OCR A GCSE BIOLOGY 9-1 PAPER 1 2022 EXAM

Advance Information for Summer 2022

GCSE (9–1)

Biology A (Gateway Science)

J247

We have produced this advance information to help support all teachers and students with revision for the Summer 2022 exams.

Information

- The format/structure of the papers remains unchanged.
- This notice covers all examined components.
- For each paper, the main list shows the major focus of the content of the exam.
- Topics **not** assessed, either directly or synoptically, have also been listed.
- The information is presented in specification order, **not** in question order.
- Assessment of practical skills, maths skills, and Working Scientifically skills will occur throughout all of the papers.
- You are **not** permitted to take this notice into the exam.
- This document has **3** pages.

Advice

- It is advised that teaching and learning should still cover the entire subject content in the specification, so that students are as well prepared as possible for progression.
- Topics not explicitly given in either list may appear in low tariff questions or via synoptic questions (e.g., questions where students are asked to bring together knowledge, skills and understanding from across the specification).
- Students will still be expected to apply their knowledge to unfamiliar contexts.

Advance Information Summer 2022 3

J247/03

- Section 1.2 What happens in cells (and what do cells need)?
- Section 2.1 Supplying the cell
- Section 2.2 The challenges of size
- Section 3.2 Coordination and control – the endocrine system

Required practical skills that **will be assessed**:

- Practical Activity Group 1: Use a microscope to make observations.
- Practical Activity Group 2: Testing for the presence of biological molecules.
- Practical Activity Group 4: Investigate the factors that can affect the rate of enzyme activity.
- Practical Activity Group 6: Investigate tropic responses in plant shoots.

There are **NO** topics that are **not assessed** in this paper.

Higher Tier, grades 9 to 4

Content is split into six teaching topics B1-B6 and a practical activity skills topic B7:

- Topic B1: Cell level systems
- Topic B2: Scaling up
- Topic B3: Organism level systems
- Topic B4: Community level systems
- Topic B5: Genes, inheritance and selection
- Topic B6: Global challenges
- Topic B7: Practical skills

Paper 3 assesses content from Topics B1–B3 and B7

Paper 4 assesses content from Topics B4–B6 and B7, with assumed knowledge of Topics B1–B3.

Paper 3 J247/03 90 marks 1 hour 45 minutes Written paper	**50% of total GCSE**
Paper 4 J247/04 90 marks 1 hour 45 minutes Written paper	**50% of total GCSE**

J247/02 and J247/04 include synoptic assessment.

Note:

This revision pack only covers the main content mentioned in the paper 1 of advance information for summer 2022 OCR A GCSE Biology exam. Students must still revise everything else in paper 1 as these can still come as low tariff questions. Everything in paper 1 will be assesses as usual.

Science With Saul
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Gateway Biology A (9-1)

OCR A GCSE 2022 Exam
Baljit Saul

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

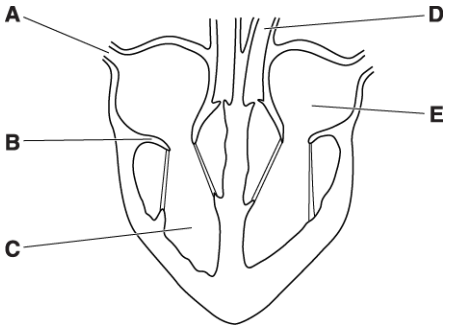
INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **325**.
- The total number of marks may take into account some 'either/or' question choices.

1(a). Look at the diagram of a human heart.



Write the letter **A** to **E** next to the correct name of each part of the heart.

name of part	letter
aorta	
left atrium	
right ventricle	
tricuspid valve	
vena cava	

[2]

(b). Blood contains cells.

One type of cell is a red blood cell.

i. Red blood cells are adapted for their job by being very small.

Explain why this helps them do their job.

---

[1]

ii. Haemoglobin is found in red blood cells.

Haemoglobin is a protein made in the cytoplasm.

Red blood cells start off life with a nucleus.

The gene for haemoglobin is **only** found in the nucleus.

Explain how it is possible that haemoglobin can be made in the cytoplasm.

---

[2]

iii. Haemoglobin is important in transporting oxygen.

Describe how haemoglobin transports oxygen from the lungs to the body cells.

---------- **[2]**

(c). Blood also contains white blood cells.

White blood cells and red blood cells are made in the bone marrow.

Why can cells in the bone marrow produce both red and white blood cells?

---------- **[2]**

2. Mangroves are trees that grow on the coasts of many tropical countries.

Mangroves grow in mud.

The mud is low in oxygen and nutrients.

i. Suggest why the lack of oxygen makes the nutrient content low.

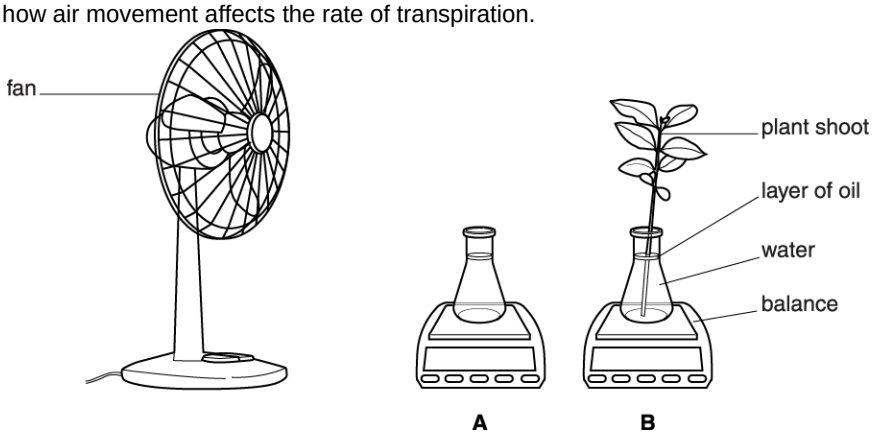
---------- **[2]**

ii. Some mangroves grow structures from their roots to absorb oxygen from the air for respiration.

Why do mangrove roots need to respire?

[3]

3. Liz wants to investigate how air movement affects the rate of transpiration.



She turns the fan on and measures how the readings on the balances change every five minutes.

Describe and explain the overall expected results for **A** and **B**.

The quality of written communication will be assessed in your answer to this question.

[6]

4(a). This question is about circulation.

Look at the graph.

It shows the changes in pressure as blood leaves the heart and passes through blood vessels.

i. Blood leaving the heart has a pressure of 93 mm Hg.

The blood pressure drops by 84 mm Hg.

Calculate the percentage drop in blood pressure.

percentage drop in blood pressure .....%

[1]

ii. Use the graph to name the type of blood vessels at point **A** and point **B**.

blood vessel at point **A** .....

blood vessel at point **B** .....

[2]

(b). The valves inside someone's heart can become damaged.

How can damaged heart valves affect a person's circulatory system?

---**[2]**

5. In 1649 a scientist called Van Helmont wanted to find out if plants gained mass from water.

He watered the soil during the experiment.

He covered the soil so that water could not evaporate from the soil.

i. The mass of the water that he added during the five years, was **much more** than the increase in mass of the plant.

Suggest why.

---**[2]**

ii. He needed to water the soil much more on windy days.

Explain why.

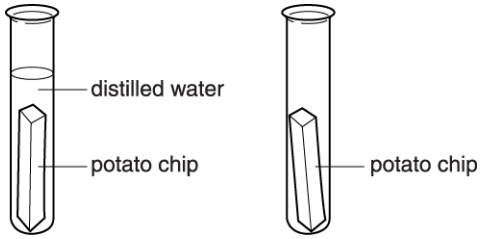
---

[2]

6. Katie cuts two chips from a potato.

She puts one of the chips into a test tube of distilled water.

Katie puts the other chip into an empty test tube.



Water enters the cells of the potato chip that has been left in distilled water by osmosis.

Explain why.

---

[2]

7. Tim is seeing a doctor about his heart.

The doctor says that Tim's heart muscle is not getting enough blood.

This is because he has a blockage in one of his coronary arteries.

The doctor tells Tim that he needs an operation.

Put a tick (✓) next to the type of surgery that can treat this problem.

a by-pass operation	☐
a valve replacement	☐
inserting a pacemaker	☐

inserting a ‘heart assist’ device ☐

8(a). Bristlecone pine trees are among the longest living things on Earth.

One of them, called Methuselah, is in California and is over 4 800 years old.

Methuselah

Bristlecone pine trees live high up in the mountains.

The low temperature, dry soil and strong wind make the trees grow very slowly.

This is because these conditions affect both transpiration and photosynthesis.

Explain how and why these conditions affect both transpiration and photosynthesis.

The quality of written communication will be assessed in your answer to this question.

---

[6]

(b). As a bristlecone pine tree gets older, much of its wood dies.

In old trees only a narrow strip of functioning tissue transports substances between the roots and the leaves.

What types of cells will be in this tissue?

Write down the names of these types of cells and what substances each type of cell transports.

[4]

9. Jo buys an apple tree and plants it in her garden.

Jo waters the tree and then gives it some fertiliser.

The tree roots absorb the minerals in the fertiliser by **active transport**.

Explain what active transport is.

[2]

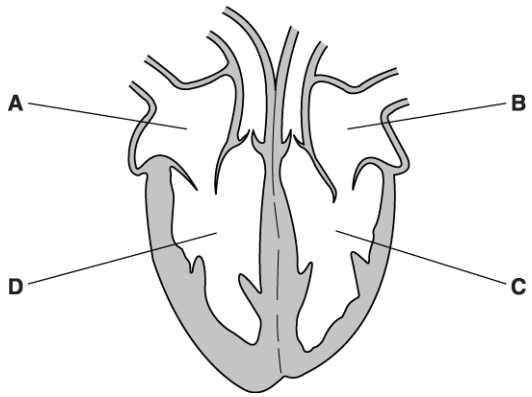
10. About 1 in 10 000 people has a condition called situs inversus.

People with this condition have **their organs reversed** so they are a '**mirror image**' of the usual arrangement.

For most people with situs inversus, there are no harmful effects on their health.

However, doctors need to know if someone has the condition if they are going to successfully treat them if they are ill or injured.

The diagram shows the heart from someone with situs inversus, viewed from the front.



i. Look at the diagram of the heart. Which part pumps blood **around the body**?

Choose from **A**, **B**, **C** or **D**, and explain your choice.

[2]

ii. If someone with situs inversus needs a heart transplant, then a normal heart can be used.

The procedure will be very similar to a normal heart transplant but there will need to be some differences.

Suggest how the procedure will be different.

Explain your answer.

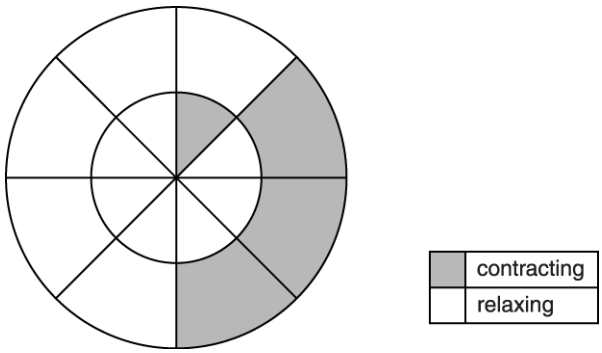
---**[2]**

11. Dicky is visiting the hospital to have his heart checked.

The doctor produces this diagram showing one complete cycle of Dicky's heart.

The inner circle shows what is happening in the atria and the outer circle shows what is happening in the ventricles.

The whole cycle lasts for 0.64 seconds.



i. For how long do the atria contract during one cycle of Dicky's heart?

answer ..... seco

ii. The longer a contraction lasts, the greater the pressure that can be generated by the heart.

Explain how and why the contraction time of the ventricles is different from the contraction time for the atria.

---**[2]**

12. Pesticides can be used to kill pests, such as insects, that damage plants.

Some pesticides are dissolved in water and can be poured onto soil. They are absorbed by plant roots and transported to the leaves to kill insects feeding there.

These pesticides move through plants more quickly on warm sunny days.

Use this information to suggest what part of the plant transports these pesticides to the leaves, and why this happens more quickly on

warm sunny days.

The quality of written communication will be assessed in your answer to this question.

[6]

13. During exercise, the rate of blood flow to different parts of the body changes.

Look at the table.

	Rate of blood flow in ml per minute	
Part of body	**At rest**	**During exercise**
digestive system	1350	600
kidneys	1100	600
muscles	1000	12500
brain	700	750
skin	300	1900
heart muscle	200	750
other	350	400
Total blood flow to the body	5000	17500

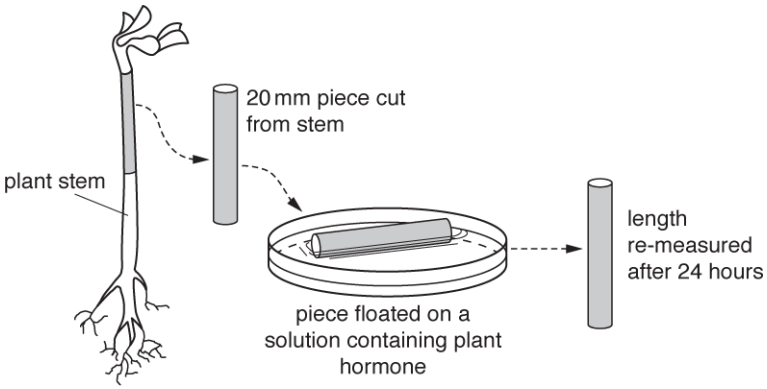
The rate of blood flow to the lungs is always the same as the total rate of blood flow shown in the table. Suggest why.

[1]

14. Growth in plants is controlled by chemicals called plant hormones.

Students want to measure the effect of a plant hormone on the growth of plant stems.

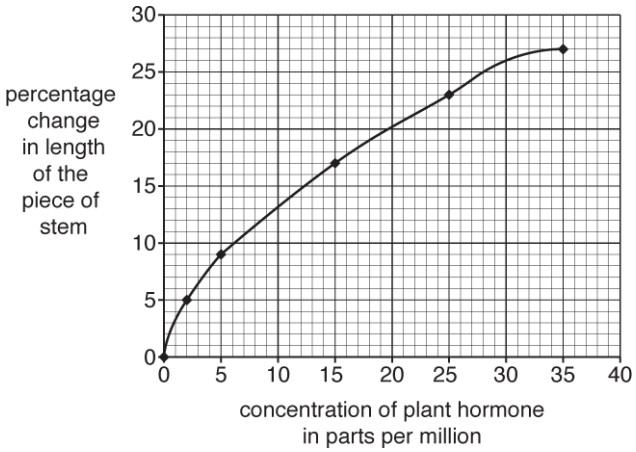
The diagram shows their method.



They repeated the experiment with different concentrations of plant hormones.

After 24 hours they worked out the percentage change in length of the stem.

The graph shows their results.



The diagram shows a piece of stem that has been floating in a plant hormone solution.

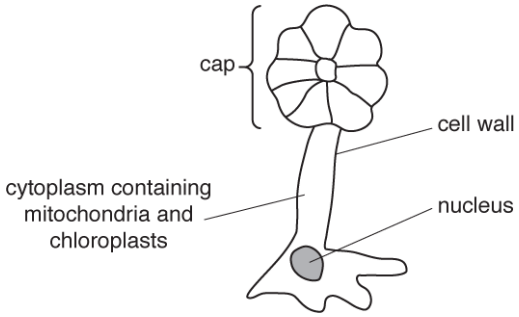
Explain the effect of the plant hormone on the pieces of stem and work out the concentration of plant hormone that **this** piece of stem was floating in.

The quality of written communication will be assessed in your answer to this question.

---**[6]**

15(a). *Acetabularia* is a unicellular organism that lives in the sea.

It has rather an unusual shape.



i. Write down **two** features shown in the diagram of *Acetabularia* that tell you that it is **not** a bacterium.

1 ---

2 ---[

ii. *Acetabularia* is one of the largest unicellular organisms.

To be larger, organisms need to be multicellular.

What is an advantage of being larger and multicellular?

Put a tick (✓) next to the **correct** answer.

Some genes can be lost from some cells.	☐
Both aerobic and anaerobic respiration can occur.	☐
Cells are able to differentiate and specialise.	☐
Organisms are able to clone themselves.	☐

iii. To become multicellular, specialised organ systems may be needed.

Write down **one** of these systems and explain why it is needed.

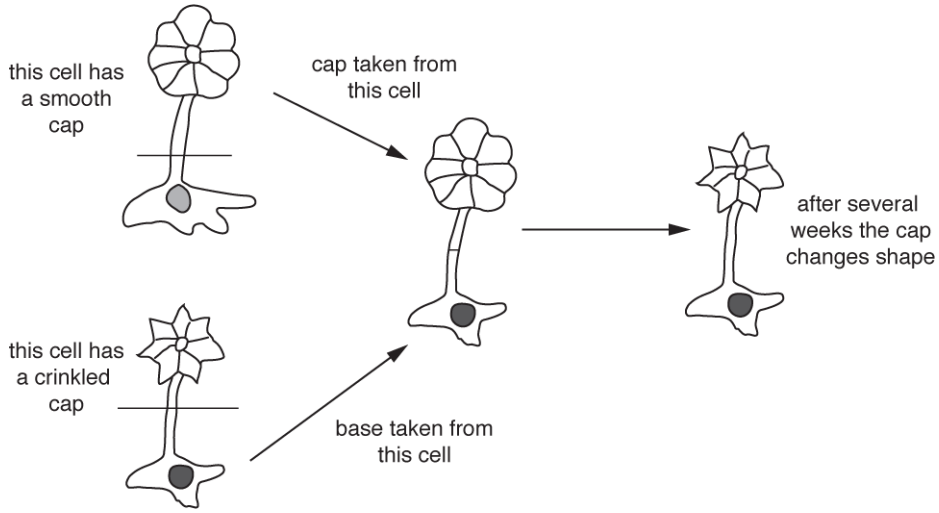
---

[1]

(b).
A scientist did an experiment with two types of *Acetabularia*.

The two types of *Acetabularia* had different shaped caps.

The diagram shows the scientists experiment.



*The shape of the cap depends on which **proteins** are made by the cell.*

Explain how the nucleus codes for proteins that are made elsewhere in the cell and suggest why it took several weeks for the cap to change shape.

The quality of written communication will be assessed in your answer to this question.

--- **[6]**

16. The table shows some information about three types of mammal.

Mammal	Metabolic rate	Surface area of one red blood cell in arbitrary units	Volume of one red blood cell in arbitrary units	Surface area to volume ratio of red blood cells
Mouse	1.0	91	52	1.75
Rabbit	1.5	114	70	1.63
Shrew	7.5	60	24	

i. Calculate the surface area to volume ratio of red blood cells for the shrew.

answer = …… **[1]**

ii. Explain how the shrew manages to maintain its metabolic rate.

Use your calculation in part **(b)(i)** and information from the table in your answer.

--- **[3]**

17. Mia investigates the effect of salt concentration on animal cells.

She puts 5 cm^3 of distilled water into a test tube.

Mia then adds 3 drops of blood to this test tube.

The liquid in the test tube is cloudy.

If the blood cells burst and release their contents then the solution becomes clear.

Mia times how long it takes for the liquid to go clear.

She then repeats the method with different concentrations of salt solution.

Here is her results table.

Concentration of salt in %	**Time to go clear in seconds**
0.00	20
0.25	300
0.50	600
1.00	remained cloudy after 15 minutes
2.00	remained cloudy after 15 minutes

Explain the results including the correct scientific terms to describe the appearance of the cells in the solution at the end of the investigation.

The quality of written communication will be assessed in your answer to this question.

---

[6]

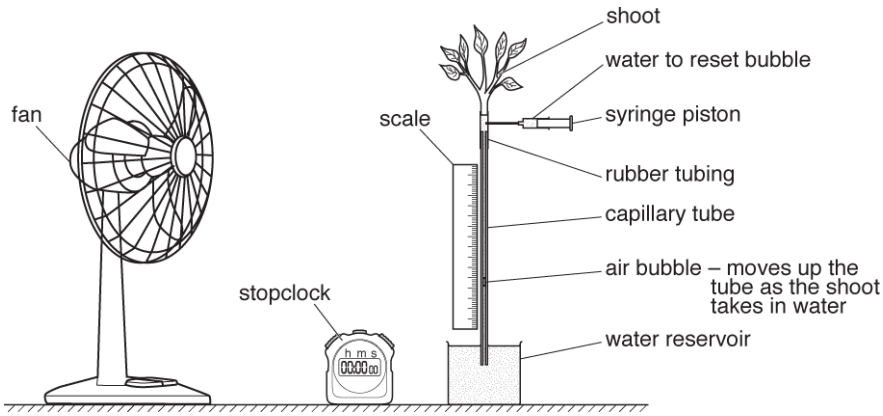
18. Transpiration is the loss of water from the leaves of a plant.
Look at the apparatus in the diagram.

The apparatus is used to measure the effect of air movement on the rate of transpiration.

The distance the air bubble moves in 5 minutes is measured.

The fan is used to change the amount of air movement around the leaves.

The method is repeated 3 times for each fan speed.



Here are the results.

Conditions	**Distance air bubble moves in 5 minutes in mm**		
	repeat 1	**repeat 2**	**repeat 3**
no fan	4	3	4
fan on slow speed	13	12	10
fan on medium speed	47	44	46
fan on fast speed	45	46	48

Explain the **complete** pattern in the results.

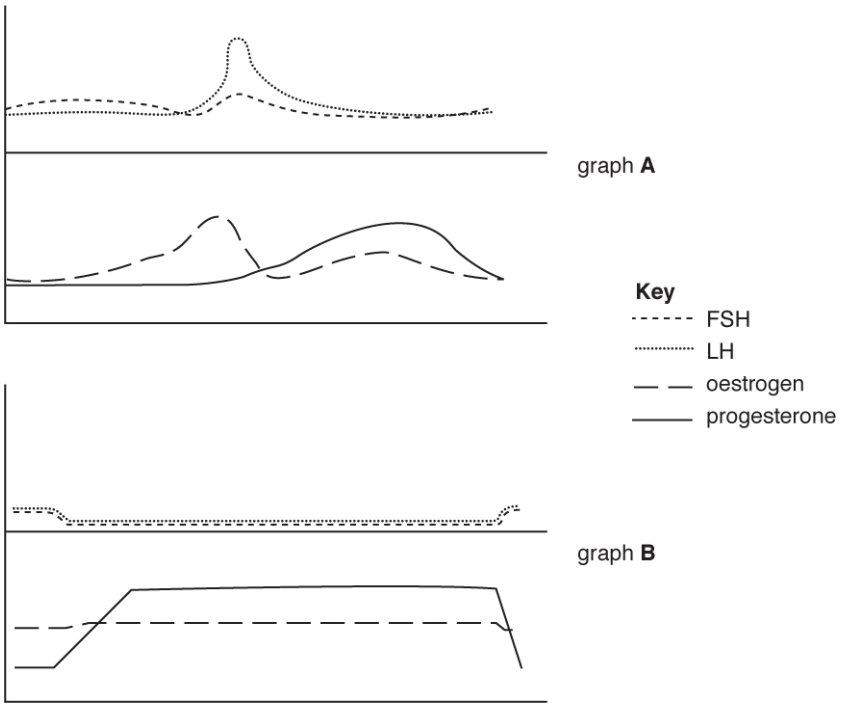
---

[3]

19. The diagram shows the hormone levels in the blood during the menstrual cycle.

Graph **A** represents a normal menstrual cycle.

Graph **B** represents a cycle if the woman is taking contraceptive pills.



Compare the graphs and use them to explain how the contraceptive pill can reduce the chance of pregnancy occurring.

The quality of written communication will be assessed in your answer to this question.

---

[6]

20(a). A student answered two questions in a biology test.

Both his answers contain mistakes.

Explain the student's mistakes in each answer.

Question one: Write down three examples of proteins.

Student's answer: amino acids, collagen, insulin

Student's mistake .....

---

[2]

(b). Question two: How do enzymes work?

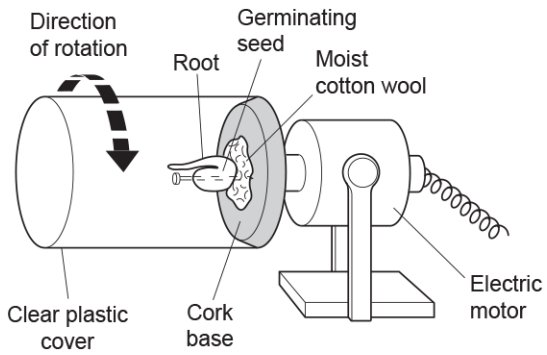
Student's answer: An enzyme is like a key that fits into a substrate's active site.

Student's mistake .....

---

[2]

21. The diagram shows apparatus used in experiments on tropisms.



When the apparatus rotates, the root grows horizontally.

Which tropism is **not** showing its usual effect on the root?

A Negative gravitropism
B Positive gravitropism
C Negative phototropism
D Positive phototropism

Your answer ☐ **[1]**

22. During protein synthesis the DNA that codes for a particular protein is copied. This copy is called mRNA.

The diagram below shows the base sequence for a section of DNA.

G G T G C A T A T

What would be the complementary sequence of mRNA for this section of DNA?

A	C	C	A	C	G	T	A	T	A
B	C	C	A	C	G	U	A	U	A
C	G	G	T	G	C	A	T	A	T
D	G	G	U	G	C	A	U	A	U

Your answer ☐ **[1]**

23. A student uses a simple potometer to study the effect of different temperatures on the cut shoot of a plant.

What does the potometer actually measure?

A Volume of water evaporating from the leaves of the shoot
B Volume of water produced by respiration in the shoot
C Volume of water taken up by the shoot
D Volume of water used in photosynthesis in the shoot

Your answer ☐ **[1]**

24. A plant cell is placed in a solution with a higher solute concentration than the cell contents.

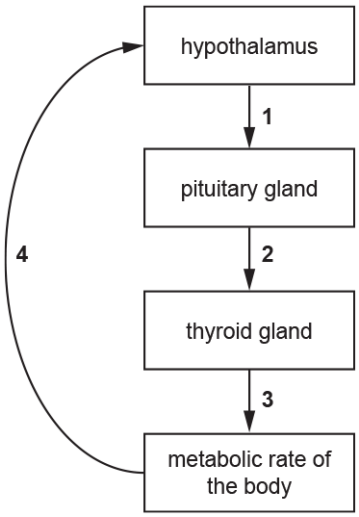
What will happen to the plant cell?

A Absorb water until it bursts.
B Absorb water until it is turgid.
C Lose cytoplasm and shrink.
D Lose water and become flaccid.

Your answer ☐ **[1]**

25. The level of thyroxine in the body is controlled by negative feedback.

The diagram shows how this takes place.



Which numbers on the diagram represent the hormones TSH and thyroxine?

A	**2** = thyroxine	**3** = TSH
B	**1** = TSH	**3** = thyroxine
C	**3** = TSH	**3** = thyroxine
D	**2** = TSH	**3** = thyroxine

Your answer

[1]

26. Which hormone is important in the fruit ripening process in plants?

A Ethene
B Gibberellin
C Progesterone
D Thyroxine

Your answer ☐ **[1]**

27. The surface area of a single red blood cell is 1.5×10^{-4} mm^2.

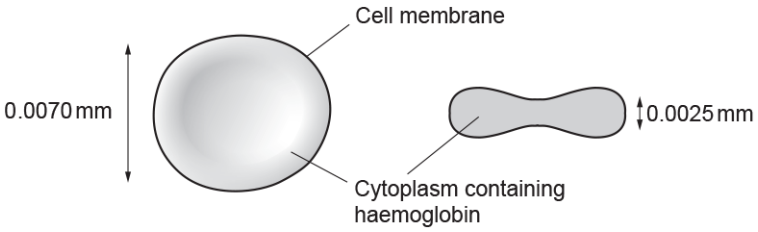
The volume is 1×10^{-7} mm^3.

What is the surface area to volume ratio of a red blood cell?

A 0.0015 : 1
B 0.7 : 1
C 1.5 : 1
D 1500 : 1

Your answer ☐ **[1]**

28. The diagram shows a red blood cell.



	Distance oxygen travels to get to haemoglobin from blood plasma	Surface area to volume ratio	Nucleus present
A	Large	Small	Yes
B	Short	Large	Yes
C	Short	Large	No
D	Large	Large	No

Which row in the table shows how red blood cells are adapted for transport of oxygen?

Your answer ☐ **[1]**

29. Which is a function of carrier proteins in a cell membrane?

A Transfer impulses across a synapse
B Transfer molecules by active transport
C Transport amino acids in protein synthesis
D Transport molecules around the blood

Your answer ☐ **[1]**

30. Sieve plates are structures found in plants.

What is their location and function?

A Found in phloem and allow movement of sucrose
B Found in phloem and allow movement of water
C Found in xylem and allow movement of sucrose
D Found in xylem and allow movement of water

Your answer ☐ **[1]**

31(a).

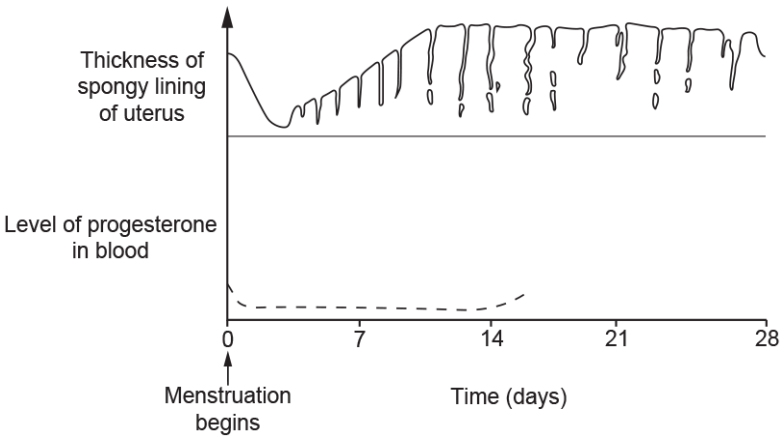
Adrenaline is an important hormone in the body. It helps to prepare the body for a 'fight or flight' response.

Sports injuries which involve cuts and bleeding are often treated with a dilute solution of adrenaline.

Explain why.

---**[2]**

(b). The graph shows how the lining of the uterus changes during the menstrual cycle and also shows the level of progesterone in the blood.



i. Where in the ovary is progesterone produced?

---**[1]**

ii. Draw a line to continue the graph to show the levels of progesterone until day 28 (assume that an egg has not been fertilised).

[2]

(c).

i. An egg develops in a follicle before ovulation. The follicle has a diameter of 25×10^{-3} mm at the start. This follicle grows to 20 mm in diameter just before the egg is released.

Calculate the increase in size of the diameter of the follicle.

Give your answer to **2** decimal places.

Answer = ... mm **[3]**

ii. The failure of a follicle to increase in size can result in less production of oestrogen.

Explain what effect this may have on the uterus.

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

iii. Explain how hormones can be used to treat infertility in women.

.....

.....

.....

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

iv. Infertility can also be caused by problems in the male.

Plasmin is a protease enzyme important in sperm movement.

Explain how changes to the structure of DNA could result in the plasmin enzyme being faulty.

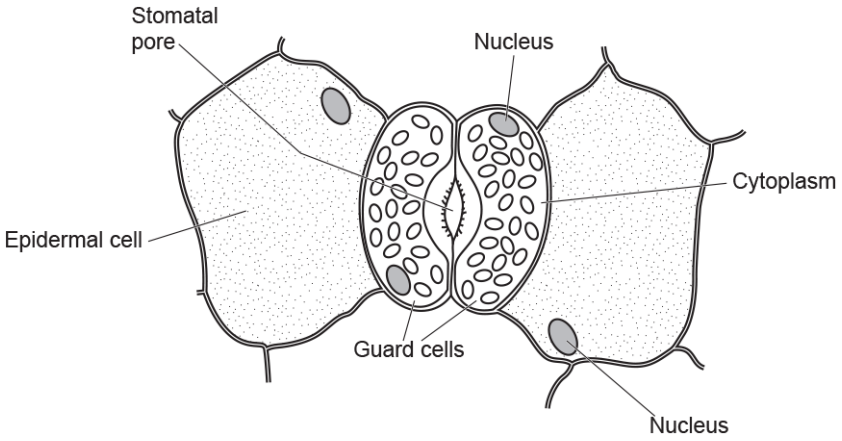
.....

.....

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

32(a).

The diagram shows structures on the surface of a leaf.



i. Photosynthesis occurs in the guard cells but not the epidermal cells.

Explain why this is important in the control of the rate of transpiration in the plant.

---

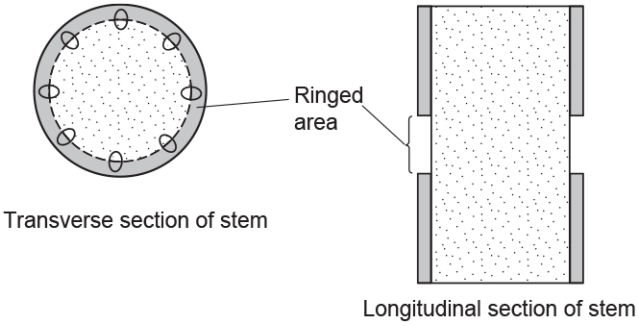
[4]

ii. Explain why guard cells are an example of specialised cells.

---**[2]**

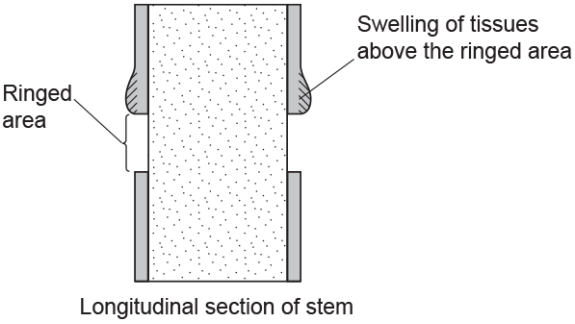
(b). An experiment was done to look at the effect of ringing on a tree trunk. Ringing removes a strip of plant tissue from around the stem of the tree.

The diagram shows where the stem is ringed.



The results were recorded after one week.

The diagram shows the results.



What conclusions can be made about the results?

---**[3]**

33(a). Students investigate how to extract DNA from peas.

Stage 1:

- Chill 10 cm^3 of ethanol. Keep it on ice throughout the method for use in stage 2.
- Make a thick 'soup' by blending 100 cm3 of peas with salt and cold water. Blend for 15 seconds in an electric blender.
- Strain the 'soup' through a mesh strainer and collect the liquid part in a beaker.
- Add 30 cm^3 of washing-up liquid and swirl to mix.
- Let the mixture settle for 510 minutes in a water bath at 60°C.

One group of students made a water bath using a beaker of water, thermometer and Bunsen burner. Another group used an electric water bath.

Write down **two** advantages of using an electric water bath.

1 ----------

---

2 ----------

---

[2]

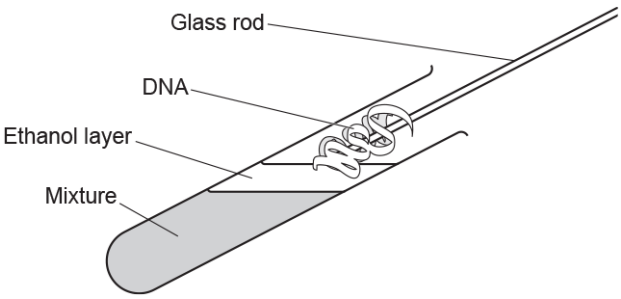
(b). Low temperatures protect DNA by slowing down the activity of enzymes that destroy DNA.
High temperatures break down membranes in the cell.

To extract DNA, some methods use a water bath at 60°C but other methods do not use an increased temperature.

Suggest **two** reasons for the different methods.

---**[2]**

(c). Stage 2 isolates the DNA.



- Pour the mixture collected from stage **1** into a test tube until a third full. Add protease enzymes to the test tube.
- Slowly pour cold ethanol at an angle of 45° into the tube. Ethanol will float on top.
- DNA is soluble in water, but salted DNA does not dissolve in ethanol and will form white clumps where the water and ethanol layers meet.
- Twirl a glass rod and the DNA will collect on the rod.

- Dry the sample on a pre-weighed filter paper and measure the mass of product.

Suggest **two** safety precautions which should be taken at stage **2**.

Explain why each safety precaution is needed.

1 Safety precaution: ----------

Explanation: ----------

2 Safety precaution: ----------

Explanation: ----------

[2]

(d). Look at the table. It shows the results from the two groups of students in the investigation.

Type of water bath used	Mass of DNA collected (mg)			
	Test 1	**Test 2**	**Test 3**	**Mean**
Beaker of water and Bunsen burner				22.9
Electric	33.6	32.3	32.3	.....

i. Calculate the mean mass collected in the investigation using the electric water bath.

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

Answer = ---------- m

ii. The range of the three test readings for the beaker of water and Bunsen burner was 3.4.

Does the evidence support using an electric water bath instead of a beaker of water and Bunsen burner?

Explain your answer.

---**[2]**

34.

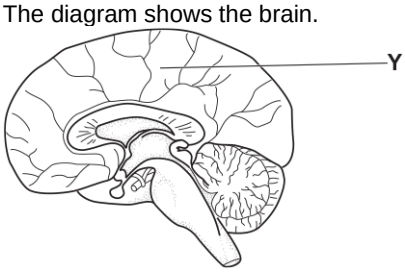
i. Motor neurone disease (MND) is a condition that affects reaction times. MND affects the speed of nerve impulse in motor neurones.

Stem cells taken from the skin of people with MND are used in research. The stem cells can be grown in the lab and used to measure the speed of the nerve impulse.

Which special feature of stem cells makes this possible?

---**[1]**

ii. The diagram shows the brain.



Name part **Y** and explain why it is an important area of the brain in the research of MND.

Part **Y**: ---

Explanation: ---

iii. Measuring the speed of the nerve impulse in the brain is more difficult than using stem cells.

Suggest **two** reasons why.

---**[2]**

35. Retinitis pigmentosa is a genetic condition that affects the eyes.

It is caused by a mutation to a gene. This mutation produces a recessive allele.

The condition causes rod cells in the retina to break down.

i. Explain why stem cells could be used as a treatment for this condition.

---

[2]

ii. Why is it an advantage to use stem cells from the patient rather than from another person?

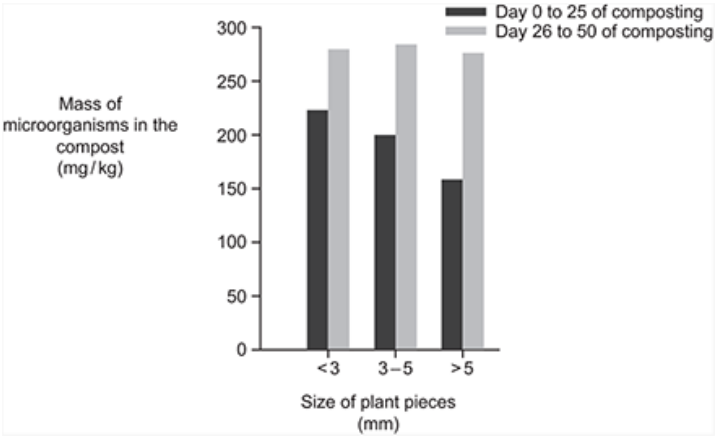
---

[1]

36. This machine helps shred plants for a compost heap.

The machine can shred plants into three different sizes.

This graph is in the instruction booklet for the machine.



The size of the plant pieces has an effect on the number of microorganisms in the compost.

Suggest why.

---

[2]

37. Switching off the protection mechanism described in part **(b)** involves the plant making a **protein.**

Scientists have put extra copies of the gene for this protein into the plants. This makes the plant make more mRNA molecules.

i. Explain why making more mRNA will switch off the mechanism faster.

---**[2]**

ii. Scientists have found that the genetically modified plants make 20% more biomass.

Use the agricultural food chain on page 21 to calculate the increase in biomass this would provide for humans.

Answer = ---------- kg **[2]**

iii. Inserting extra copies of a plant's gene into a plant is a type of genetic modification (GM).

Another example of GM involves inserting a bacterial gene into a plant which makes the plant produce an insecticide.

Suggest reasons why.

---**[2]**

38. An experiment is carried out to find the concentration of potato tissue.

Four chips are cut from a potato.

At the start, each chip is 50 mm long, 10 mm wide and 10 mm high.

Each chip is put in a different sucrose solution **A**, **B**, **C** and **D**.

The volumes of the chips are calculated after 1 hour.

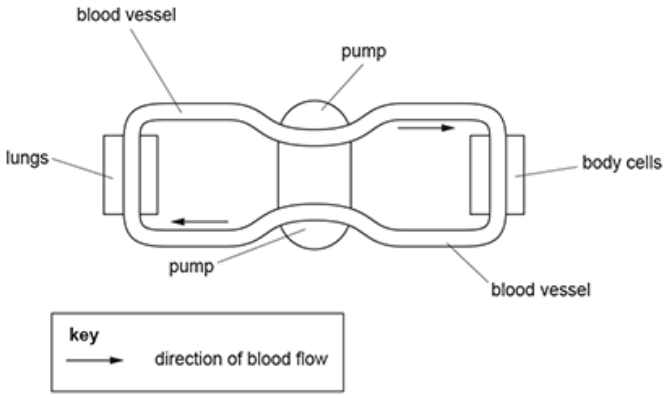
Sucrose solution	Volume of chip (mm^3)
A	50

B	500
C	5000
D	50 000

Which sucrose solution has the same concentration as the potato tissue?

Your answer ☐ **[1]**

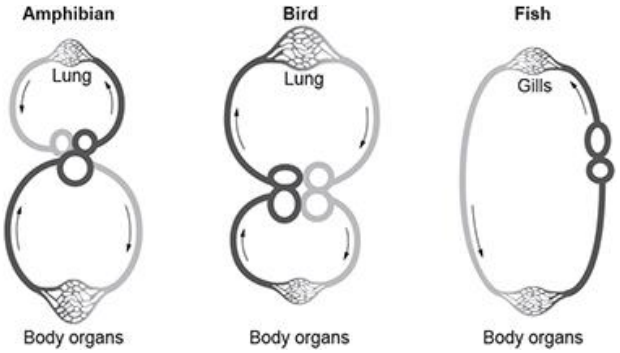
39(a). Look at the diagram. It represents the human circulatory system.



Describe how the diagram shows that humans have a double circulatory system.

--- **[2]**

(b). Look at the diagrams of the circulation systems in an amphibian, bird and fish.



Which of these has a circulatory system most similar to humans?

Tick (✓) **one** box.

Amphibian ☐

Bird ☐

Fish ☐

Explain your choice.

---[3]

(c). Scientists investigate how exercise affects blood flow to different organs in the body.

This is their method.

- Ask a healthy person to sit in a room at 20 °C
- Measure the blood flow to different organs in the person's body
- Repeat this with the person exercising at a constant speed on a treadmill in the same room.

The table shows the scientists' results.

Organ	**Rate of blood flow (ml per minute)**	
	Sitting	**Doing exercise**
Brain	750	750
Heart muscle	250	1000
Muscles	1200	22 000
Skin	500	600
Other organs	3100	650
Total	**5800**	**25 000**

i. By how many times has the **total** blood flow increased by doing exercise?

Give your answer to the **nearest whole number**.

Number of times the total blood flow has increased = ... **[2]**

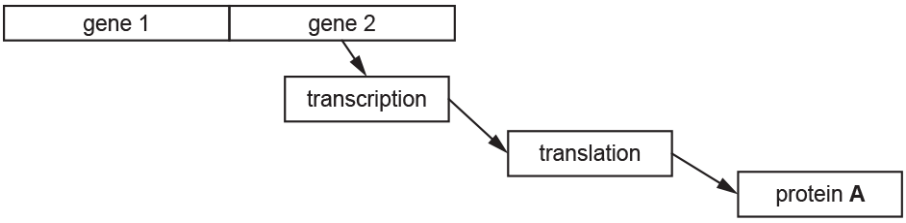
ii. The table shows that blood flow to other organs has decreased by nearly 5 times when a person is **doing exercise**.

The blood flow to the muscles has increased by more than eighteen times.

Explain these changes to blood flow rate.

---**[2]**

40. Gene **1** and gene **2** are both needed for the production of protein **A**.



What is the function of **gene 1** in this process?

A It codes for the amino acids in protein **A**.
B It codes for the mRNA needed to make protein **A**.
C It acts as the site for protein synthesis.
D It controls the expression of **gene 2.**

Your answer ☐ **[1]**

41. An experiment is carried out to find the concentration of potato tissue.

Four chips are cut from a potato.

At the start, each chip is 50 mm long, 10 mm wide and 10 mm high.

Each chip is put in a different sucrose solution **A**, **B**, **C** and **D**.

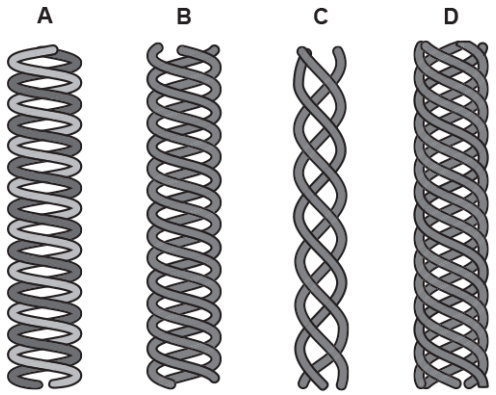
The volumes of the chips are calculated after 1 hour.

Sucrose solution	Volume of chip (mm^3)
A	50
B	500
C	5000
D	50 000

Which sucrose solution has the same concentration as the potato tissue?

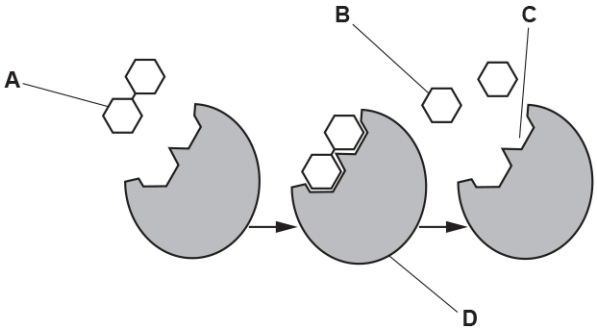
Your answer ☐ **[1]**

42. Which structure most closely resembles DNA?



Your answer ☐ **[1]**

43. Look at the model of enzyme activity.



Which label represents the active site of an enzyme?

Your answer ☐ **[1]**

44. Which biological molecule is **not** a polymer?

A Amylase
B DNA
C Nucleotide
D Starch

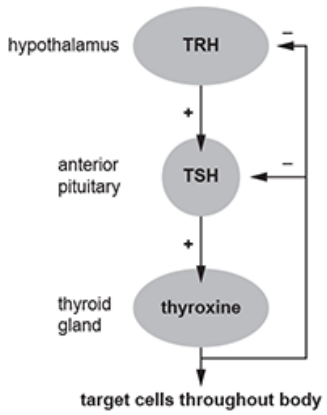
Your answer ☐ **[1]**

45. Why are plant hormones used to cause parthenocarpic fruit development?

A To delay dormancy
B To selectively kill weeds
C To produce seedless fruit
D To shed leaves

Your answer ☐ **[1]**

46. Thyroxine is a hormone controlled by negative feedback.



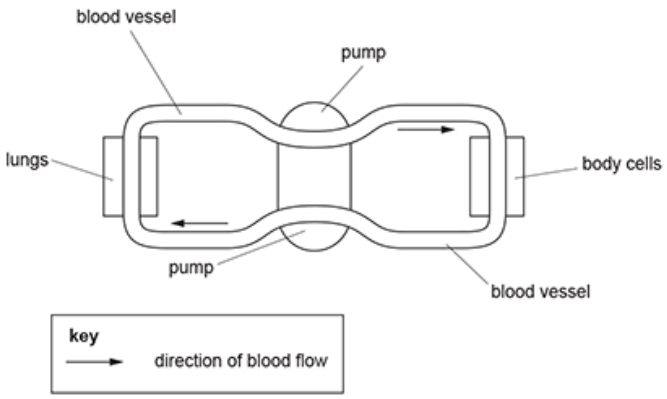
There is an **increase** in the metabolic rate of the body until the cells of the body have the required amount of energy.

Once the cells of the body have the required amount of energy what will happen to the levels of the three hormones in the blood?

A all three will increase
B all three will decrease
C TRH and TSH will increase and thyroxine will decrease
D TRH and TSH will decrease and thyroxine will increase

Your answer ☐ **[1]**

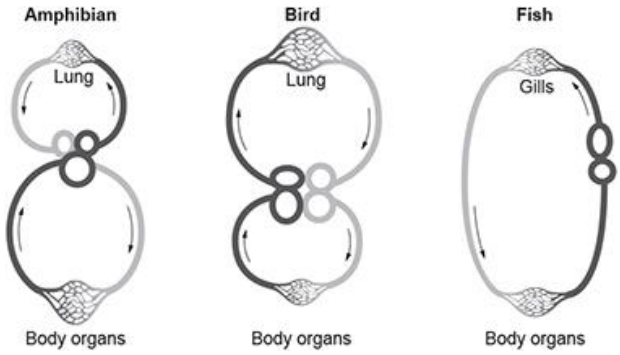
47(a). Look at the diagram. It represents the human circulatory system.



Describe how the diagram shows that humans have a double circulatory system.

---**[2]**

(b). Look at the diagrams of the circulation systems in an amphibian, bird and fish.



Which of these has a circulatory system most similar to humans?

Tick (✓) **one** box.

Amphibian	☐
Bird	☐
Fish	☐

Explain your choice.

---**[3]**

(c). Scientists investigate how exercise affects blood flow to different organs in the body.

This is their method.

- Ask a healthy person to sit in a room at 20 °C
- Measure the blood flow to different organs in the person's body
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The table shows the scientists' results.

Organ	Rate of blood flow (ml per minute)	
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Skin	500	600
Other organs	3100	650
Total	**5800**	**25 000**

i. By how many times has the **total** blood flow increased by doing exercise?

Give your answer to the **nearest whole number.**

Number of times the total blood flow has increased = ...**[2]**

ii. The table shows that blood flow to other organs has decreased by nearly 5 times when a person is **doing exercise**.

The blood flow to the muscles has increased by more than eighteen times.

Explain these changes to blood flow rate.

.....

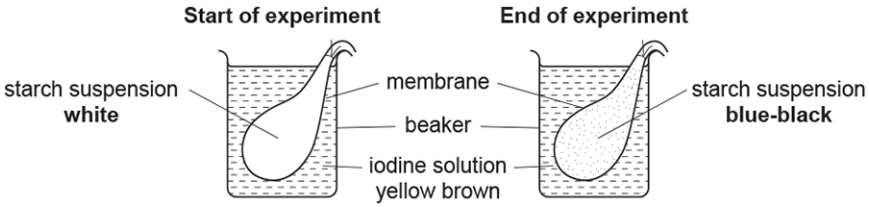
.....

.....

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

48(a). An experiment is set up to investigate how substances move into and out of cells.

Look at the results.

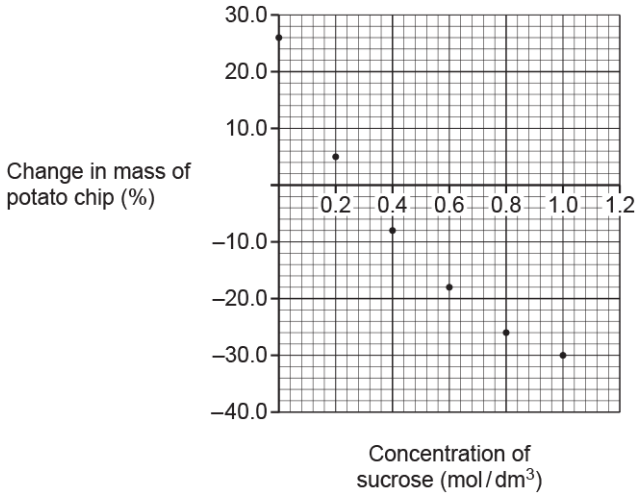


Explain the results of this experiment.
Use ideas about molecules in your answer.

---**[3]**

(b). Plant cells are affected by osmotic conditions.

Look at the graph. It shows the percentage change in mass of potato chips in different concentrations of sucrose.



i. Draw a curve of best-fit on the graph.

[1]

ii. Use the graph to estimate the concentration of sucrose that has the same water potential as the potato cells.

Concentration = ... mol / dm^3 **[1]**

iii. In a different experiment a sucrose concentration of 0.0 mol / dm^3 increases the mass of a carrot chip by 30%.

The carrot chip shows a 10% decrease in mass compared with its original mass for every 0.2 mol / dm^3 increase in sucrose concentration.

Calculate the x-axis intercept for the carrot chip.

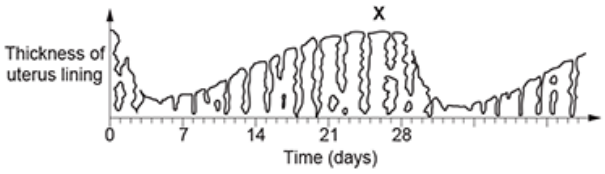
x-axis intercept = ... mol / dm^3 of sucrose **[1]**

(c). Osmotic conditions can increase the size of plant tissue but stem cells are responsible for growth of new cells.

What name is given to plant tissue that contains stem cells?

[1]

49(a). Look at the diagram. It shows changes to the uterus lining during the menstrual cycle.



i. Which hormone would peak at point **X**?

---

[1]

ii. Name **two** hormones that peak immediately before ovulation.

1 ---

2 --- **[1]**

(b). Explain how hormones can be used by women for contraception.

--- **[4]**

(c). Scientists are using human embryonic stem cells to grow cells to treat type 1 diabetes.

Explain why scientists use embryonic rather than adult stem cells.

--- **[2]**

(d). Plant development is controlled by hormones.

Describe **one** effect of gibberellins and **one** effect of ethene on plant development.

gibberellins

---

ethene

---[2]

50(a). A scientist clones a cauliflower plant.

He uses small pieces of the cauliflower plant called explants.

This is the method the scientist uses to get the explants:

- Place the equipment in a beaker of bleach and swab the bench with 70% alcohol.
- Collect a small piece of cauliflower and place on a white tile.
- Using a scalpel cut the piece of cauliflower lengthways into small 3–5 mm pieces called explants.
- Measure the mass of the explants.

What equipment should be used to measure the mass of the explants to 1 hundredth of a gram?

---[1]

(b). The scientist prepares the explants for cloning on an agar jelly plate.

He does this by placing the explants on the agar.

To grow the explants into cauliflower plants, the scientist places the agar jelly plate in a warm room near to a window.

i. Before they form new plant structures, the explants must take in sugars from the agar jelly.

Explain why explants cannot make their own sugars.

---[2]

ii. The experiment could be improved by placing the agar jelly plate with explants into a heated cabinet containing light bulbs.

Describe how this cabinet could be further improved to maximise the growth and development of the explants.

---**[2]**

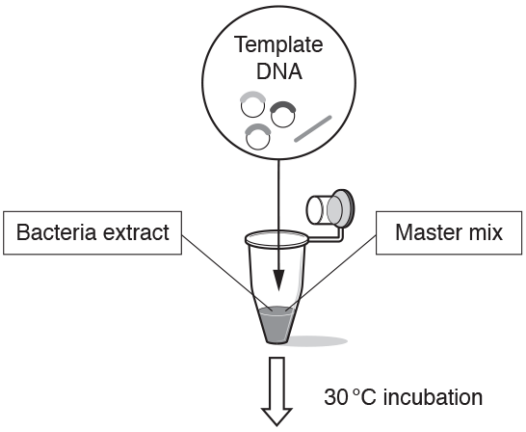
51(a). Scientists can make the proteins they need outside of living cells (*in vitro*).

To do this they use cell free protein synthesis kits.

The kit includes three different parts:

- A template DNA molecule
- An extract from bacteria containing mRNA and tRNA nucleotides
- A master mix containing amino acids, energy sources, enzymes and ribosomes.

To make a protein the three different parts are mixed together and incubated for 3 hours at 30 °C.



i. Describe the role of the DNA template and mRNA nucleotides in the production of the protein.

---**[2]**

ii. Describe the role of the tRNA nucleotides and ribosomes in the production of the protein.

---------- **[2]**

(b). Thirty years ago, identifying a person from their DNA required a large sample of DNA.

Polymerase chain reaction (PCR) is a technique developed in 1983.

PCR allows a single copy or segments of DNA to quickly make multiple copies of a DNA sequence.

i. Many crimes committed over 30 years ago can now be solved using PCR.

Explain why.

---------- **[2]**

ii. Which part of the cell cycle takes place in PCR?

---------- **[1]**

(c).

i. DNA databases involve storing a person's individual DNA profile. The DNA profile identifies DNA sequences present in an individual.

DNA databases are used by many different organisations.

Solving crimes is one use of a DNA database.

Suggest **other** reasons why organisations might need a DNA database.

---------- **[2]**

ii. Write down **one** reason why people might **not** want to be included on a DNA database.

---------- **[1]**

52(a). Rats are a major pest in many areas of the world. They can reduce food security and spread diseases.

Warfarin is a chemical that is used as a rat poison. It stops the correct functioning of platelets in the blood.

Explain why warfarin can be used as a rat poison.

---**[2]**

(b). In 1958, some rats were found that were resistant to warfarin. They did not die, even when fed with large amounts of the poison. Scientists found that the resistance was due to dominant allele **R**.

Two resistant rats can mate and produce non-resistant rats.

Draw a genetic diagram below to show how these non-resistant rats can be produced.

(c). When scientists studied the resistant rats they found that there were two different types.

Homozygous rats are resistant to warfarin but need to eat 20 times more vitamin K.

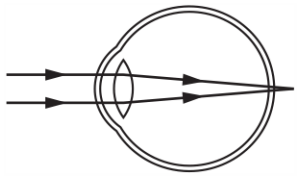
Heterozygous rats are resistant to warfarin but only need slightly increased amounts of vitamin K.

The scientists found that the non-resistant rats never died out completely.

Explain why.

---**[2]**

53. Look at the diagram showing an eye defect.



What is the defect and which lens could be used to correct it?

A Long-sightedness, corrected with a concave lens
B Long-sightedness, corrected with a convex lens
C Short-sightedness, corrected with a concave lens
D Short-sightedness, corrected with a convex lens

Your answer

54. Which row shows the correct direction of blood flow through a double circulatory system?

A	left side of heart	→	body organs	→	right side of heart	→	lungs
B	left side of heart	→	lungs	→	right side of heart	→	body organs
C	right side of heart	→	body organs	→	lungs	→	left side of heart
D	right side of heart	→	lungs	→	body	→	left side of heart

Your answer

55. A student models the process of mitosis using cookies and sprinkles.

Mitosis is part of the cell cycle.

Which process in the cell cycle has the student modelled?

A Cell division
B Chromosome movement
C DNA replication
D Growth of cell

Your answer

56. How is sugar transported around a plant?

A Upwards in phloem
B Upwards in xylem
C Upwards and downwards in phloem
D Upwards and downwards in xylem

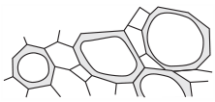
Your answer ☐ [

57. Which diagram shows cells that swell, creating an opening during daylight conditions?

A

B

C

D


Your answer ☐ [

58. Arsenic is a toxin that stops respiration in cells.

What other cell process would be stopped because of arsenic?

A Active transport
B Diffusion
C Osmosis
D Transpiration

Your answer ☐ **[1]**

59. In people with multiple sclerosis their immune cells stop working as they should. HSCT is a treatment for multiple sclerosis which destroys all the immune cells.

Once the immune cells are destroyed, cells from a patient's bone marrow can replace the immune cells.

What type of cell is used to replace the destroyed immune cells?

A Neurone cell
B Red blood cell
C Stem cell
D White blood cell

Your answer ☐ **[1]**

60. A side effect of some antibiotics is to inhibit the release of thyroxine into the blood.

What will these antibiotics do to levels of TSH and TRH?

A Both decrease
B Both increase
C Both stay the same
D TSH increases and TRH decreases

Your answer ☐ **[1]**

61(a). Some students investigate the effect of the surface area : volume ratio on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes that have been stained blue using a pH indicator solution. The indicator will turn red in acidic conditions.

They put different sized cubes into 3 different test tubes of hydrochloric acid and time how long it takes for the cubes to completely change to red.

Fig. 16.1 shows the apparatus they use.

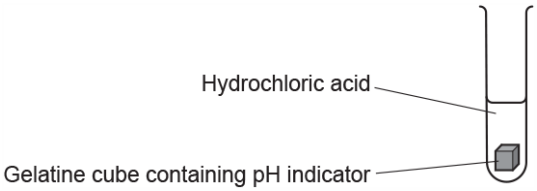


Fig. 16.1

The table shows the students' results.

Length of each side of the cube (mm)	surface area : volume ratio	Time to completely change colour (seconds)
2	.....	32
4	3 : 2	61
6	1 : 1	170

i. Calculate the surface area : volume ratio for the cube with sides of 2 mm.

surface area : volume ratio = ... **[2]**

ii. What conclusion can be made about the effect of surface area : volume ratio on the rate of diffusion?

---**[1]**

iii. Emphysema causes some of the walls of alveoli in the lungs to break down. This produces a smaller number of larger air sacs.

Use the results to explain the effect of emphysema on oxygen diffusing into the blood.

---**[2]**

(b). In a condition called sickle cell anaemia, the red blood cells can change shape. This reduces the amount of oxygen getting to cells in the body.

Fig. 16.2 shows a red blood cell and a sickled red blood cell.

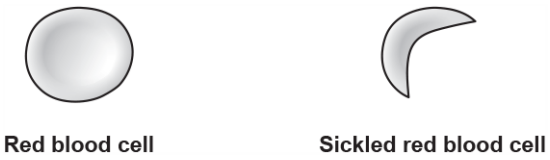


Fig. 16.2

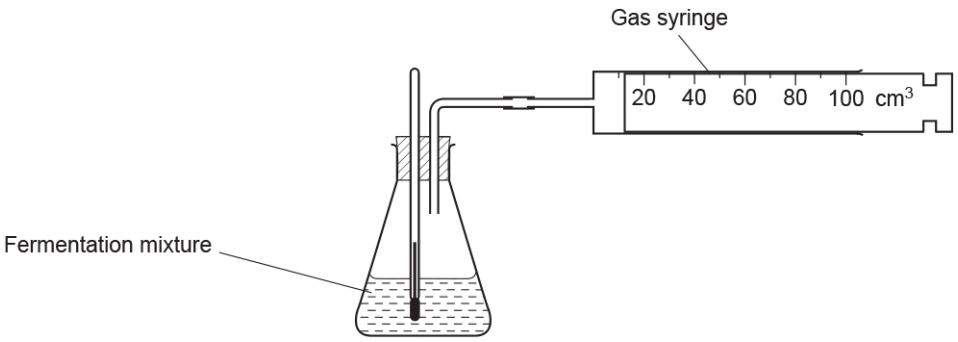
Explain why sickle cell anaemia reduces the amount of oxygen getting to cells in the body.

---**[2]**

62(a). Fermentation involves enzymes that break down sugar releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.
She measures the volume of carbon dioxide released in 10 minutes.
The diagram shows the apparatus she uses.



The student could have measured the volume of carbon dioxide by collecting the gas over water in a measuring cylinder.

Why is it better to use a gas syringe?

---------- **[1]**

(b). The student's results are shown in the table.

Temperature (°C)	Volume of carbon dioxide gas (cm^3) released in 10 minutes		
	Trial 1	**Trial 2**	**Trial 3**
25	23	25	22
30	34	27	33

i. Calculate the **mean** rate of gas produced at **25 °C** in cm^3 / minute.

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

Mean rate of gas produced at 25 °C = ... cm^3 / minute **[3]**

ii. The rate of gas produced at 30 °C is greater than at 25 °C.

Use ideas about enzymes to explain why.

---------- **[3]**

(c). Phenols are chemicals that inhibit enzymes during fermentation.

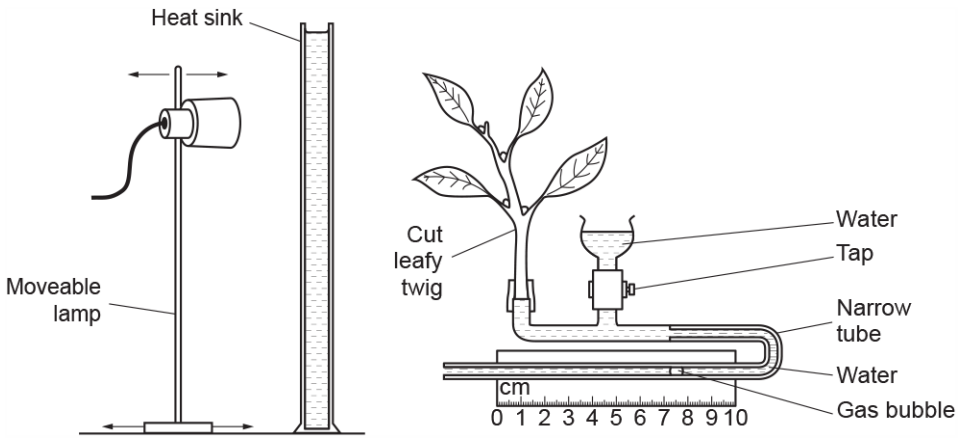
They bind to amino acids on enzyme molecules.

Suggest how phenols inhibit enzymes.

---[2]

63(a). The diagram shows a simple potometer.

The apparatus can be used to investigate the effect of light intensity on transpiration rates.



i. Describe what happens during transpiration.

---[2]

ii. Describe how the apparatus can be used to investigate the effect of light on transpiration rates.

---[3]

iii. The heat sink is a transparent tube of cold water.

Explain why a heat sink is used in this experiment.

---------- **[2]**

(b). The table shows the results from using the potometer.

Distance of potometer from the light (cm)	Distance gas bubble moved in one minute (mm)		
	Trial 1	**Trial 2**	**Trial 3**
10	70	74	72
20	73	75	71
30	52	49	51
40	42	30	31
50	12	14	13

i. The mean distance the gas bubble moved along the tube at 10 cm from the light was 72 mm.

The diameter of the narrow tube was 1 mm.

Calculate the volume of water taken up by the plant.

Use the equation: volume = $\pi r^2 l$
where r is the radius of the tube and *l* is the distance the bubble moves
π = 3.14

Give your answer to **2** significant figures.

Volume of water = ... mm^3 / minute **[**

ii. Identify the anomalous reading in their recorded results and suggest a possible reason for this.

---------- **[2]**

iii. How should the scientists deal with this anomalous reading when they process the data?

---------- **[1]**

iv. The scientists described their results for **20 cm** as 73 ± 2.
Explain why they did this.

---------- **[2]**

64(a). Carolina horsenettle is a weed that grows in crop fields in the USA.

New horsenettle shoots develop from buds on roots in spring. The shoots die in the autumn but the roots remain alive under the ground.

Effective weed control involves stopping seed production and killing the root system.

Selective herbicides are used to control Carolina horsenettle.

The best time to apply selective herbicide is when the horsenettle is actively growing between the bud and flower stage.

i. Describe how a selective herbicide works.

---**[2]**

ii. **Fig. 20.1** and **Table 20.1** show information about four different herbicides **A, B, C** and **D**.

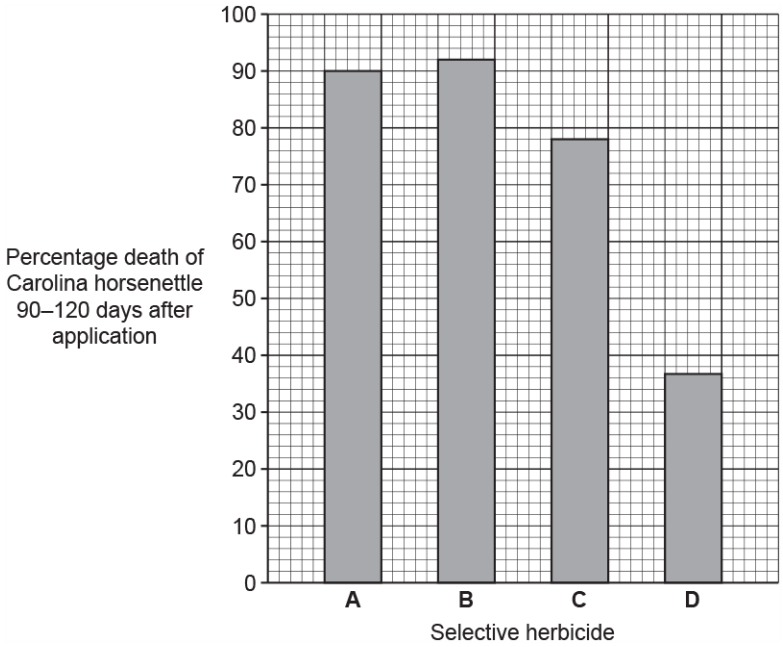


Fig. 20.1

Selective herbicide	**A**	**B**	**C**	**D**
Effect on Carolina horsenettle	prevents seeds and roots of plants growing	prevents seeds and roots of plants growing	prevents seeds and roots of plants growing	prevents shoot grow and fruiting but minim damage to roots
What plants herbicide works on	Carolina horsenettle	Carolina horsenettle and several other broad-leaved plant species	Carolina horsenettle	Carolina horsenettle most other broad-lea plant species
Cost of herbicide	medium	high	medium	low

Table 20.1

Carolina horsenettle is growing in a field with a crop and other broad-leaved weeds.
Evaluate the information on selective herbicides **A, B, C** and **D**.

Which selective herbicide would be best to use and when it should be applied?
Explain your decision.

---**[4]**

(b).

i. Describe **one** effect that gibberellin hormones have on plants.

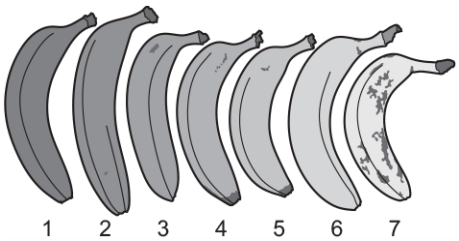
---**[1]**

ii. A student investigates ripening in bananas.

The student keeps bananas in different conditions. After 1 week he decides if each banana was **ripe** or **not ripe**.

The results were difficult to interpret so he planned to develop the experiment.

He found a picture that he thought he could use.



Explain how this could help develop his experiment.

---

65. Protein synthesis takes place inside cells.

Describe what happens during protein synthesis.

Use terms from the list in your answer.

amino acids **DNA** **mRNA** **transcription**

translation **ribosome**

---**[4]**

66(a). Fanconi anaemia is a genetic disorder. It results in the bone marrow being destroyed.
This causes a decrease in the numbers of red blood cells, white blood cells and platelets.

Explain **two** possible symptoms of Fanconi anaemia.

1 ---

---

2 ---

(b). Table 19.1 shows normal ranges for blood components in people **without** Fanconi anaemia.

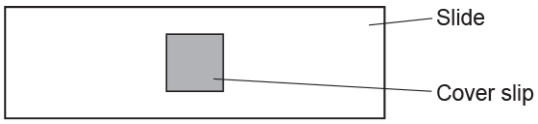
Blood component	Number per mm^3
red blood cell	$4.5 – 6.5 \times 10^6$
white blood cell	$6.0 – 16.0 \times 10^3$
platelet	$1.5 – 4.0 \times 10^5$

Table 19.1

i. Suggest why there is such a wide range of white blood cell numbers.

---**[2]**

ii. The diagram shows a microscope slide containing blood from a patient.



The square cover slip is 10 mm wide and the thickness of the blood underneath is 0.001 mm.

Calculate the volume of blood under the cover slip.

Volume of blood = ... mm

iii. Under the cover slip are 1000 white blood cells.

Does the blood sample provide evidence that the patient has Fanconi anaemia?

Use **Table 19.1** and your answer to part **(ii)** to justify your answer.

---**[3]**

(c). There are many different genetic disorders that can affect blood cells. Details of three of these are found in **Table 19.2**.

Name of disorder	Cause of disorder	Symptom
D-B anaemia	dominant allele	low red blood cell numbers
S-D syndrome	recessive allele	low white blood cell numbers
Fanconi anaemia	recessive allele	small numbers of all blood cells

Table 19.2

A blood smear from another patient shows that he has 3×10^6 red blood cells per mm^3 of blood. Neither

of his parents have a blood disorder.

Use **Table 19.1** and **Table 19.2** to explain which blood disorder the patient could have.

Name of disorder

Explanation

67(a). Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

Write the words **allele, chromosome, genome** and **nucleotide** in the boxes to show their size from smallest feature to largest feature.

Smallest feature	
Largest feature	

(b). One in 500 people are heterozygous for HC.

There are 66 000 000 people in the UK.

Calculate how many people in the UK are heterozygous for HC.

Number of people = ...

(c). A woman who does not have HC and a man who is heterozygous are expecting a baby.

What is the probability of the baby having HC?

Complete the genetic diagram to explain your answer.

Use **D** for the dominant HC allele and **d** for the recessive allele.

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	Man	
Woman		

Probability = ...

(d). The allele that is affected by HC codes for a protein called LDL receptor protein. The faulty allele often has four extra nucleotides, making a total of 2521 nucleotides.

Calculate the number of **amino acids** found in the healthy, **unaffected** protein.

Number of amino acids = ...

(e). People with HC are more likely to develop heart disease. **Fig. 21.1** shows the heart of a person who has heart disease.

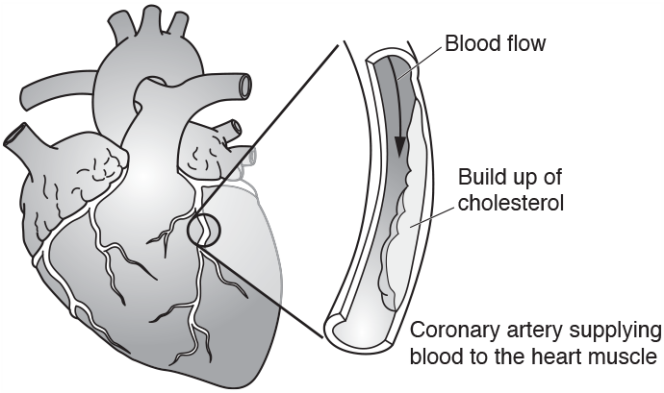


Fig. 21.1

The LDL receptor protein is found on the cell membrane of liver cells. The receptor picks up cholesterol from the blood and transports it into the liver cell. Inside the liver cell the cholesterol is broken down or used.

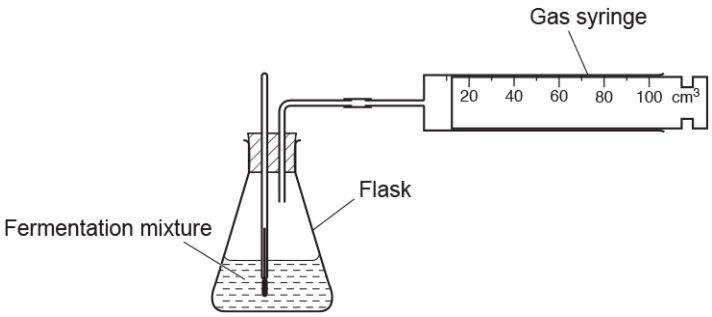
Explain why people who have the mutation in the allele for the LDL receptor are much more likely to develop heart disease.

---**[6]**

68(a). Fermentation involves enzymes breaking down sugar and releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.
She measures the volume of carbon dioxide released in 10 minutes.
The diagram shows the apparatus she uses.



Using a Bunsen burner to heat a water bath is **one** way the student could keep the flask at a constant temperature.

i. What other way could be used to keep the flask at a constant temperature?

---**[1]**

ii. She chooses to use a Bunsen burner and water bath.

Give **one** safety precaution she should take.

---**[1]**

iii. Explain why using a Bunsen burner and water bath may introduce errors into her results.

---**[2]**

(b). The table shows the student's results.

Temperature (°C)	Volume of carbon dioxide gas released in 10 minutes (cm^3)				
	Trial 1	**Trial 2**	**Trial 3**	**Mean**	**Ran**
25	23	25	22	23	22-
30	34	29	33	.....	29-

i. Calculate the **mean** for the results at 30 °C and **complete the table**.

ii. The student repeated the experiment at two more temperatures, 20 °C and 35 °C, to get enough readings to plot a line graph.

Which measurement should the student plot on the **x-axis**?

---------- **[1]**

iii. Describe **one** way that the range would improve any conclusions made from the graph.

---------- **[1]**

iv. The mean volume at a temperature of 20 °C was 15 cm^3 and for a temperature of 35 °C it was 27 cm^3.

Describe what the student's results show about the effect of temperature on enzyme activity.

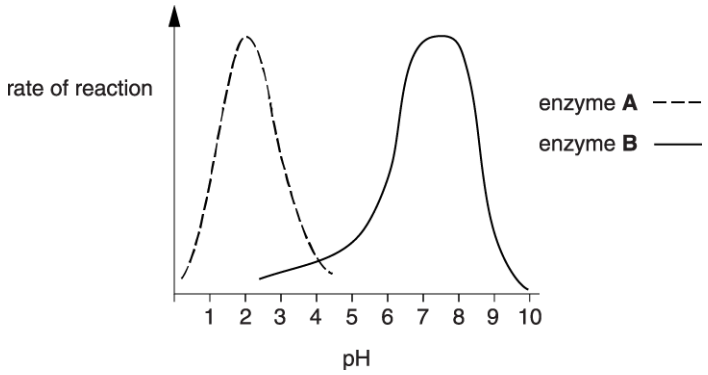
---------- **[2]**

69. This question is about digestion.

Scientists investigate two enzymes and pH levels in the digestive system.

Look at the graph.

It shows the rate of reaction of enzyme **A** and enzyme **B** in different pH conditions.



Look at the table.

It shows the pH in different parts of the digestive system.

Part of digestive system	pH
mouth	6.5
stomach	2.0
small intestine	7.5
large intestine	7.0

The scientists claim their results show enzyme **A** is a protease enzyme and is found in the stomach.

Do the results back up their claim?

Explain your answer.

---**[2]**

70(a). A group of students investigate the effect of temperature on the breakdown of the fat in milk by the enzyme lipase.

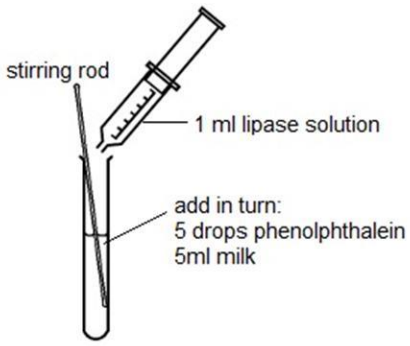
In their investigation they use an indicator called phenolphthalein.

Phenolphthalein is pink in alkali conditions but becomes colourless when the pH falls below pH8.

A student puts 5 drops of phenolphthalein and 5 ml of full fat milk into a test tube.

She adds 1 ml of lipase, stirs the mixture and times how long it takes to lose the pink colour.

Other students repeat this but at different temperatures.



The table shows the group's results.

Temperature (°C)	Time for pink colour to disappear (s)
20	480
40	240
60	270
80	960

Explain the difference between the results at 20 °C and 40 °C.

---**[3]**

(b). Explain the difference between the results at 80 °C and 40 °C.

---**[3]**

(c).

i. One student says that the results show that the optimum temperature for the lipase is 40 °C.

The teacher says that she **cannot** say for certain that it is 40 °C.

Explain why.

---

[1]

ii. Give **two** reasons how the students could modify their method to find out the optimum temperature more accurately.

[2]

(d). The students rounded their times to the nearest 10 seconds.

They did this because they found it difficult to judge exactly when the pink colour had disappeared.

Describe and explain **two** ways the method could be improved to give more accurate measurements.

1

2

[2]

71(a). A group of students investigate the effect of temperature on the breakdown of the fat in milk by the enzyme lipase.

In their investigation they use an indicator called phenolphthalein.

Phenolphthalein is pink in alkali conditions but becomes colourless when the pH falls below pH 8.

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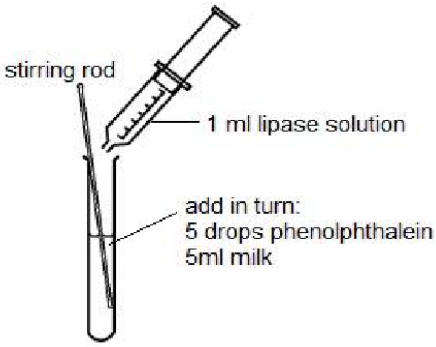
Other students repeat this but at different temperatures.



The table shows the group's results.

Temperature (°C)	Time for pink colour to disappear (s)

20	480
40	240
60	270
80	960

Explain the difference between the results at 20°C and 40°C.

---**[3]**

(b). Explain the difference between the results at 80°C and 40°C.

---**[3]**

END OF QUESTION PAPER