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F

Tuesday 14 May 2019 – Afternoon

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/01 Biology (Foundation Tier)

Time allowed: 1 hour 45 minutes

7713809170

You must have:
- a ruler (cm/mm)

You may use:
- a scientific or graphical calculator
- an HB pencil

J260001

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- 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.

INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in the question marked with an asterisk (*).
- This document consists of **32** pages.

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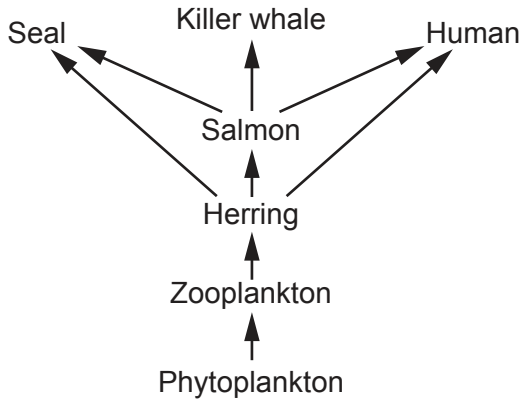
Answer **all** the questions.

1 Herring are a type of fish. They live in the North Sea.

(a) The diagram shows a food web for the North Sea.



(i) Draw lines to connect each **organism**, below, to its **role** in the food web.

Organism	Role
Herring	1st consumer
Phytoplankton	2nd consumer
Zooplankton	Producer

[2]

(ii) Write down the names of the **three** animals in the food web that eat herring.

1 .....

2 .....

3 .....

[2]

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(b) Biomass is passed along a food chain when organisms are eaten.

(i) Biomass is made by photosynthesis.

Complete the word equation for photosynthesis.

carbon dioxide + ... $\xrightarrow[\text{chlorophyll}]{\text{sunlight}}$ oxygen + ...

[2]

(ii) The sentences describe photosynthesis.

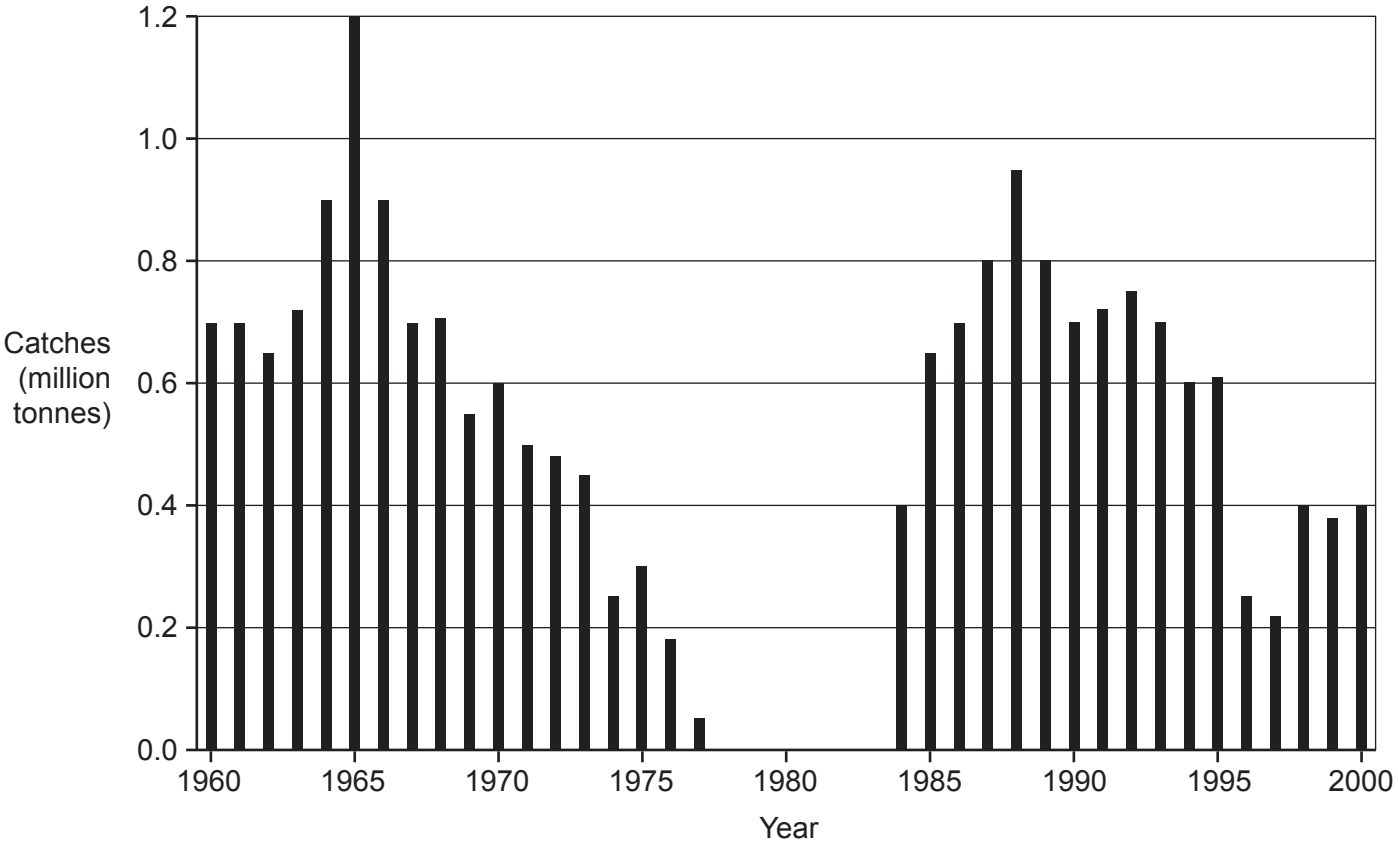
Put a (ring) around the correct choice to complete each sentence.

Light is needed for **the first** / **the second** / **both** stage(s) of photosynthesis.

Photosynthesis is **endothermic** / **exothermic** / **respiration** because it uses energy from the Sun.

[2]

The bar chart shows how many herring were caught from the North Sea each year from 1960 to 2000.



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(c) Read the statements about the graph.

Tick (✓) **true** or **false** for each statement.

Statement	True	False
Catches of over 0.8 million tonnes are recorded for 4 years.		
No herring were caught between 1978 and 1983.		
Recorded catches are always between 0.2 and 1.0 million tonnes.		

[3]

(d) Since 1998 the fishing of herring from the North Sea has been described as sustainable.

Which statements are true for **sustainable** fishing of herring?

Tick (✓) **two** boxes.

Future generations could continue fishing without wiping out the herring population. ☐

It causes the herring population to decrease over a number of years. ☐

The herring reproduce fast enough to replace all the herring that are caught. ☐

The herring that are caught are recycled. ☐

The number of herring caught has to be exactly the same each year. ☐

The number of herring caught is very low. ☐

[2]

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2 Sarah is studying the cell cycle in a chicken embryo.

She makes a slide of some cells from the embryo. She looks at the slide using a light microscope.

Fig. 2.1 shows what she sees.

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Fig. 2.1

(a) How many of the 20 visible cells are in mitosis in **Fig. 2.1**?

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

(b) **(i)** The field of view and the magnification change depending on the combination of eyepiece lens and objective lens used.

Put a (ring) around the combination of lenses that produces the highest magnification.

Eyepiece lens	Objective lens
×10	×20
×15	×20
×10	×40
×15	×40

[1]

(ii) Put a (ring) around the combination of lenses that produces the largest field of view.

Eyepiece lens	Objective lens
×10	×20
×15	×20
×10	×40
×15	×40

[1]

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(iii) When making the slide Sarah added a coloured chemical called methylene blue.

Explain why.

.....

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

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(c) Chicken embryos develop inside an egg with a hard shell.

Fig. 2.2 shows some structures in a chicken egg.

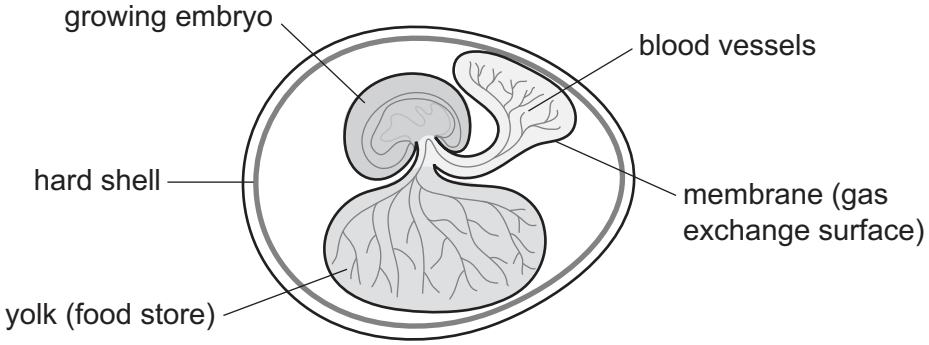


Fig. 2.2

(i) Suggest **two** ways that the gas exchange surface is similar in humans and chicken eggs.

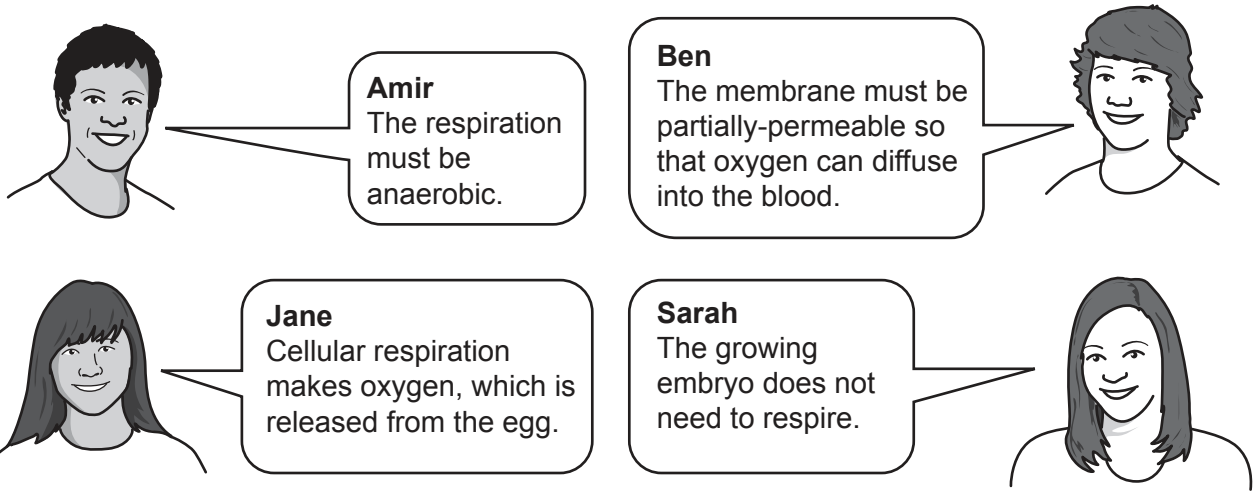
1 .....

.....

2 .....

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

(ii) Sarah and some of her friends discuss cellular respiration in the chicken embryo.



Who is correct?

Tick (✓) **one** box.

Amir ☐

Ben ☐

Jane ☐

Sarah ☐

[1]

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3 Sickle cell disease is an inherited condition.

(a) Sickle cell disease is caused by a single gene. A person will only have sickle cell disease if they inherit a faulty allele of this gene from both parents.

(i) Two parents do **not** have sickle cell disease. These parents can have a child that **does have** sickle cell disease.

Complete the Punnett square in **Fig. 3.1** to explain how this is possible.

Use:

a to represent a sickle cell disease allele

A to represent a normal allele.

		father	
	gametes	**A**	**a**
mother	gametes		

Fig. 3.1

[2]

(ii) Put a (ring) around the heterozygous fertilised eggs in the Punnett square in **Fig. 3.1**.

[1]

(iii) What is the probability that these parents in **Fig. 3.1** will have a child that has sickle cell disease?

Tick (✓) **one** box.

0.25 ☐

0.5 ☐

0.75 ☐

1 ☐

[1]

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(b) People with sickle cell disease have differences in their red blood cells. They are often treated by being given extra oxygen.

Fig. 3.2 shows red blood cells from two different people. The drawing shows the same volume of blood from each person.

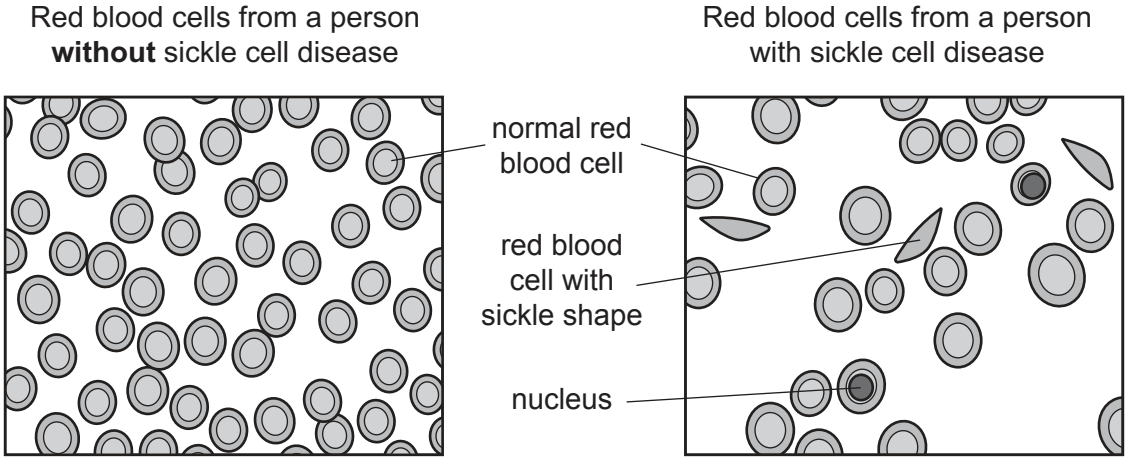

Fig. 3.2

(i)* Look at the differences in the red blood cells of people with and without sickle cell disease in **Fig. 3.2**.

Explain how normal red blood cells are adapted to carry oxygen **and** suggest why people with sickle cell disease often need to be given extra oxygen.

.....

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.....

..... **[6]**

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(ii) Red blood cells contain a protein called haemoglobin. Red blood cells are made from stem cells in the bone marrow.

The sentences below explain why only these stem cells can make haemoglobin.

Use words from the list to complete the sentences.
Each word or phrase can be used once, more than once or not at all.

amino acids

carbohydrates

deleted

genes

not present

proteins

switched on

switched off

Every human body cell nucleus contains instructions to make ..... .

These instructions are called ..... .

In red blood stem cells the instructions give the order of ..... needed to make haemoglobin.

Other body cells cannot make haemoglobin because the instructions are

..... .

[4]

(c) In 2017 scientists claimed to have found a cure for sickle cell disease. The cure used stem cells. The stem cells were taken from a man's bone marrow.

(i) Which statement about stem cells from bone marrow is true?

Tick (✓) **one** box.

They are adult stem cells ☐

They are embryonic stem cells ☐

They are specialised cells ☐

They divide by meiosis ☐

[1]

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(ii) The scientists' results were published in a **peer-reviewed** journal.

Which statements explain why we can have confidence in the reported results?

Tick (✓) **two** boxes.

Friends of the authors have checked their work and found it accurate. ☐

Other scientists can copy the methods described to reproduce similar results. ☐

Other scientists have checked the work before it is published. ☐

Other scientists have come to different conclusions using the same data. ☐

The work is imaginative and no one else has done these experiments before. ☐

[2]

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4 The human heart beats continuously.

(a) Diagrams **A**, **B**, **C** and **D** in **Fig. 4.1** show stages in a heartbeat. The shading shows which chambers and arteries contain blood during each stage.

The diagrams are **not** in the correct order.

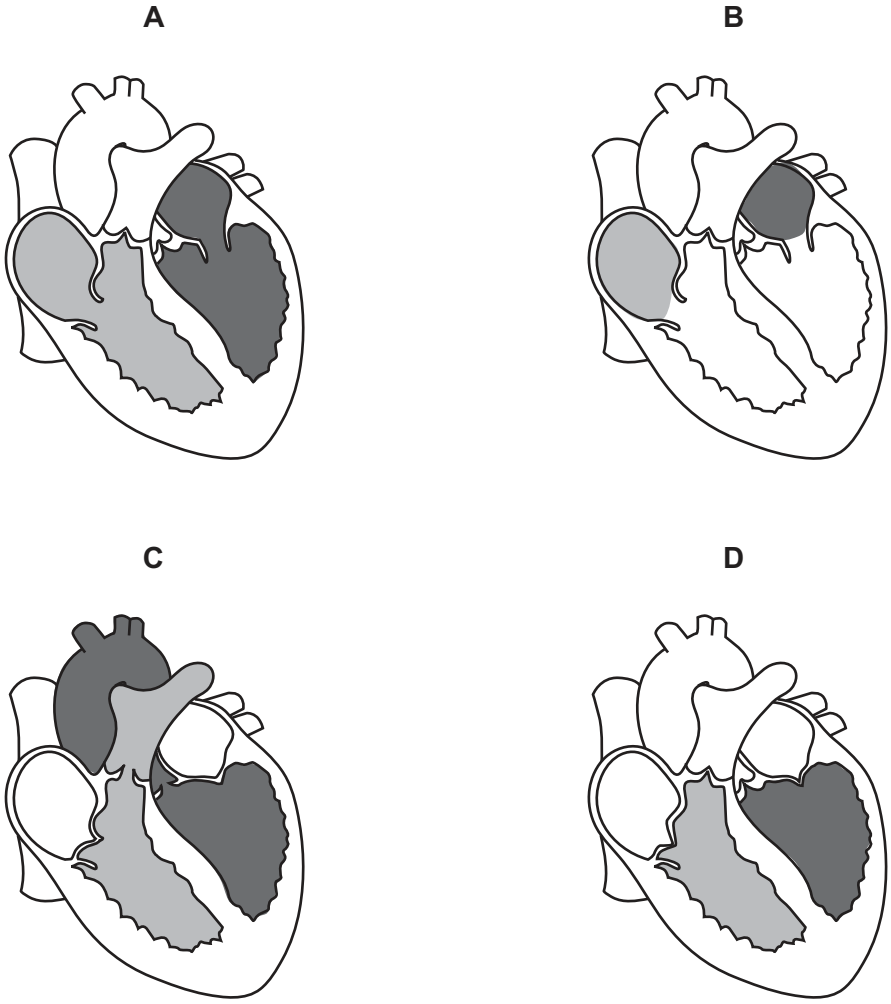

Fig. 4.1

Write down the correct order of the stages in a heartbeat. One has been done for you.

	A		

[2]

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(b) **Fig. 4.2** shows the relationships between the circulatory system and other systems in the human body.

The numbers **1**, **2**, **3** and **4** represent substances that move from one system to another.

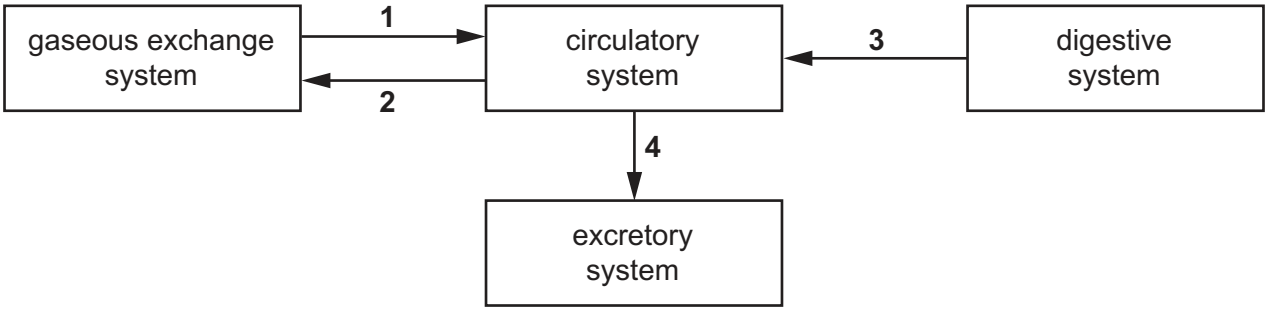

Fig. 4.2

Complete **Table 4.1** to identify each substance.

Use substances from the list.
Each substance can be used once, more than once or not at all. One has been done for you.

carbon dioxide
food
oxygen
urea

Number	Substance
1	
2	
3	
4	urea

Table 4.1

[3]

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(c) A student writes a plan to investigate the effect of exercise on pulse rate and recovery rate.

Method:

1. Measure the resting pulse rate by placing two fingers against the wrist (do not use your thumb) and count the number of beats in 10 seconds.

2. Step up and down on the step 30 times per minute, for 3 minutes.
3. Stop after 3 minutes and immediately measure the pulse.
4. Measure the pulse again every 30 s.

(i) The student is correct that the thumb should **not** be used to take the pulse.

Suggest why.

.....

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

(ii) In step 1 the student plans to count the number of beats.

How should the student calculate the resting **pulse rate** per minute from the count?

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

(iii) Describe how the student can work out the **recovery rate** from her measurements.

.....

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

(d) The student's results are shown in **Table 4.2**.

Time after exercise (s)	Pulse rate (bpm)
0	95
30	82
60	74
90	72
120	72
150	72

Table 4.2

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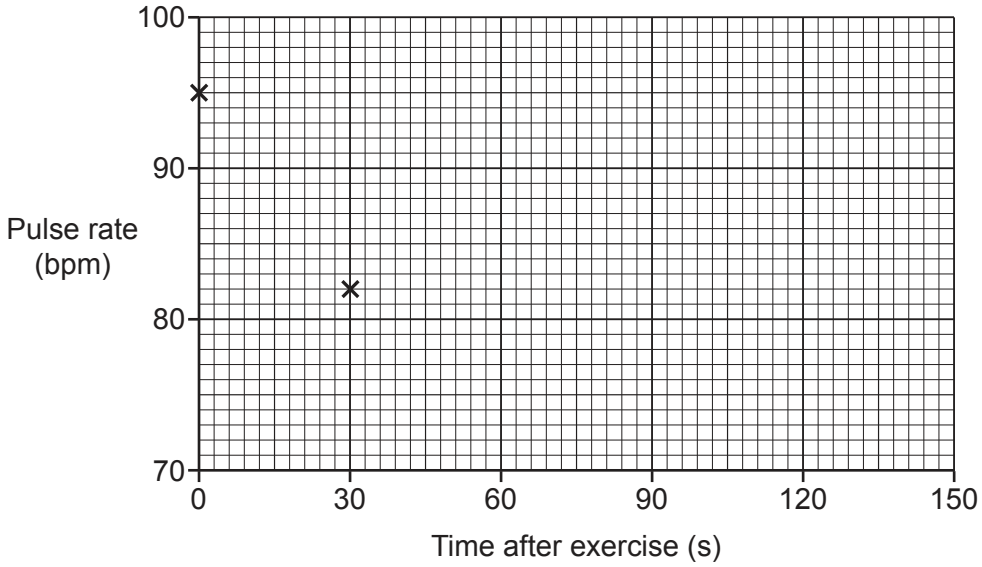
(i) Plot the results from **Table 4.2** on the graph **and** draw a curve of best fit.



[2]

(ii) The student's resting pulse rate was 72 bpm.

She uses **Table 4.3** to decide her fitness rating.

Time taken to return to resting pulse rate (s)	Fitness rating
0–30	Excellent
31–60	Good
61–90	Fair
91–120	Poor
121+	Very poor

Table 4.3

Write down her fitness rating.

Fitness rating = ... **[1]**

(iii) From these results, how confident should the student be about her fitness rating?

Explain your answer.

.....

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

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5 This question is about evolution.

(a) Put a (ring) around the best choice to complete each sentence.

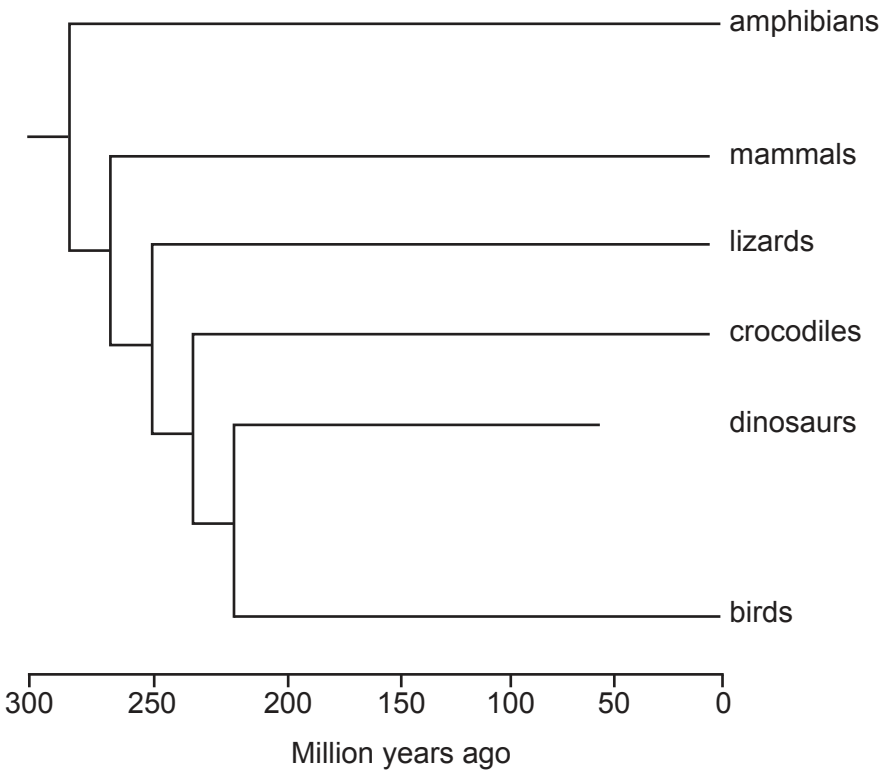
Evolution is a change in a population's **fossil** / **inherited** / **observable** / **natural** characteristics.

This change occurs through a process of **extinction** / **fossilisation** / **genetic engineering** / **natural selection**.

[2]

(b) Scientists think all animals with backbones evolved from a common ancestor.

The diagram shows the likely evolutionary relationships between some groups of animals with backbones.



Here are some statements about the evolutionary relationships shown in the diagram.

Tick (✓) **true** or **false** for each statement.

Statement	**True**	**False**
Evidence for the evolutionary relationships of dinosaurs comes from fossils.		
The common ancestor of all animals with backbones lived 250 million years ago.		
The DNA of birds will be most similar to that of dinosaurs.		

[2]

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(c) Evolution can result in the formation of new species.

Explain why although horses and donkeys can breed they are classed as two different species.

.....

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

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6 Influenza (flu) is a common human infection.

It is caused by a virus.

(a) The poster in **Fig. 6.1** teaches people how to prevent the flu virus spreading.

Fig. 6.1

Draw lines to connect each **part of the poster** to **why it is necessary**.

Part of the poster	Why it is necessary
CATCH IT	Flu virus can survive on skin for several hours.
BIN IT	Touching a tissue after use can contaminate you with flu virus.
KILL IT	Coughing and sneezing can spread flu virus through droplets in the air.

[2]

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(b) People can be given a vaccination to help protect them from flu.

(i) Vaccination causes white blood cells in the body to make antibodies against the pathogen.

How else do white blood cells protect against pathogens?

Tick (✓) **two** boxes.

Help pathogens destroy body cells. ☐

Prevent pathogens entering the body. ☐

Release chemicals that break pathogens down. ☐

Take in and digest pathogens. ☐

Trap pathogens in mucus. ☐

[2]

(ii) Flu vaccines cannot be given to very young babies.

Which **two** statements explain why vaccinating adults helps protect **young babies** from flu?

Tick (✓) **two** boxes.

Each vaccination only costs a few pounds. ☐

Only people ill with the flu virus can pass it on. ☐

Unvaccinated people are more likely to get flu. ☐

Vaccinations don't always work. ☐

Very few vaccinated people have any side effects. ☐

[2]

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(c) A new flu vaccine is made every year. The vaccines contain proteins from the surface of the flu virus.

Fig. 6.2 shows the flu virus from 2018.

Fig. 6.3 shows the antibodies made by a person who had the vaccination in 2018.

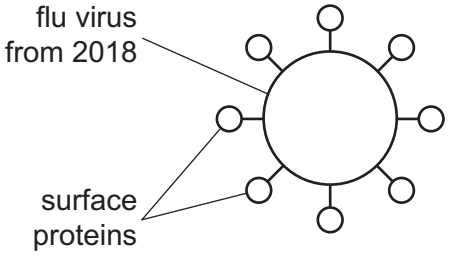

Fig. 6.2

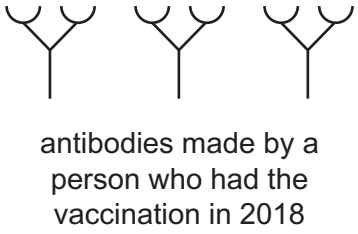

Fig. 6.3

The flu virus changes regularly.

Fig. 6.4 shows the flu virus from 2019.

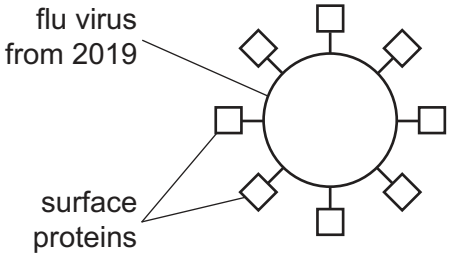

Fig. 6.4

Explain why the vaccine from 2018 would **not** protect you against the flu virus from 2019.

Use **Fig. 6.2**, **Fig. 6.3** and **Fig. 6.4** to help you.

.....

.....

.....

.....

.....

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

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(d) In 2017 there was a flu epidemic in Australia. 170 000 people in Australia were infected. The population of Australia in 2017 was 25 000 000.

(i) Calculate the percentage of the population of Australia infected with flu in 2017.

Give your answer to **1** decimal place.

Percentage of population = ...% **[3]**

(ii) The same flu virus could affect the UK. The population of the UK is approximately 66 000 000.

In Australia the death rate from flu was approximately 4 people in every million. Assume that the death rate in the UK would be the same as in Australia.

Estimate how many people would die of flu in the UK.

Estimated number of deaths = ... **[2]**

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(e) Scientists used an electron microscope to look at a flu virus.

(i) What are the advantages of electron microscopes over light microscopes?

Tick (✓) **two** boxes.

A higher magnification is possible with electron microscopes. ☐

Electron microscopes are expensive. ☐

Electron microscopes have a very high resolution. ☐

Living cells can be seen using a light microscope. ☐

[2]

(ii) The virus is 0.1 μm in diameter. It infects a human cell that is 50 μm in diameter.

How many times bigger is the human cell than the virus?

Number of times bigger = ... **[2]**

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(f) Pneumonia is a disease of the lungs. It is caused by an infection.

Fig. 6.5 shows the number of people per 100 000 who caught pneumonia between 2004 and 2012.

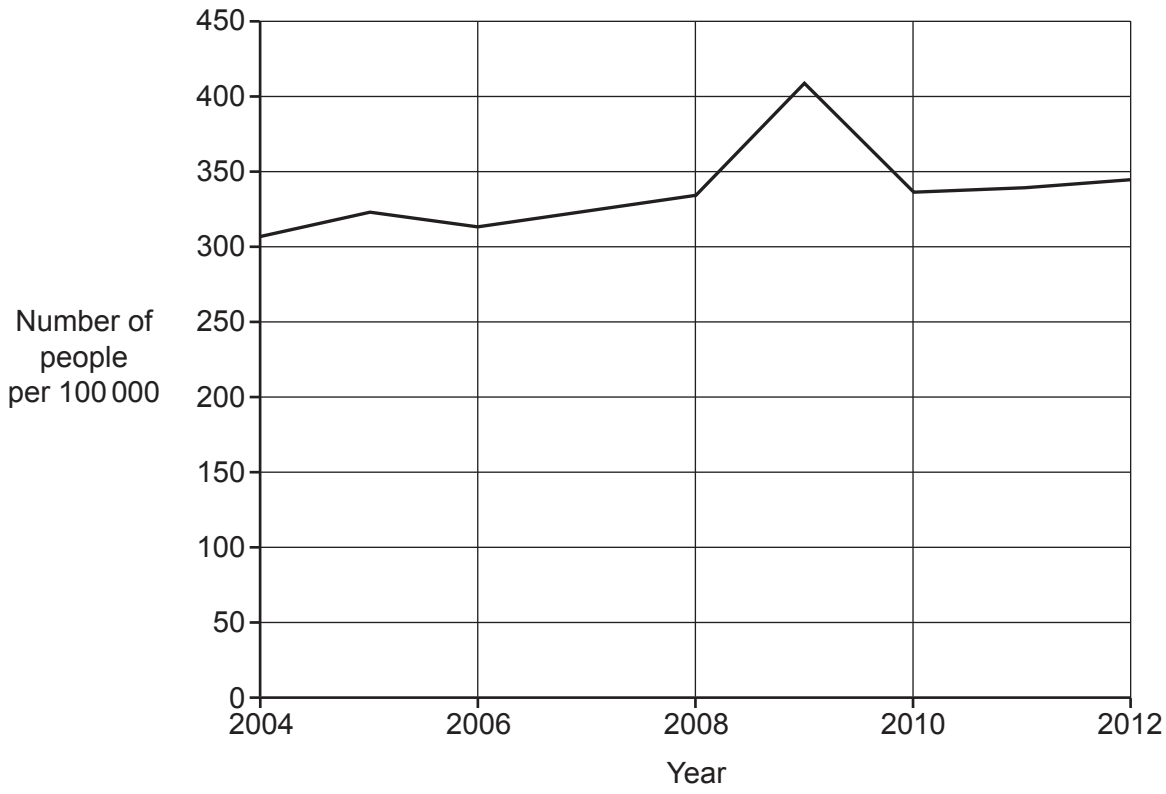

Fig. 6.5

Flu and pneumonia both affect the breathing system.

(i) There was a flu epidemic in 2009.

Use **Fig. 6.5** to estimate the increase in pneumonia cases from 2008 to 2009.

Increase = ... people per 100 000 **[1]**

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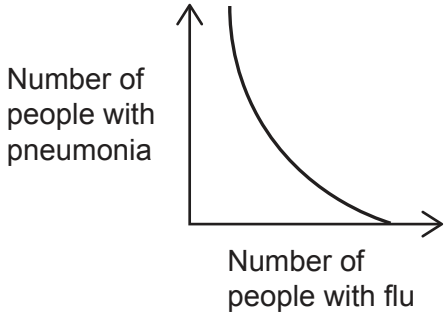
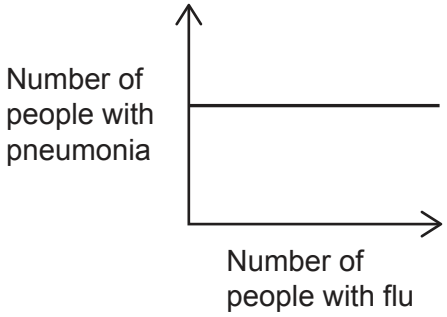
(ii) There is a positive correlation between having flu and having pneumonia.

Which graph, **A**, **B**, **C** or **D**, shows a positive correlation?

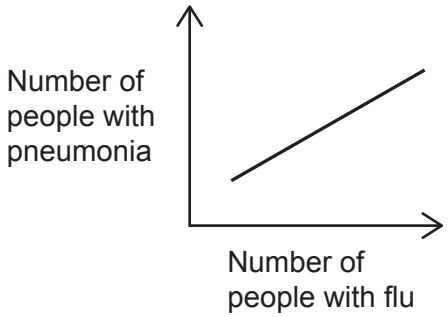
A



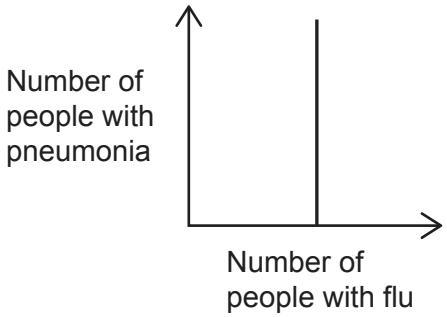
B



C



D



Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

[1]

(iii) Does a correlation between flu and pneumonia prove that having flu causes pneumonia?

Explain your answer.

.....

.....

.....

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

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7 Cellular respiration takes place in living cells.

(a) In which parts of a cell do the reactions of cellular respiration take place?

Tick (✓) **two** boxes.

- Cell wall ☐
- Chloroplasts ☐
- Cytoplasm ☐
- Mitochondria ☐
- Nucleus ☐
- Plasmids ☐

[2]

(b) Which processes need energy from cellular respiration?

Tick (✓) **two** boxes.

- Active transport ☐
- Diffusion ☐
- Gaseous exchange ☐
- Muscle contraction ☐
- Osmosis ☐
- Transpiration ☐

[2]

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All living cells produce hydrogen peroxide (H_2O_2) as a waste product.

The cells in potatoes contain an enzyme called catalase. It breaks down H_2O_2 to water and oxygen, this is the equation for the reaction that takes place.

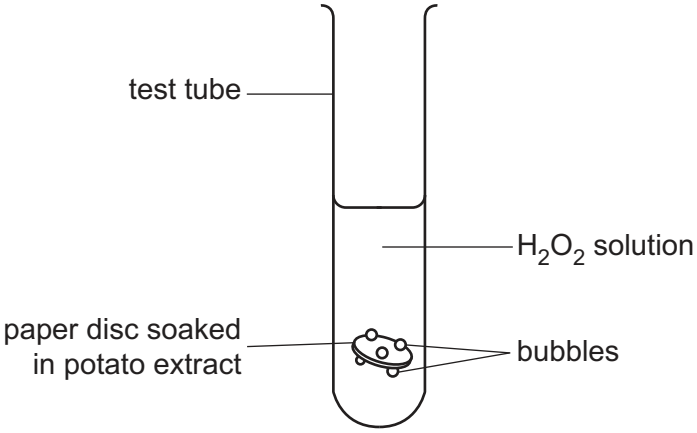
$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$

Mia investigates the effect of H_2O_2 concentration on the rate of this reaction.

She writes out her method.

1. Put a peeled potato in a liquidiser with some water to make potato extract.
2. Dip a paper disc in the potato extract. The potato extract is a source of catalase.
3. Drop the paper disc into a test tube containing H_2O_2 solution.
4. Wait until the disc has sunk to the bottom.
5. Time how long it takes for the disc to rise to the surface of the H_2O_2.

This is a diagram of her apparatus.



(c) Mia's method lacks the detail needed for another scientist to reproduce her findings.

Suggest additional detail which would allow another student to follow the method exactly.

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

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(d) Bubbles form on the paper disc when it is in the H_2O_2 solution. This causes the disc to rise to the surface of the solution.

Mia thinks that if a disc rises more quickly, this means that the rate of reaction is faster.

Explain why she is correct.

.....

.....

.....

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

(e) The table shows Mia's results.

Concentration of H_2O_2 solution (%)	**Time taken for paper disc to reach the surface (s)**
0.75	19.69
1.50	15.13
3.00	12.90
4.50	10.00
6.00	7.66

(i) Calculate the rate of reaction for 6.00% H_2O_2 solution.

Give your answer to **3** significant figures.

Rate = ... s^{-1} **[3]**

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(ii) Which conclusions are supported by the data in the table?

Tick (✓) **two** boxes.

- Between 0.75% and 6.00% H_2O_2 the reaction rate increases by approximately 2.5 times. ☐
- Doubling the concentration of H_2O_2 halves the time taken for the disc to reach the surface. ☐
- Increasing the concentration of H_2O_2 decreases the rate of reaction. ☐
- Increasing the concentration of H_2O_2 increases the time taken for the disc to reach the surface. ☐
- The biggest difference in time taken for the paper disc to reach the surface is between 0.75 and 1.50% H_2O_2. ☐

[2]

(f) Describe what Mia could do to increase confidence in her data.

.....

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

(g) Use the lock and key model to explain why the enzyme catalase can **only** break down H_2O_2.

.....

.....

.....

.....

.....

.....

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

END OF QUESTION PAPER

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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).

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