damage to capillaries so that blood proteins move out of the capillaries into the tissue fluid.

Explain how this would affect the return of tissue fluid into the capillaries.

[2 marks]

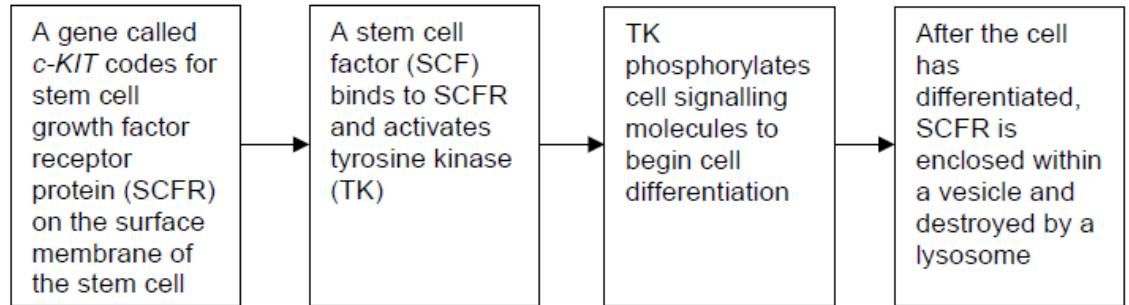
4. No.4

0	4
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Following a body injury, bone marrow stem cells move to the site of damage and undergo cell differentiation.

Figure 5 shows how this differentiation occurs.

Figure 5



0	4
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1

Suggest how SCFR is destroyed by a lysosome.

[2 marks]

After a heart attack, cardiomyocytes (cardiac muscle cells) die, and become infarcted tissue. Infarcted tissue cannot contract.

Stem cells in bone marrow **cannot** move to the infarcted tissue and differentiate into cardiomyocytes.

Scientists used laboratory rats to investigate if bone marrow stem cell transplants could be used to repair infarcted tissue resulting from a heart attack.

They split the rats into three groups.

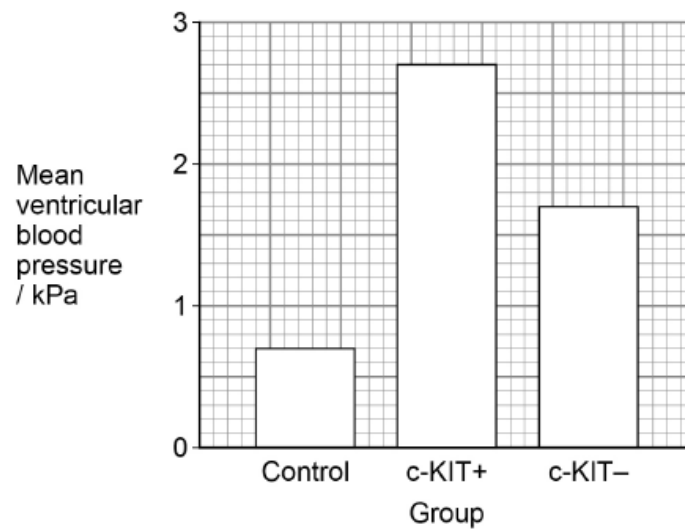
- **Control** group did not get a transplant of bone marrow stem cells.
- **c-KIT+** group got a transplant of bone marrow stem cells with a functioning *c-KIT* gene.
- **c-KIT–** group got a transplant of bone marrow stem cells with **no** functioning *c-KIT* gene.

After 9 days, the scientists measured the mean ventricular blood pressure of each of the three groups.

Figure 6 shows their results.

The differences between the groups were all statistically significant.

Figure 6



0 4 . 2

Using all of the information, suggest explanations for the results for the **Control** group and the **c-KIT-** group shown in **Figure 6**.

[4 marks]

Control _____

c-KIT- _____

0 4 . 3

Nine days after transplantation, the **c-KIT+** group showed that 68% of infarcted tissue was made up of new cardiomyocytes. The control group had **no** new cardiomyocytes.

Assuming that mean ventricular blood pressure is directly proportional to the number of cardiomyocytes, calculate the percentage of infarcted tissue that was made up of new cardiomyocytes in the **c-KIT-** group.

[2 marks]

Answer _____ %

All new cardiomyocytes produced:

- Connexin-43, a channel protein that allows electrical impulses to pass between cardiomyocytes
- GATA-4, a transcriptional factor that stimulates the expression of genes for actin and myosin.

0 4 . 4

Suggest how production of Connexin-43 and GATA-4 could give the result seen in the **c-KIT+** group in **Figure 6** (on page 13).

Do **not** include details of transcription or translation in your answer.

[2 marks]

Connexin-43 _____

GATA-4 _____

5. No.6

0 6 . 1

Give **two** types of cell that can stimulate an immune response.

[2 marks]

- 1 _____
- 2 _____

An autoimmune disease causes the immune system to attack healthy body tissues. Scientists investigated the immune responses of healthy mice and mice with autoimmune disease.

The chemical OXA causes an immune response in mice and can make their skin swell. Mice had olive oil applied to their left ear and OXA in olive oil applied to their right ear.

The immune response was recorded in two ways:

- the cellular response by measuring the mean increase in ear thickness 24 hours after exposure to OXA
- the humoral response by measuring the mean concentration of anti-OXA antibody in blood 14 days after exposure to OXA.

Table 2 shows the results of this investigation. The values in the brackets show ± 2 standard deviations. A value of ± 2 standard deviations from the mean includes over 95% of the data.

Table 2

Type of mice	Sex of mice	Mean increase in ear thickness / $\text{cm} \times 10^{-3}$	Mean concentration of anti-OXA antibody / arbitrary units
Healthy	Male	17.9 (± 4.1)	16 (± 3)
	Female	18.5 (± 2.9)	14 (± 4)
Autoimmune disease	Male	25.9 (± 4.5)	14 (± 2)
	Female	16.7 (± 3.0)	26 (± 7)

0 6 . 2

Suggest and explain **one** reason why olive oil was applied to the left ear of the mice.

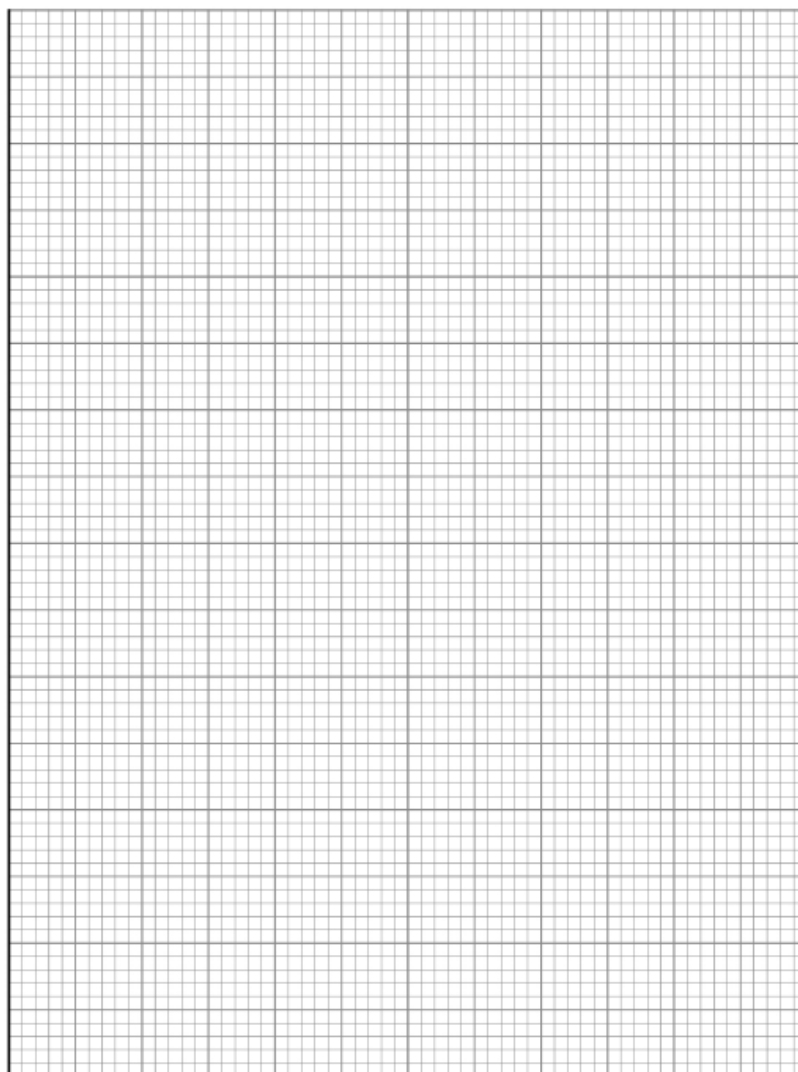
[1 mark]

06.3

Plot a suitable graph for mean increase in ear thickness for each group of mice in Table 2.

Include the data for ± 2 standard deviations on your graph.

[3 marks]



06.4

What can you conclude about the effects of autoimmune disease on the cellular response and the humoral response in male and female mice?

Use the data to justify your conclusions.

[3 marks]

0	6	.	5
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Some studies have shown that in humans, oestrogen has the opposite effect on two different autoimmune diseases. Oestrogen:

- accelerates the progression of systemic lupus erythematosus (SLE)
- prevents the progression of rheumatoid arthritis (RA).

The scientists investigated the effect of oestrogen on the immune response in healthy mice and mice with autoimmune disease.

Table 3 shows the scientists' results.

Table 3

Type of mice	Effect of oestrogen on humoral response	Effect of oestrogen on cellular response
Healthy	No effect	No effect
Autoimmune disease	Increase in response	Decrease in response

A student studying these data made the following conclusions.

1. In humans, SLE is caused by an overproduction of antibodies.
2. In humans, RA is caused by an overproduction of cytotoxic T cells (T_C cells).

Evaluate the student's conclusions.

[4 marks]

[illegible]

0 6 . 6

In mice, one type of autoimmune disease is inherited as a dominant allele. Would the Hardy–Weinberg principle hold true for a population of mice, some of which had this autoimmune disease?

Explain your answer.

[2 marks]

6. No.7(7.2)

0 7

Write an essay on **one** of the topics below.

0 7 . 2

The importance of membranes in the functioning of cells.

[25 marks]
