| Surname | Centre Number | Candidate Number |
|---|---|---|
| First name(s) | | 0 |

**GCSE**

3445U20-1

S24-3445U20-1

**MONDAY, 10 JUNE 2024 – MORNING**

# APPLIED SCIENCE (Double Award)

## UNIT 2: Space, Health and Life

## FOUNDATION TIER

1 hour 30 minutes

### ADDITIONAL MATERIALS

- Separate Resource Folder
- Calculator
- Pencil
- Ruler.

### INSTRUCTIONS TO CANDIDATES

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

You may use a pencil for graphs and diagrams only.

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.

| | For Examiner's use only | | |
|---|---|---|---|
| | Question | Maximum Mark | Mark Awarded |
| Section A | 1. | 8 | |
| | 2. | 5 | |
| | 3. | 6 | |
| | 4. | 10 | |
| | 5. | 5 | |
| | 6. | 3 | |
| | 7. | 4 | |
| | 8. | 9 | |
| Section B | 9. | 6 | |
| | 10. | 19 | |
| | Total | 75 | |

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### INFORMATION FOR CANDIDATES

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

Question **8**(b) is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

You will need to refer to the separate resource folder to answer questions **9 and 10**.

A Periodic Table is printed on page 28.

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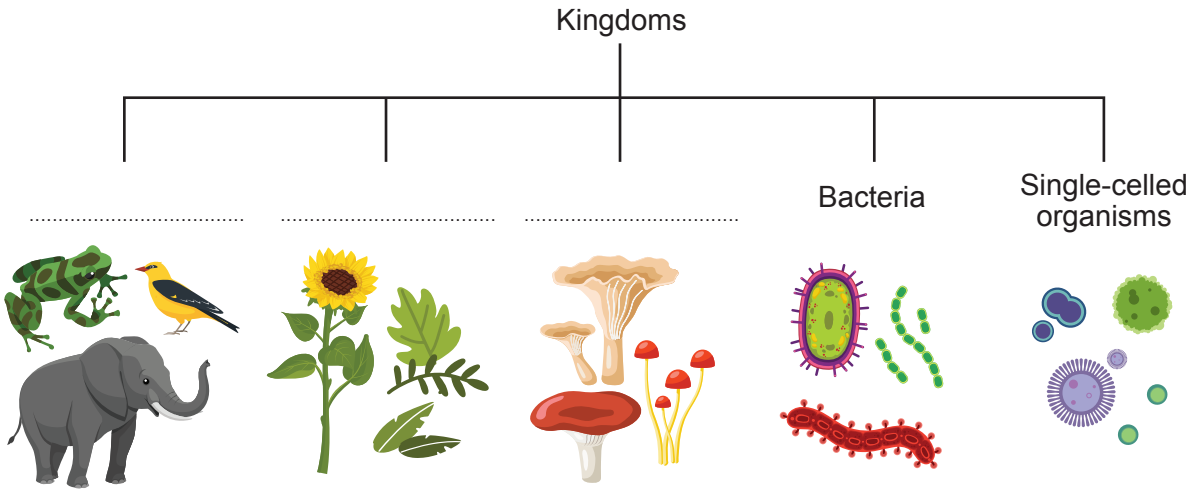
## Section A

Answer **all** questions.

**1.** Living things are classified using a system developed by Carl Linnaeus.

(a) The first division of living things is to place them into a kingdom. There are 5 kingdoms.

Complete the labelling of the kingdoms on the diagram below. [3]



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(b) Linnaeus' system further ranked living things to a species level. This is illustrated below. The levels are not in the correct order.

| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| species | order | class | phylum | genus | kingdom | family |

Place the letters representing the levels in the correct order in the column below. Some have been done for you. [2]

| |
|---|
| F |
| ..... |
| C |
| B |
| ..... |
| E |
| ..... |

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(c) The classification of a brown bear is shown below. Its scientific name is *Ursus arctos*.

| | |
|---|---|
| Kingdom | Animalia |
| [redacted] | Chordata |
| Class | Mammalia |
| Order | Carnivora |
| [redacted] | Ursidae |
| Genus | *Ursus* |
| [redacted] | *arctos* |

A wolf has the scientific name *Canis lupus*. Complete the classification table for a wolf. [3]

| | |
|---|---|
| Kingdom | Animalia |
| [redacted] | ..... |
| Class | ..... |
| Order | Carnivora |
| [redacted] | Canidae |
| Genus | ..... |
| [redacted] | *lupus* |

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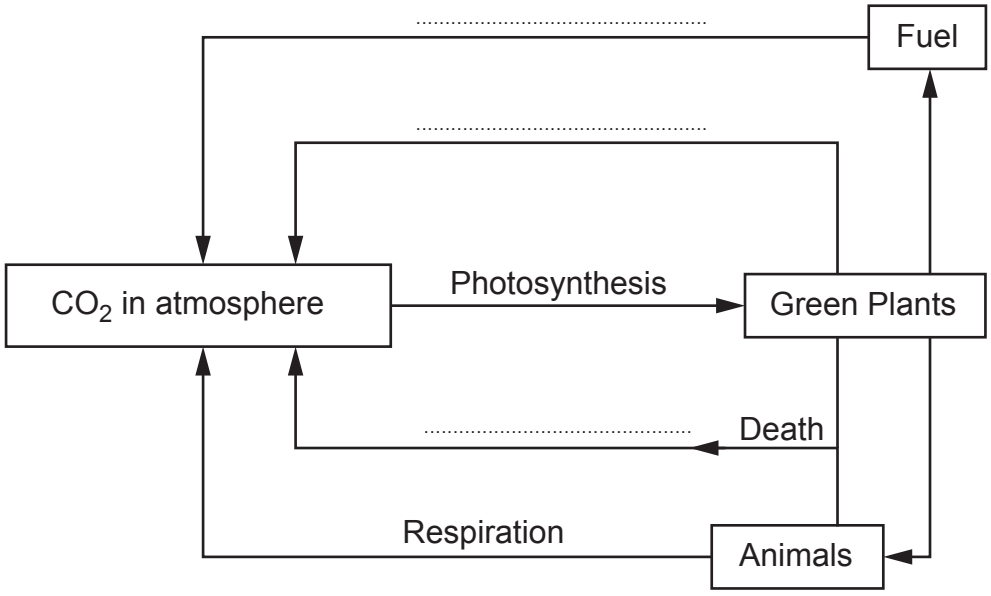
**2.** (a) Label the carbon cycle diagram below. Use words from the box. [3]

| dissolving | evaporating | decay | respiration | combustion |
|---|---|---|---|---|




(b) Complete the following sentences by underlining the correct word in the brackets. [2]

(i) When plant and animal waste decomposes, **( sulfates / nitrates / oxides )** are added to the soil.

(ii) Plants use **( sulfates / nitrates / oxides )** in the soil to grow.

5

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**3.** Indicator species may be used in an investigation to monitor water pollution at three different locations along a stream.

(a) The method for an investigation to monitor water pollution in a stream is described below. However, some of the stages are missing.

Complete the method by writing in the missing steps. [2]

1. Take a tray and a net to the first location.

2. .....

3. Study the organisms in the tray.

4. .....

5. Pour the invertebrates and the water gently back into the stream.

6. Repeat steps 1–5 at the second and third locations.

(b) The following chart is available to you.

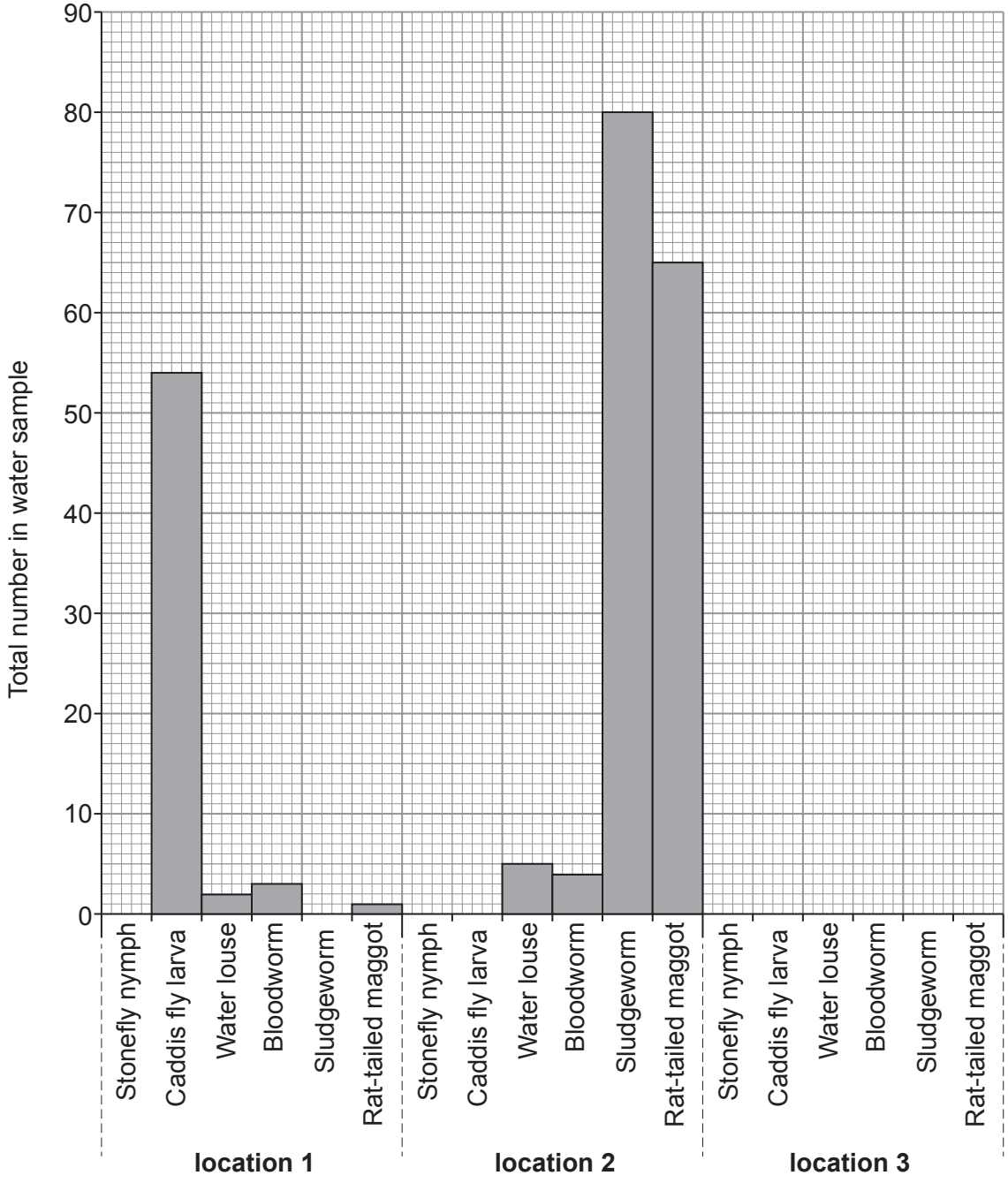
| Pollution level | Indicator species | |
|---|---|---|
| **A** Clean water |  Stonefly nymph |  Mayfly nymph |
| **B** Some pollution |  Freshwater shrimp |  Caddis fly larva |
| **C** Moderate pollution |  Water louse |  Bloodworm |
| **D** High pollution |  Sludgeworm |  Rat-tailed maggot |
| **E** Very High pollution – no life | | |

Results from the water sampling at each location are given in the table below.

| Species | Total number in water sample | | |
|---|---|---|---|
| | location 1 | location 2 | location 3 |
| Stonefly nymph | 0 | 0 | 31 |
| Caddis fly larva | 54 | 0 | 4 |
| Water louse | 2 | 5 | 3 |
| Bloodworm | 3 | 4 | 2 |
| Sludgeworm | 0 | 80 | 1 |
| Rat-tailed maggot | 1 | 65 | 1 |

Examiner only

(i) Use the data in the table to complete a bar chart on the grid below. [2]




(ii) State which location is the cleanest. [1]

.....

(iii) Give **one** reason for your answer. [1]

.....

.....

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6

Examiner only

**4.** (a) Theories about the Universe have changed over time.

Tick (✓) the boxes next to the names of **two** of these theories. [2]

Liquid State ☐

Steady State ☐

Loud Bang ☐

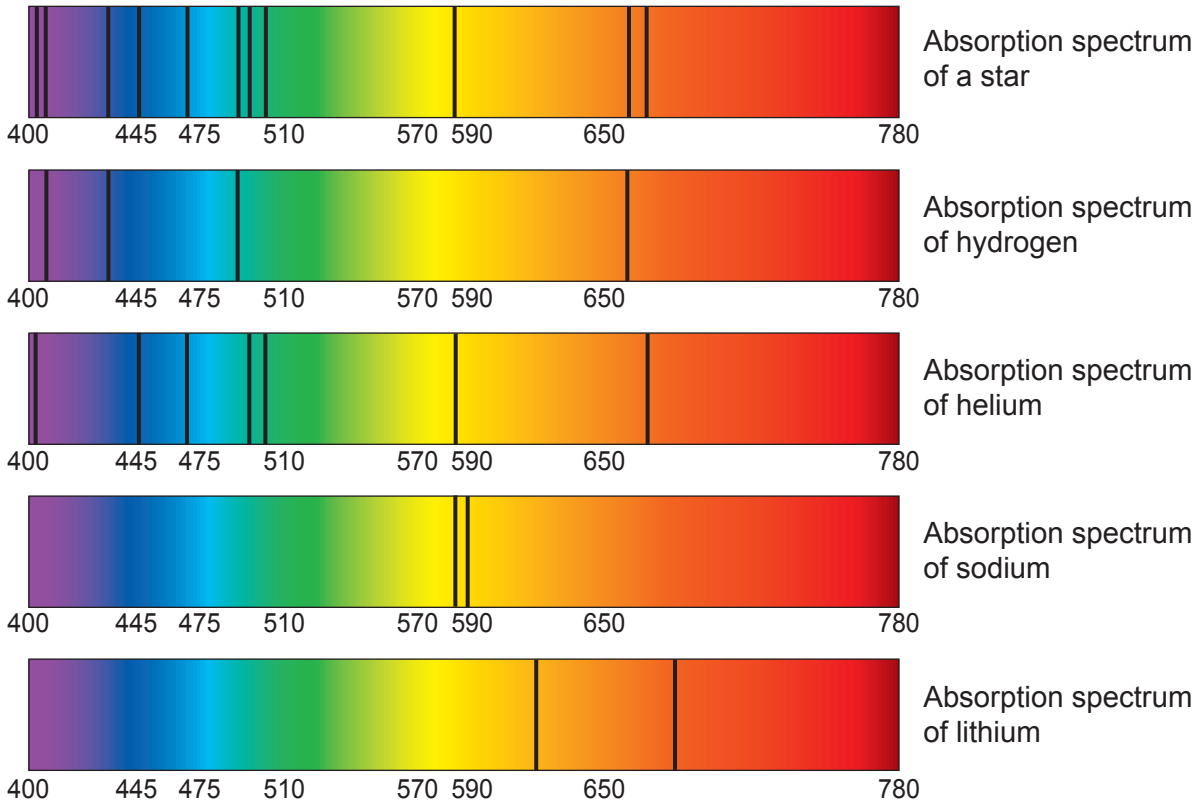
Big Bang ☐

(b) Images of the Universe are taken using electromagnetic waves.

Name **two** types of electromagnetic wave. [2]

..... and .....

(c) The diagram shows a spectrum from a star and four elements.



Examiner only

Complete the table by placing a tick (✓) if the element is present in the star. Hydrogen has been done for you. [1]

| Element | Element is present (✓) |
|---|---|
| hydrogen | ✓ |
| helium | |
| sodium | |
| lithium | |









**Turn over.**

Examiner only

(d) The table gives information about the planets in our solar system.

| | Mercury | Venus | Earth | Mars | Jupiter | Saturn | Uranus | Neptune |
|---|---|---|---|---|---|---|---|---|
| density ($kg/m^3$) | 5427 | 5243 | 5514 | 3933 | 1326 | 687 | 1271 | 1638 |
| mean distance from the Sun (million km) | 58 | 108 | 150 | 228 | 779 | 1434 | 2873 | 4495 |
| mean speed of orbit (km/s) | 47.4 | 35.0 | 29.8 | 24.1 | 13.1 | 9.7 | 6.8 | 5.4 |
| mean temperature (°C) | 167 | 464 | 15 | −65 | −110 | −140 | −195 | −200 |
| number of moons | 0 | 0 | 1 | 2 | 79 | 82 | 27 | 14 |

Use the information in the table to answer the questions below.

(i) Name the coldest **rocky** planet. ..... [1]

(ii) State how many **rocky** planets have moons. ..... [1]

(iii) Name the gas giant that orbits the Sun with the greatest **speed**. ..... [1]

(iv) Eris is a dwarf planet. Its orbit is 10 180 million km away from the Sun.
Shaun says it is found in the asteroid belt between the orbits of Mars and Jupiter.
Explain whether you agree with Shaun. [1]

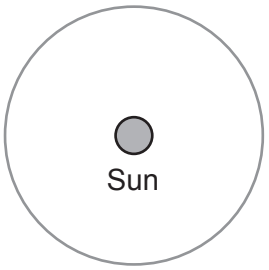
.....

.....

.....

Examiner only

(e) Tick (✓) the box next to the shape of the orbit of a comet around the Sun. [1]

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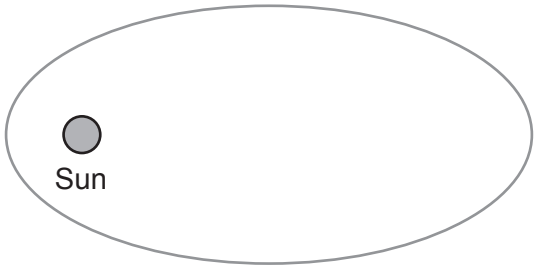


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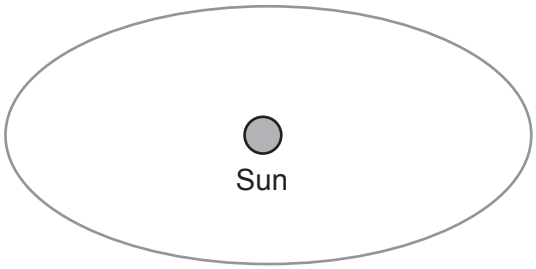


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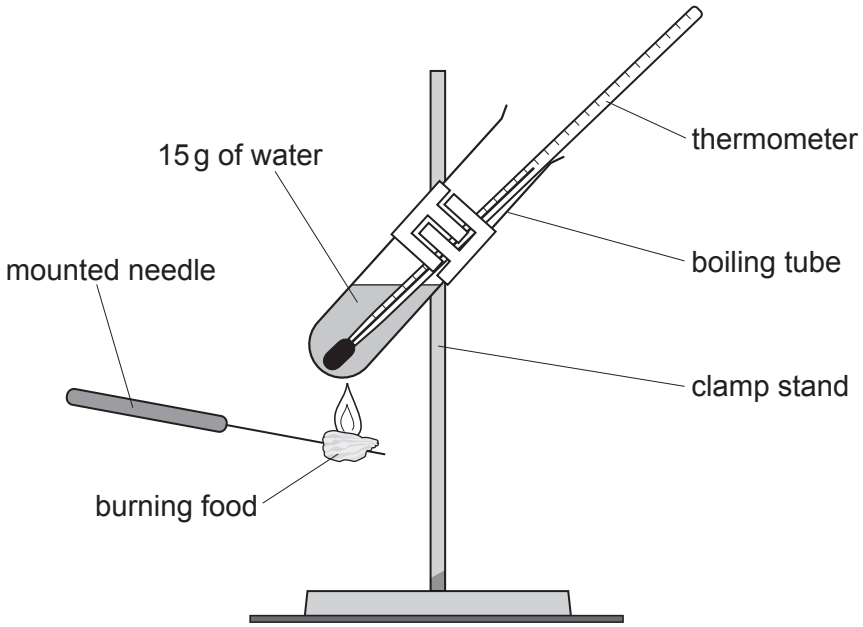
**5.** Some students investigated the energy content of food.




Their results are shown in the table below.

| Food | Mass of food burnt (g) | Initial water temperature (°C) | Final water temperature (°C) | Temperature increase (°C) |
|---|---|---|---|---|
| bread | 2.5 | 18 | 23 | 5 |
| cheese | 4.0 | 17 | 31 | 14 |
| cornflakes | 3.0 | 17 | 29 | 12 |
| oatie biscuit | 5.0 | 18 | 25 | 7 |

(a) Use the equation

energy released = 15 × 4.2 × temperature increase

to calculate the energy released by the bread. [2]

energy released = ..... J

Examiner only

(b) The students were asked to use their results to calculate the energy provided by a snack consisting of 15 g of oatie biscuits and 20 g of cheese.
Complete the tables below to work out their answer. [3]

| Energy from **5 g** of oatie biscuits (J) | Energy from **15 g** of oatie biscuits (J) |
|---|---|
| 441 | ..... |

| Energy from **4 g** of cheese (J) | Energy from **20 g** of cheese (J) |
|---|---|
| 882 | ..... |

Space for working

total energy from snack = ..... J

5

Examiner only

**6.** All drugs can have side effects. New drugs undergo testing before they can be prescribed by doctors.

The following terms are used in drug development studies.

Join each term to its description with a straight line. [3]

| Term | Description |
|---|---|
| Blind study | an inactive substance made to look like the real drug |
| Double-blind study | when the patient and the researcher do not know if they are using the real drug |
| Placebo | when only the researcher does not know if they are using the real drug |
| | when the patient does not know if they are given the real drug |

3

Examiner only

**7.** Some of the methods used in the treatment and diagnosis of disease are included in the table below.

Place **one** tick (✓) in each row underneath the method used by each treatment or diagnosis. [4]

| Treatment or diagnosis | Uses high intensity light waves | Uses short wavelength electromagnetic waves | Uses high frequency sound waves | Uses strong magnetic fields | Uses drugs |
|---|---|---|---|---|---|
| chemotherapy | | | | | |
| ultrasound | | | | | |
| MRI scan | | | | | |
| CAT scan | | | | | |

4

Examiner only

**8.** Vaccines are used to protect against disease.

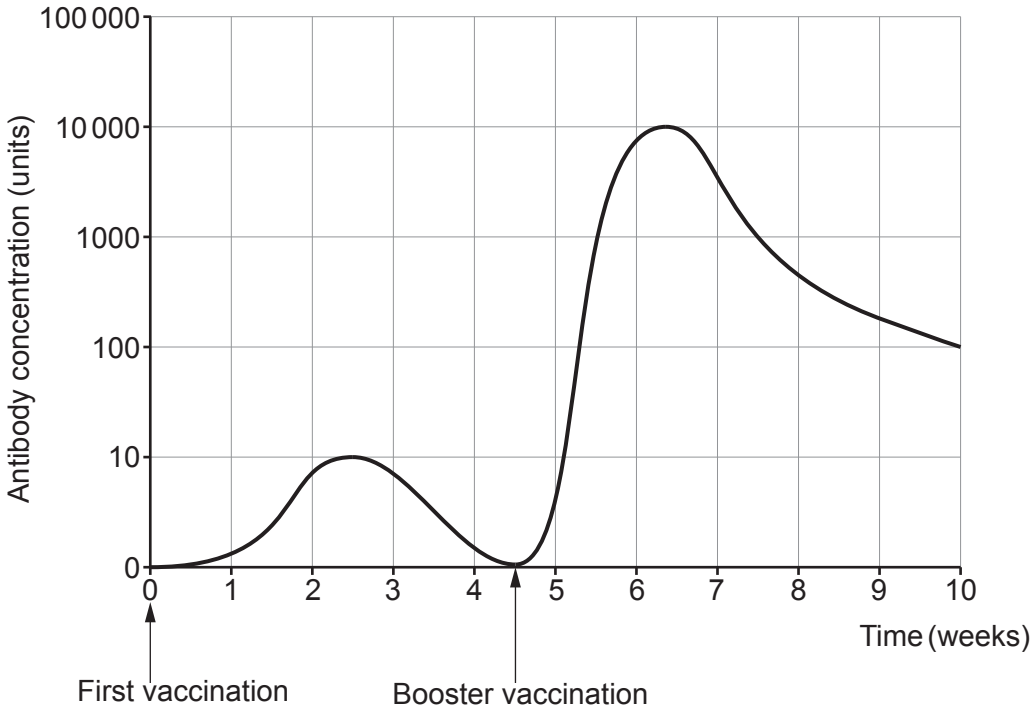
(a) Complete the following sentences about how the body reacts after infection or vaccination by underlining the correct term in the brackets.

(i) Vaccines contain molecules called **( antibodies / antigens / memory cells )**. [1]

(ii) White blood cells respond to these molecules and produce **( antibodies / antigens / pathogens )**. [1]

(iii) **( Antibiotics / antigens / memory cells )** are produced following infection or a vaccination. [1]

(b) The graph below shows the immune response over a 10-week period when a vaccine was given as two doses.




Describe the changes in antibody concentration over 10 weeks using data from the graph. [6 QER]

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9

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## Section B

Refer to the separate Resource Folder to answer questions **9** and **10**.

**9.** Jake's heart rate, breathing rate and airflow were monitored during a training session. Use the information in **Table 2** to answer the following questions.

(a) State the value of the resting heart rate. [1]

heart rate = ..... bpm

(b) State the time at which the exercise stopped. [1]

time = ..... min

(c) Calculate the time the exercise lasted. [1]

time = ..... min

(d) (i) Calculate the drop in heart rate between 14 and 15 minutes. [1]

drop in heart rate = ..... bpm

(ii) Assuming that the heart rate drops at the same rate, calculate the heart rate after 16 minutes. [1]

heart rate after 16 minutes = ..... bpm

(e) Estimate the breathing rate after 16 minutes. [1]

breathing rate = ..... breaths per minute

6

Examiner only

**10.** (a) Dave says the distances of each leg in a long-distance triathlon are all double those in a middle-distance triathlon.

Tom says the distances of each leg in an Olympic triathlon are double those in a sprint triathlon.

Use data from **Table 1** to explain whether Dave or Tom is correct. [2]

.....

.....

.....

.....

(b) Piera says Jake breathed in less air per minute at 4 minutes than at 3 minutes because his breathing rate was lower.

Petula disagrees because Jake's airflow per breath was greater at 4 minutes than at 3 minutes.

Use data from **Table 2**, and the equation below it, to explain whether you agree with Piera or Petula. [2]

.....

.....

(c) Use the information in **Table 4** and equations from pages 4 and 5 to answer the following questions.

(i) Calculate Malcolm's BMI. [2]

BMI = .....

(ii) Calculate Malcolm's maximum heart rate. [1]

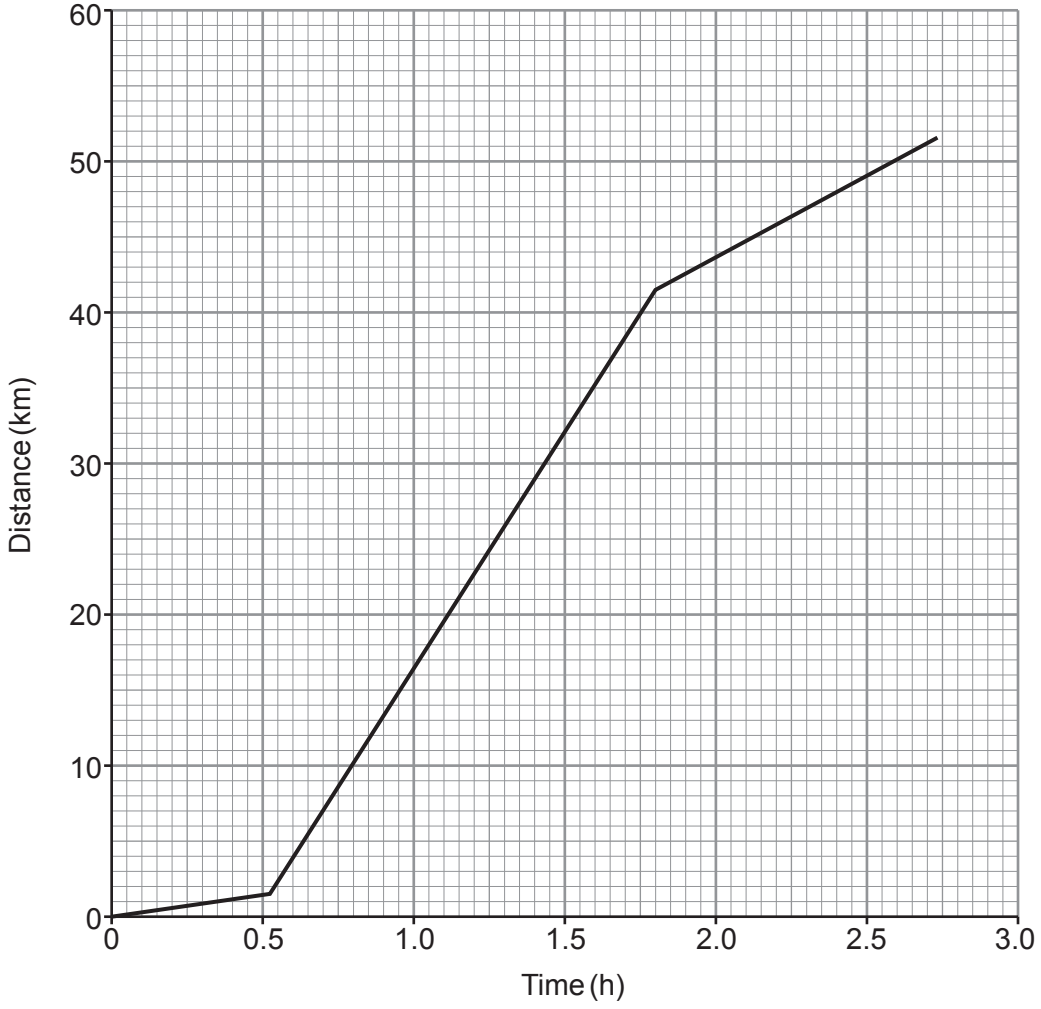
maximum heart rate = ..... bpm

Examiner only

(d) Karen wants to exercise in the aerobic zone. Use the information in **Tables 3** and **4** and on page 4 to determine the range in heart rate she should aim for. [1]

heart rate range is from ..... bpm to ..... bpm.

(e) Data in the **Triathlon times** section (page 5) and **Table 1** was used to plot distance-time graphs for each of the triathlons described. There were three sections in each graph to show the swim, cycle and run legs. The graphs did not include transition times. One of the graphs is shown below.



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Determine which type of triathlon is represented by the graph and give **two** reasons for your answer. [3]

Type of triathlon: .....

Reason 1: .....

.....

Reason 2: .....

.....

(f) Use the information about Triathlon times on page 5, the information in **Table 1** and an equation on page 7 to calculate the mean speed during an Ironman triathlon. [3]

mean speed = ..... km/h

(g) When a triathlete mounts their bike they are travelling at 1.5 m/s.
Use the information in **Table 5** and an equation on page 7 to calculate the acceleration along level ground in a cycle leg. [3]

acceleration = ..... $m/s^2$

(h) It is thought that the higher the age group of the triathlete, the lower the mean speed in the cycle leg. Use data from **Graph 1** to explain whether this statement is true for all age groups. [2]

.....

.....

.....

.....

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**END OF PAPER**

| Question number | Additional page, if required.<br>Write the question number(s) in the left-hand margin. |
|---|---|
| | |

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# THE PERIODIC TABLE

| Group 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 H Hydrogen 1 | | | | | | | | | | 4 He Helium 2 |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | | | | | | 11 B Boron 5 | 12 C Carbon 6 | 14 N Nitrogen 7 | 16 O Oxygen 8 | 19 F Fluorine 9 | 20 Ne Neon 10 |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | | | | | | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulfur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 45 Sc Scandium 21 | 48 Ti Titanium 22 | 51 V Vanadium 23 | 52 Cr Chromium 24 | 55 Mn Manganese 25 | 56 Fe Iron 26 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 63.5 Cu Copper 29 | 65 Zn Zinc 30 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 |
| 86 Rb Rubidium 37 | 88 Sr Strontium 38 | 89 Y Yttrium 39 | 91 Zr Zirconium 40 | 93 Nb Niobium 41 | 96 Mo Molybdenum 42 | 99 Tc Technetium 43 | 101 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 128 Te Tellurium 52 | 127 I Iodine 53 | 131 Xe Xenon 54 |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 139 La Lanthanum 57 | 179 Hf Hafnium 72 | 181 Ta Tantalum 73 | 184 W Tungsten 74 | 186 Re Rhenium 75 | 190 Os Osmium 76 | 192 Ir Iridium 77 | 195 Pt Platinum 78 | 197 Au Gold 79 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | 210 Po Polonium 84 | 210 At Astatine 85 | 222 Rn Radon 86 |
| 223 Fr Francium 87 | 226 Ra Radium 88 | 227 Ac Actinium 89 | | | | | | | | | | | | | | | |

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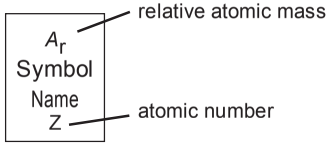






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