OCR
Oxford Cambridge and RSA

AS Level Biology B (Advancing Biology)

H022/02 Biology in depth

Monday 4 June 2018 – Afternoon

Time allowed: 1 hour 30 minutes

*7 0 9 2 2 8 2 7 8 6 *

You may use:
- a scientific or graphical calculator
- a ruler (cm/mm)

*H 0 2 2 0 2 *

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **20** pages.

Answer **all** the questions.

1 The yellow fever mosquito, *Aedes aegypti*, is one of the vectors responsible for transmitting pathogenic viruses such as the Zika virus.

Fig. 1 is a diagram of a cell from *A. aegypti* during prophase of mitosis.

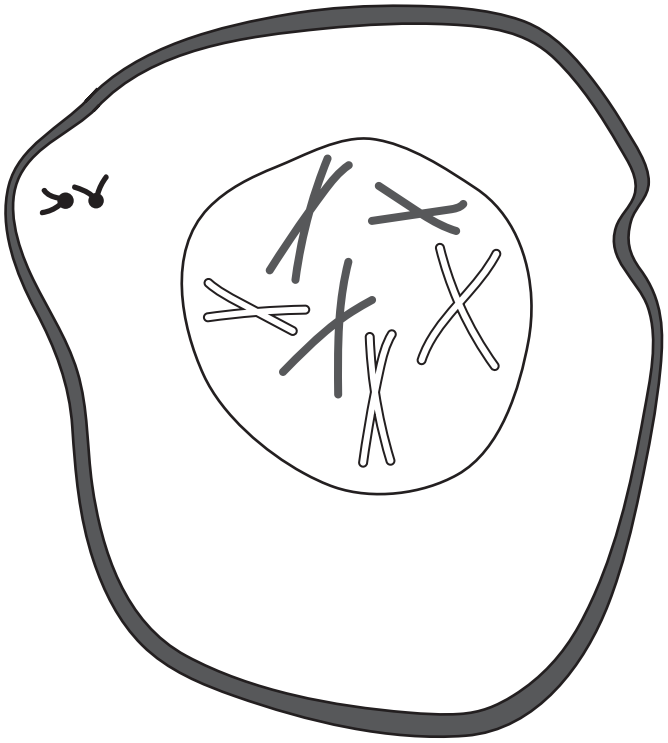
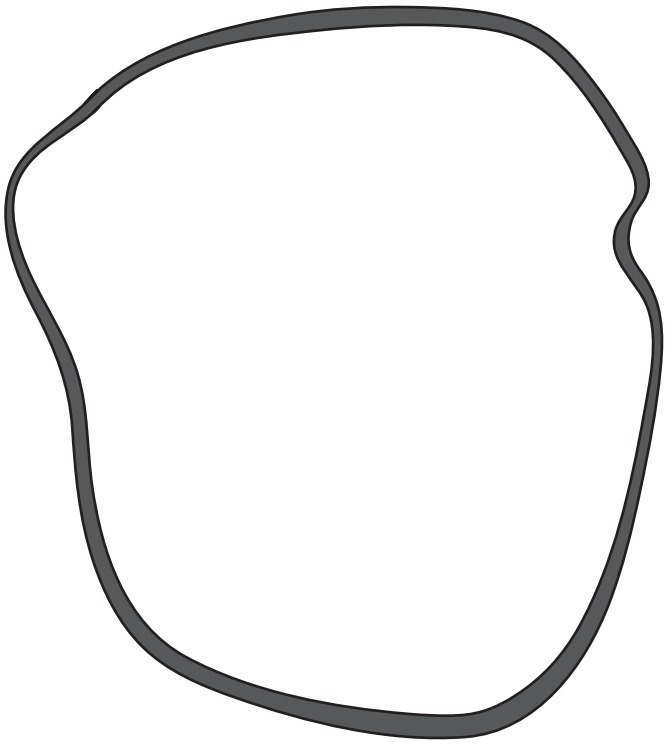


Fig. 1

(a) (i) Using the information in Fig. 1 complete and label the diagram in the space below to show the cell during **metaphase** of mitosis.



[3]

(ii) Using Fig. 1 state the number of chromosomes that would be found in the following cells taken from *A. aegypti*.

A stem cell .....

A sperm cell (gamete) ..... **[1]**

(iii) Cells that develop mutations in DNA during the cell cycle can be destroyed to prevent the replication of damaged cells.

Name the process by which damaged cells are destroyed.

..... **[1]**

(b) After fertilisation, female mosquitoes lay their eggs directly into the external environment.

Suggest **one** disadvantage to the embryo of developing inside eggs laid into the external environment.

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..... **[1]**

(c)* Stem cells removed from *A. aegypti* embryos have been used in scientific research to develop potential strategies for limiting the transmission of the Zika virus.

Discuss the potential uses for **human** embryonic stem cells taking into account any concerns that could arise by using these cells for research purposes.

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2 A rapid heart rate reduces the volume of oxygen reaching the cardiac muscle of the heart. This can lead to chest pain known as angina.

Digoxin is a drug that can be used to treat angina by reducing the resting heart rate.

A study into the effect of digoxin on heart rate was carried out on a group of patients being treated for angina.

The resting heart rates of these patients were recorded before starting treatment and then again after eight weeks of treatment with digoxin.

(a) (i) Explain why it is important to record the resting heart rates of patients before starting treatment with digoxin.

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..... **[1]**

(ii) State one variable that would need to be taken into account when conducting this study.

..... **[1]**

Fig. 2 shows the results for one of the patients in this study.

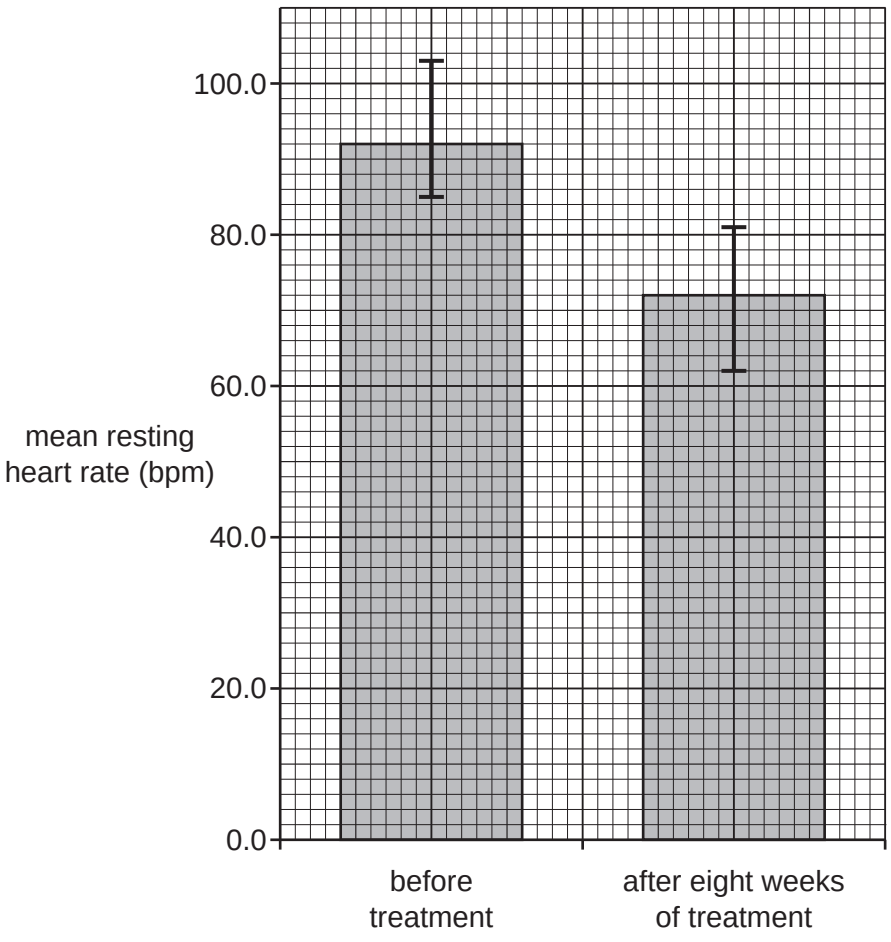

Fig. 2

(iii) Using Fig. 2, state the range in the resting heart rates for this patient before **and** after eight weeks of treatment with digoxin.

Before treatment .....

After eight weeks of treatment .....
[1]

(iv) Calculate the percentage change in the **mean** resting heart rates of this patient.

..... **[2]**

(b) Digoxin may reduce resting heart rate by acting on the atrioventricular node (AVN).

(i) What is the role of the AVN in coordinating the heart action?

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(ii) Suggest how the action of digoxin on the AVN could lead to a decrease in resting heart rate and how this could affect cardiac function.

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3 Quinine is a drug that occurs naturally in the bark of cinchona trees. It is used to treat malaria caused by the parasite, *Plasmodium falciparum*, which infects human erythrocytes.

- The medicinal properties of cinchona bark were first realised by the Quechua people of South America.
- The use of cinchona bark in treating fever was documented in Europe during the 17th century.
- In the 1800s, researchers isolated quinine from cinchona bark and identified it as the medicinally active compound.

(a) (i) Suggest why researchers concentrated on studying cinchona bark when looking for a treatment for malaria.

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..... **[2]**

(ii) Quinine interferes with the ability of *P. falciparum* to completely digest haemoglobin resulting in the death of the parasite.

Suggest how incomplete digestion of haemoglobin results in the death of *P. falciparum*.

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(b) Quinine has been used to treat muscle cramps associated with a neurological condition known as restless leg syndrome. A clinical trial to assess the effectiveness of quinine in treating restless leg syndrome was carried out on a large number of volunteers divided into two groups. One group was given oral quinine and the other group was given a placebo.

(i) Explain what is meant by a placebo in this context.

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..... **[1]**

(ii) Describe how the volunteers could have been allocated to each group for this trial.

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..... **[2]**

(c) The dose required to treat a patient with malaria using oral quinine is 10 mg kg^{-1} every eight hours.

Calculate the mass of quinine required in the first four days of treatment for a patient who weighs 75 kg.

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Turn over for the next question

4 Following the injection of a vaccine the antibody concentration in the blood changes.

Fig. 4 shows the concentration of antibody in the blood of an individual following a BCG vaccination for tuberculosis (TB).

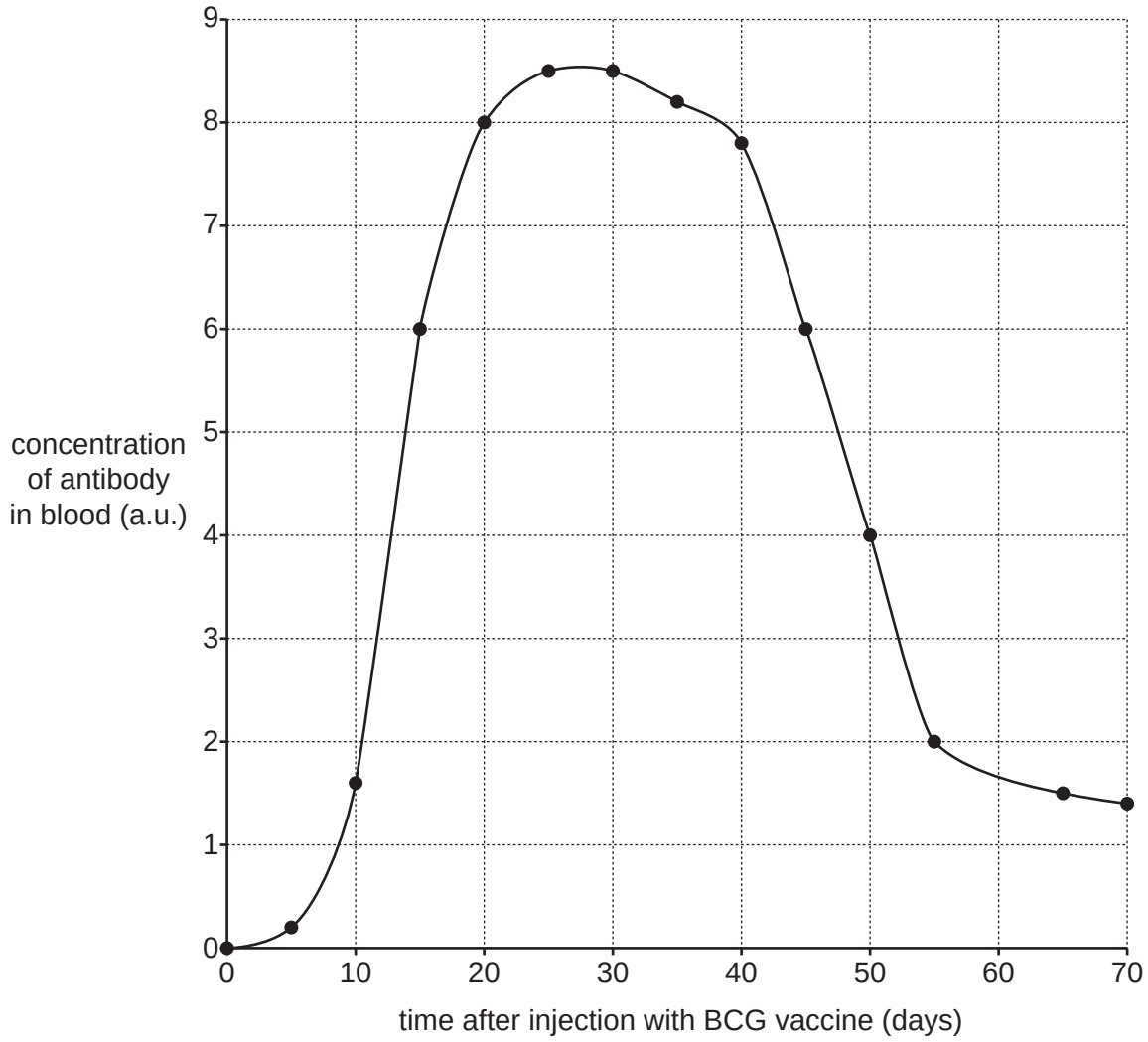

Fig. 4

(a) Describe **and** explain the pattern in the data shown in Fig. 4.

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..... **[4]**

(b) The BCG vaccination can be given to babies and young children considered to be at high risk of contracting TB.

- In 2004, approximately 95 000 babies born in the UK were considered at high risk of contracting TB.
- Only 84 300 of these babies under one year old received the BCG vaccine.
- The BCG vaccine is estimated to be around 74% effective against TB when administered before a baby is one year old.

Using this information, calculate the percentage of babies who would still have been at high risk of contracting TB.

Give your answer to **two** significant figures.

..... **[2]**

(c) Complete the table below by indicating which of the statements about different types of immunity are true (T) or false (F).

Statement	True (T) or False (F)
An injection of antibodies against the rabies virus will provide artificial active immunity.	
A person recovering from an infection of measles will have natural active immunity to the measles virus.	
A breast-fed baby receiving maternal antibodies will have natural passive immunity.	

[2]

(d)* When certain types of pathogen enter the body they trigger a specific immune response.

Compare the roles of B and T lymphocytes in the specific immune response.

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5 Glucose is produced by plants during photosynthesis. It can be combined with fructose to form the disaccharide sucrose, which can then be transported to other tissues inside the plant.

Fig. 5 is a diagram of glucose and fructose.

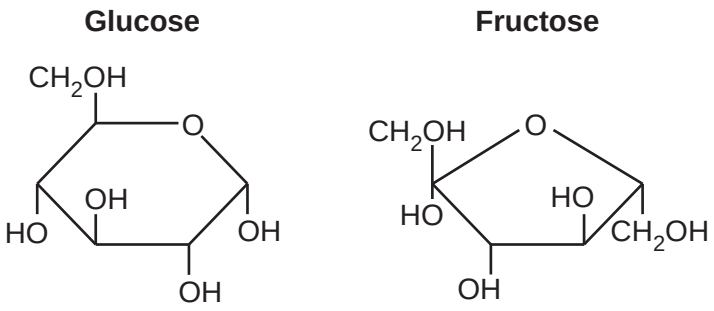

Fig. 5

(a) Using the information in Fig. 5, draw a diagram of a sucrose molecule in the space below.

[2]

(b) A student used the following procedure to test different organs from a tomato plant for the presence of sucrose.

1. Remove a leaf from the tomato plant and after dipping it into boiling water grind it using a mortar and pestle.
2. Add water to the ground up leaf and filter the mixture.
3. Pour a small sample of the filtrate into a test tube and add dilute hydrochloric acid.
4. Place the test tube into a water bath.
5. Remove the test tube from the water bath and add sodium hydrogen carbonate.
6. Add Benedict's reagent and then place the test tube back into the water bath.
7. Record the colour of the contents of the test tube.
8. Repeat steps 1 to 7 with stem and root samples taken from the same tomato plant.

Table 5 shows the observations recorded by the student.

Plant organ being tested	Observations
Leaf	Blue-green
Stem	Green-orange
Root	Blue-green

Table 5

(i) The student made the following statement:

My observations support the theory of translocation.

Using the information in Table 5 and your knowledge of translocation discuss the validity of this statement.

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(ii) State **three** modifications to the procedure that would allow the observations in Table 5 to be reproducible.

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[3]

(c) Tomato plants are broad-leaved crop plants.

Compare the structure of a tomato plant with that of a cereal crop plant, such as wheat with regards to their transport systems.

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(d) The presence of starch in seeds can be detected using iodine-KI reagent.

When tested with iodine-KI reagent, dry seeds showed a high concentration of starch but after the seeds had been soaked in water for seven days they tested negative for the presence of starch.

Explain why the seeds tested negative for starch after being soaked in water.

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..... **[3]**

6 Pathologists are often required to produce blood smears for analysing blood samples and determining the health of patients.

A pathologist produced a blood smear and then observed it using a light microscope.

Fig. 6 shows the image of the blood smear seen by the pathologist.

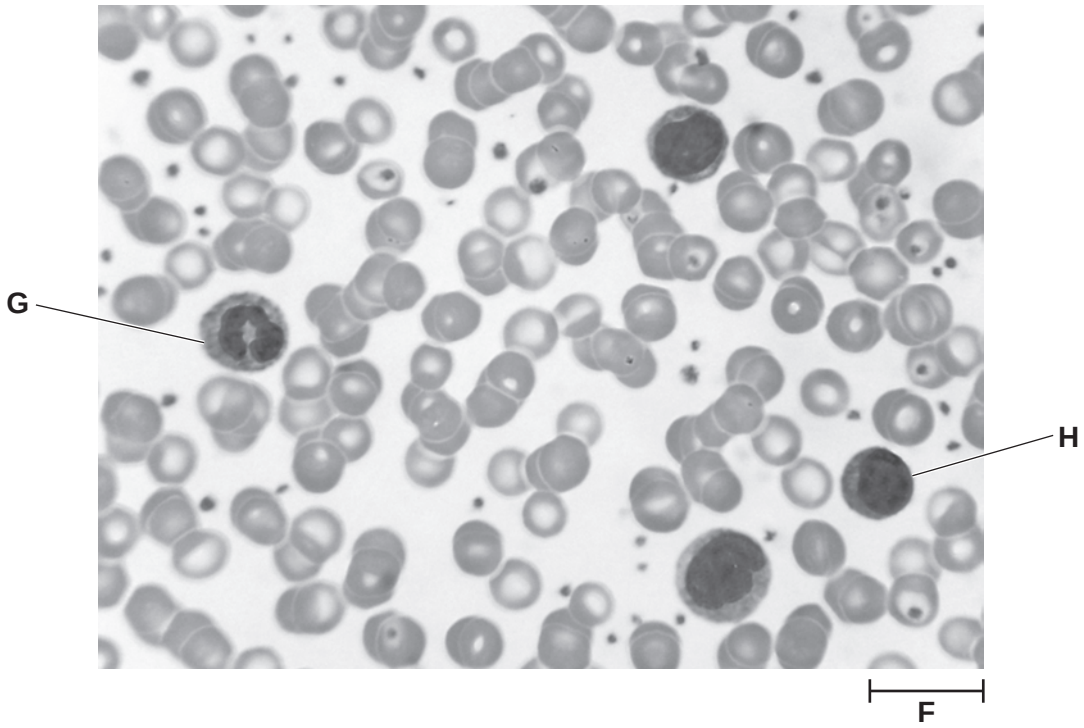

Fig. 6

(a) (i) Name cells **G** and **H** in Fig. 6.

G .....

H .....

[2]

(ii) The magnification of the image in Fig. 6 is ×500.

Calculate the length represented by the scale bar labelled **F**.

..... **[2]**

(b) Stages for preparing a stained blood smear in a school laboratory are outlined in the notes below.

A small drop of blood was placed on a microscope slide and allowed to dry. The slide was labelled and then flooded with Leishman's stain. After two minutes the slide was rinsed with water and left for a further five minutes. The slide was then rinsed again and left to dry.

(i) Give one stage that is missing from the notes **and** explain the effect this would have on the resulting blood smear.

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(ii) Leishman's stain mentioned in the notes is a differential stain.

Explain why a differential stain is used when producing a blood smear.

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(c) Flow cytometry is another technique used by pathologists for analysing blood samples.

Describe the usefulness of flow cytometry for analysing blood samples.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).