AH

National Qualifications 2018

X707/77/02

Biology
Section 1 — Questions

TUESDAY, 15 MAY

9:00 AM – 11:30 AM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X707/77/01.

Record your answers on the answer grid on *page 03* of your question and answer booklet.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

◇SQA

X7077702

1. Which row in the table describes properties of proteins that allow them to be separated using the techniques shown?

	Protein separation technique	
	Centrifugation	Gel electrophoresis
A	density	charge
B	charge	density
C	shape	charge
D	charge	shape

2. Which of the pairs of cell types are fused in order to produce monoclonal antibodies?

   A   T lymphocyte and myeloma

   B   B lymphocyte and myeloma

   C   T lymphocyte and hybridoma

   D   B lymphocyte and hybridoma

**3.** The three-dimensional structure of a protein is shown.
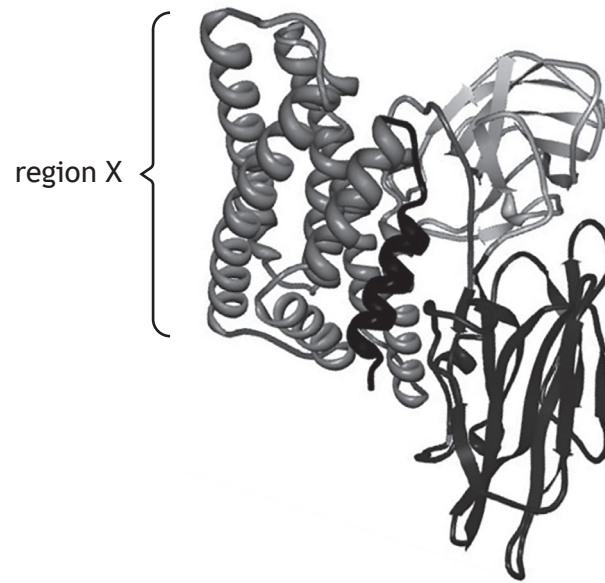
region X

Which row in the table describes region X?

	Type of secondary structure	Bonding that stabilises secondary structure
A	β-sheet	peptide
B	α-helix	peptide
C	β-sheet	hydrogen
D	α-helix	hydrogen

4. The diagram shows some interactions between amino acid R-groups in a polypeptide chain.

Which letter shows hydrophobic interactions?
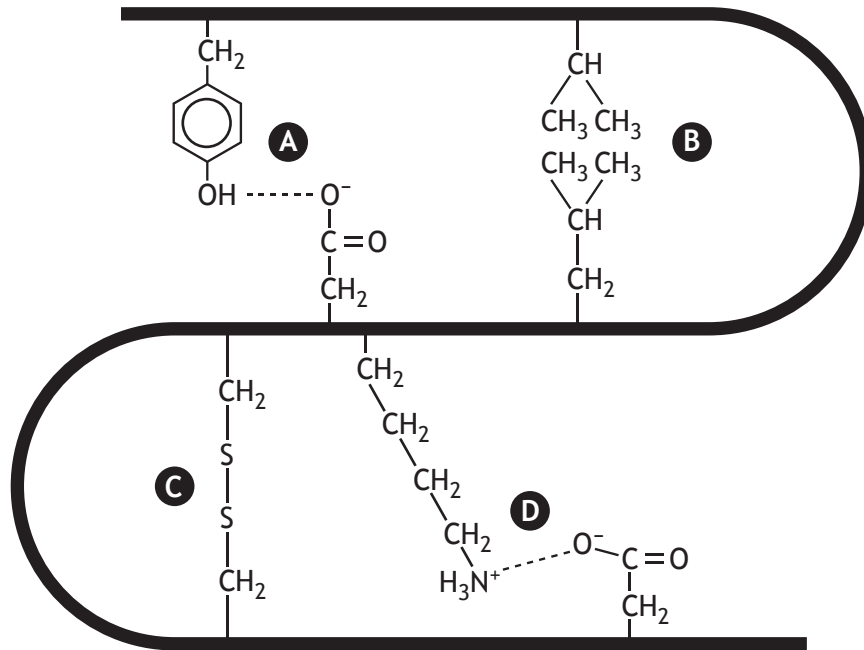
5. A student is preparing media for an experiment to investigate the effect of an inhibitor on cell growth. Flask 1 contains a control medium with no inhibitor.

The concentration of the stock inhibitor solution used to prepare the final solution is **80%**.

Flask	Inhibitor volume (cm^3)	Glucose volume (cm^3)	FBS volume (cm^3)	Buffer volume (cm^3)	Final inhibitor concentration (%)
1	0·00	1·00	5·00	19·00	0
2		1·00	5·00		20

What volumes of inhibitor and buffer should be added to flask 2 to give 25 cm^3 of medium with an inhibitor concentration of 20%?

A   4·75 cm^3 inhibitor + 20·25 cm^3 buffer

B   4·75 cm^3 inhibitor + 14·25 cm^3 buffer

C   6·25 cm^3 inhibitor + 18·75 cm^3 buffer

D   6·25 cm^3 inhibitor + 12·75 cm^3 buffer

6. Transcription of gene Z only occurs when its transcription factor is dephosphorylated.

The distribution of the transcription factor together with the activities of a protein kinase and protein phosphatase specific to this transcription factor are shown in the table.

Tissue	Transcription factor present	Protein kinase activity	Protein phosphatase activity
Muscle	–	–	+
Heart	+	+	–
Brain	+	–	+

Gene Z is transcribed in the

A   brain only

B   heart only

C   muscle and brain only

D   heart and brain only.

7. The effect of changing the concentration of extracellular potassium ions on the function of sodium potassium pumps was investigated.

Starting with an extracellular solution containing no potassium ions, as the concentration of potassium ions is increased the pumps would be expected to

A   pump out potassium ions at a faster rate

B   stay in their phosphorylated conformation for longer

C   pump in sodium ions at a faster rate

D   hydrolyse ATP at a faster rate.

[Turn over

8. A sample of 10^6 cells was found to contain $0 \cdot 4$ mg protein. Actin comprises $4 \cdot 5\%$ of the total protein. 42 g of actin contains $6 \cdot 02 \times 10^{20}$ molecules.

    1 g $= 1000$ mg

    The number of actin molecules **per cell** is

    A $2 \cdot 58 \times 10^8$

    B $2 \cdot 58 \times 10^{10}$

    C $2 \cdot 58 \times 10^{11}$

    D $2 \cdot 58 \times 10^{14}$

9. An outcome of the activation of a cell's thyroid hormone receptors by thyroxine is

    A   decreased production of Na/KATPase

    B   increased production of Na/KATPase

    C   decreased metabolic rate

    D   opening of ligand-gated ion channels.

10. The flow diagram shows part of the ADH signal transduction pathway in a collecting duct cell.

ADH binds to its receptor

↓

Receptor activates G-protein

↓

G-protein activates protein kinase
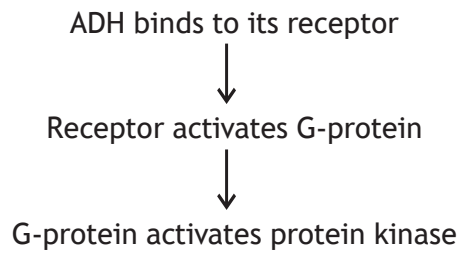
Which row in the table shows how this pathway would be altered in an individual with diabetes insipidus?

	Concentration of inactive G-proteins	*Phosphorylation of proteins*
A	decreased	decreased
B	decreased	increased
C	increased	decreased
D	increased	increased

11. Which row in the table describes the states of the proteins p53 and Rb that would increase the rate of cell division?

	Protein	
	p53	*Rb*
A	activated	phosphorylated
B	inhibited	phosphorylated
C	activated	dephosphorylated
D	inhibited	dephosphorylated

12. Which diagram shows the correct positions of the cell cycle checkpoints?

Checkpoint is represented by ▮

A

G_0

G_1 S

M G_2

B

G_0

G_1 S

M G_2

C

G_0

G_1 S

M G_2

D

G_0

G_1 S

M G_2
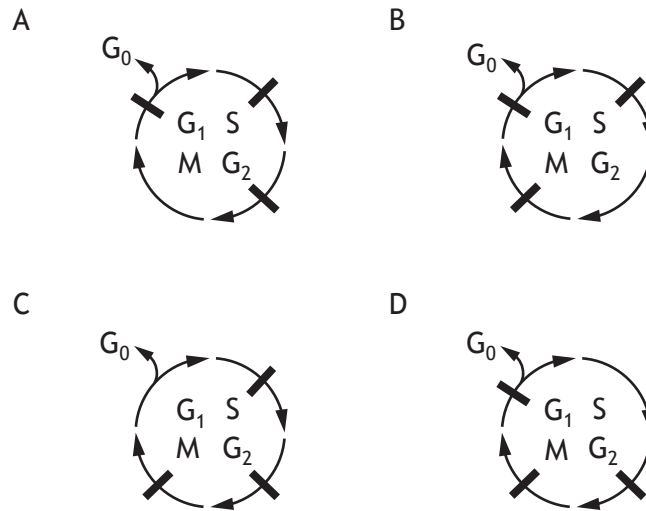
13. In a study of transmission of the rabies virus by vampire bats, the density of bat colonies was estimated using mark and recapture techniques.

The total population estimate is given by (MC)/R where the first sample captured is M, the second sample captured is C and the number recaptured is R.

One colony was estimated to have a bat population of 440 following the capture of a second sample of 64 bats, of which 8 were marked.

The number of bats captured initially, marked and released was

A   32

B   55

C   110

D   128

14. Which of the following describes the purpose of a randomised block design?

A   Controlling for confounding variables

B   Ranking sample data

C   Ensuring that sampling is representative

D   Monitoring the dependent variable

15. Merlins are small birds of prey which chase and capture skylarks. The effect of skylark song on hunting by merlins was studied.

Graph 1 shows the number of successful and unsuccessful attacks on skylarks showing different singing behaviours.

Graph 2 shows how the different singing behaviours affected the mean duration of chases by merlins attacking skylarks.

Graph 1

Graph 2

Key

☐ Unsuccessful attack

▨ Successful attack
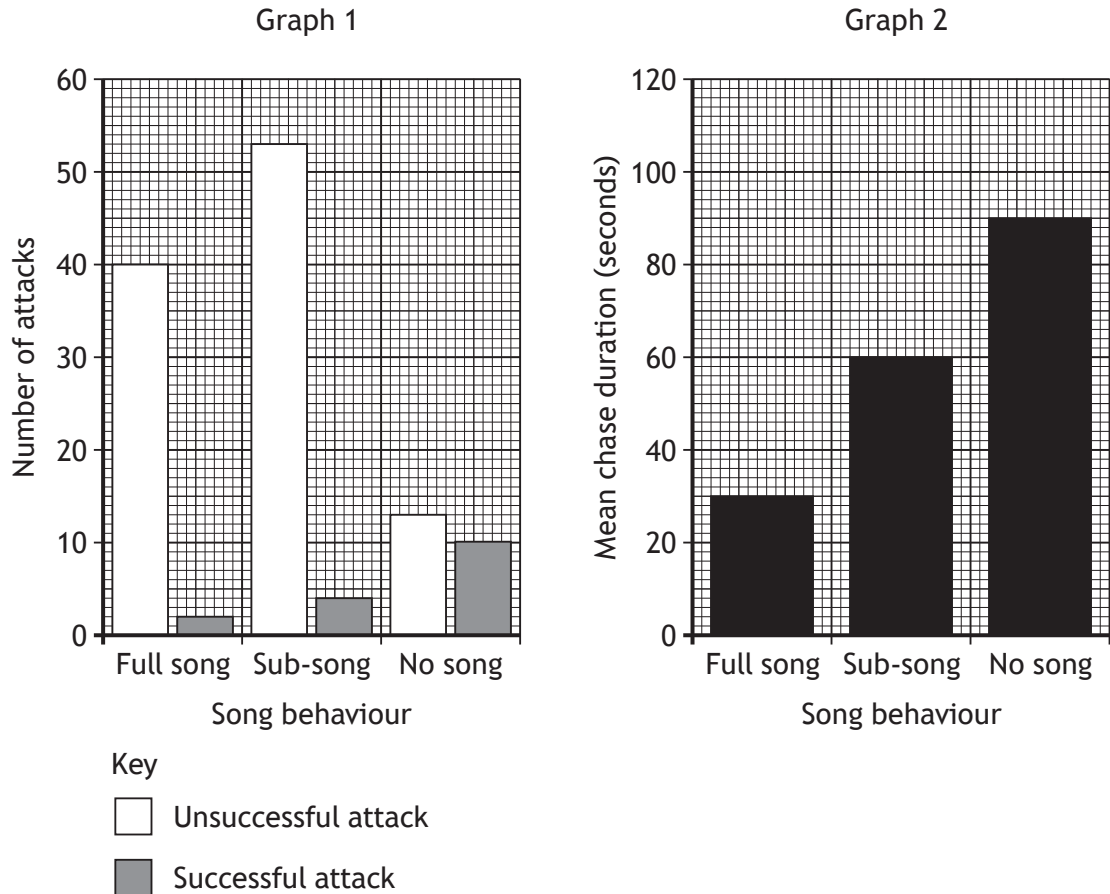
Which of the following generalisations about skylark singing behaviour is valid?

A No song decreases the number of attacks by merlins and the time they will chase.

B No song increases the success of attacks by merlins and the time they will chase.

C No song increases the number of attacks by merlins and the time they will chase.

D No song decreases the success of attacks by merlins and the time they will chase.

[Turn over

16. Humans and many other primates have opposable thumbs. In the giant panda, a modified wrist bone forms a false 'thumb' which is used along with the five digits to manipulate bamboo.

The list shows processes related to evolution.

1   Convergent evolution

2   Divergent evolution

3   Natural selection

Evolution of the thumbs of primates and the false 'thumbs' of giant pandas has involved

A   1 only

B   2 only

C   1 and 3 only

D   2 and 3 only.

17. Which statement includes representatives of all three domains of life?

A   Insects can be vectors for bacterial infections in plants.

B   Photoreceptor proteins are found in archaea, plants and animals.

C   Scientists have cloned genes from archaea that can be expressed in *Escherichia coli*.

D   Diseases in potato crops can be caused by the transmission of viruses by nematodes.

18. Haemophilia A is a sex-linked condition that slows blood clotting. The allele for normal clotting (X^H) is dominant to the allele for haemophilia A (X^h).

The diagram gives information about the inheritance of haemophilia A in one family.
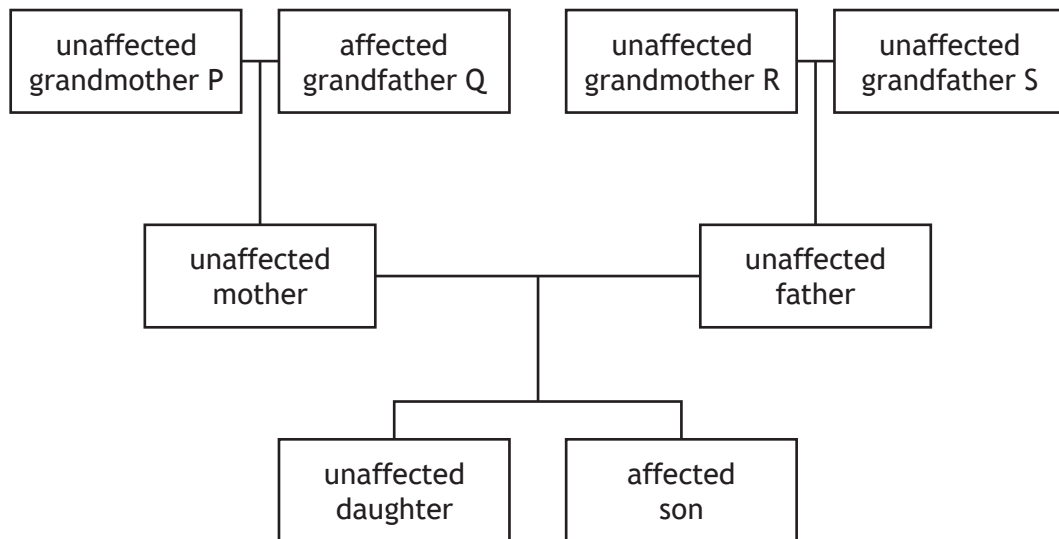
From the information given, which of the statements is true?

A   The genotype of grandmother P must be $X^H X^h$ but the genotype of grandmother R cannot be determined.

B   The genotype of neither grandmother can be determined.

C   The genotype of both the unaffected mother and her daughter must be $X^H X^h$.

D   The genotype of neither the mother or her daughter can be determined.

[Turn over

19. Red deer in Scotland have no natural predators. Control of the growth of a population to prevent it from outstripping resources is achieved by annual culling. The number killed annually must be greater than the *recruitment* (annual population increase due to births). Since birth rates vary, computer models are used to generate three estimates for recruitment based on birth rates of 30%, 35% and 40%. The number of red deer culled annually is recorded in different areas.

The table shows cull totals for one year in four areas, along with estimated recruitment at each birth rate.

Area	Cull total	Estimated recruitment based on birth rate		
		30%	*35%*	*40%*
North Ross	2654	2151	2557	2963
East Loch Ericht	887	897	1066	1234
Breadalbane	3026	1396	1659	1922
Knoydart	1082	1079	1283	1487

If the true birth rate is 35%, the area(s) in which the cull is sufficient to prevent population growth would be

A   North Ross, East Loch Ericht, Breadalbane and Knoydart

B   North Ross, Breadalbane and Knoydart only

C   North Ross and Breadalbane only

D   Breadalbane only.

20. Many species display some characteristics that are typical of r-selection and some that are typical of K-selection.

Which of the following species displays **only** K-selected characteristics?

A   Leatherback turtles: lay up to nine large clutches of eggs per breeding season; hatchlings receive no parental care; small proportion survives to reach sexual maturity.

B   Arctic terns: usually lay two eggs per clutch; adults are aggressive in defence of their young; more than 50% of offspring live to 30 years of age.

C   English oak trees: slow-growing; do not produce seeds until at least 40 years of age; mature trees produce many thousands of seeds annually but only a small proportion germinate.

D   Common dandelions: readily colonise disturbed ground; grow rapidly; flower several times a year; produce many seeds per flower head.

21. During the ritualised courtship in peafowl, *Pavo muticus*, the male spreads and shakes his tail feathers to attract a female before stepping back and bowing. This is followed by loud mating calls.

This type of fixed action pattern response can be a result of

A   honest signals

B   imprinting

C   male-male rivalry

D   species-specific sign stimuli.

22. An *in vivo* study involves observations made in

A   the natural habitat of an animal

B   a living cell culture in the laboratory

C   a living organism

D   extracts prepared from living tissues.

[Turn over

23. Eggs of the parasitic liver fluke *Leucochloridium paradoxum* are found on vegetation and can be eaten by marsh snails, *Succinea putris*. Inside snails, eggs develop into larvae which move to the ends of their tentacles. The tentacles become swollen and brightly coloured, resembling striped caterpillars. Infected snails become more active during daylight when predatory birds mistake the abnormal tentacles for caterpillars and eat them. The larvae within the tentacles complete their life cycle within the birds' bodies. Eggs are passed out of the birds in faeces.

Which items on the list represent part of the extended phenotype of the parasite?

1   Prey selection by birds

2   Modification of snail tentacles

3   Changed activity of snails

4   Feeding method of snails

A   1 and 2 only

B   1 and 3 only

C   2 and 3 only

D   3 and 4 only

24. Which row in the table identifies white blood cells capable of long term survival as a part of immunological memory in mammals?

	Type of white blood cell			
	B lymphocytes	T lymphocytes	Phagocytes	Natural killers
A		✓		✓
B	✓		✓	
C			✓	✓
D	✓	✓		

25. The graphs show data derived from a study investigating the effectiveness of the drug praziquantel (PZQ) on Ugandan children with symptoms of schistosomiasis.
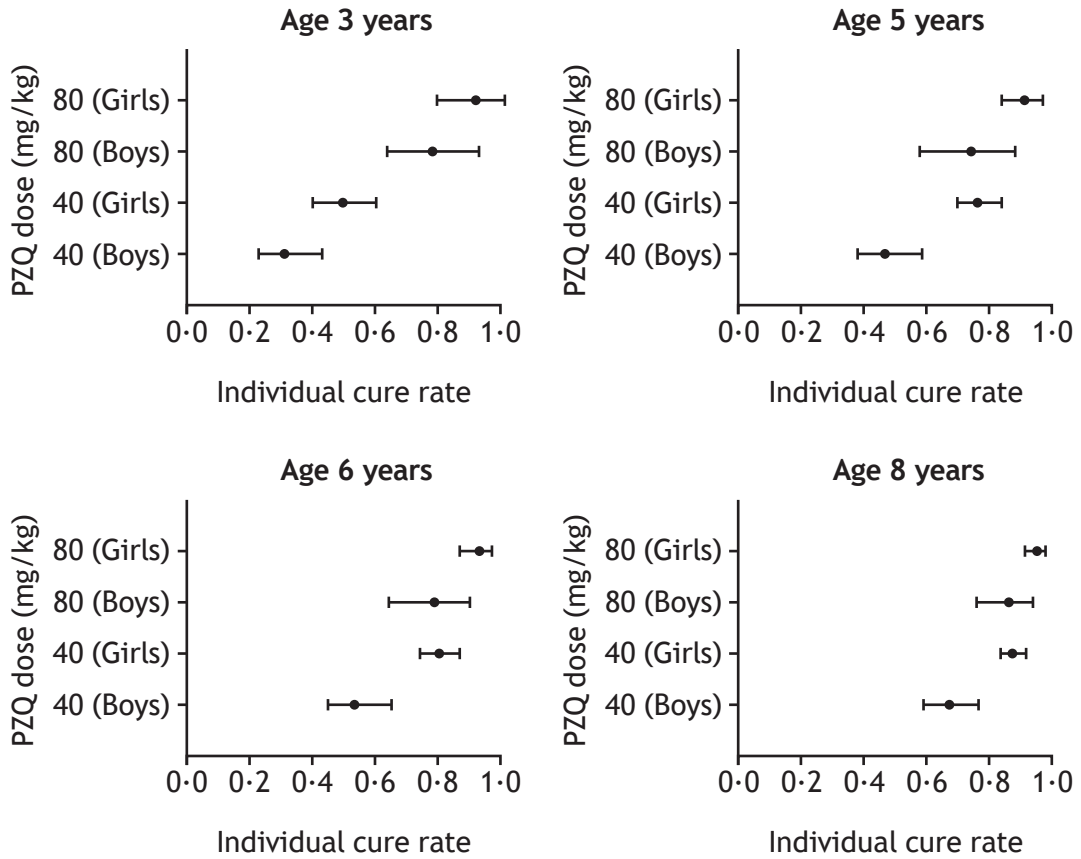
At what age does the data suggest that children would receive most benefit by increasing the dose of the drug?

A 3 years

B 5 years

C 6 years

D 8 years

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET]

ACKNOWLEDGEMENTS

AH

National Qualifications 2018

Mark

X707/77/01

Biology
Section 1 — Answer Grid and Section 2

TUESDAY, 15 MAY
9:00 AM – 11:30 AM

X7077701

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day	Month	Year	Scottish candidate number

Total marks — 90

SECTION 1 — 25 marks
Attempt ALL questions.
Instructions for the completion of Section 1 are given on *page 02*.

SECTION 2 — 65 marks
Attempt ALL questions.

A supplementary sheet for question 1 is enclosed inside the front cover of this question paper.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. Score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

◇ SQA ©

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A/HTP

The questions for Section 1 are contained in the question paper X707/77/02.

Read these and record your answers on the answer grid on *page 03* opposite.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

2. There is **only one correct** answer to each question.

3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample question

The thigh bone is called the

     A   humerus

     B   femur

     C   tibia

     D   fibula.

The correct answer is **B** — femur. The answer **B** bubble has been clearly filled in (see below).

Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.

If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○
21	○	○	○	○
22	○	○	○	○
23	○	○	○	○
24	○	○	○	○
25	○	○	○	○

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[Turn over for next question

SECTION 2 — 65 marks

Attempt ALL questions

Question 11 contains a choice

1. **Read through the supplementary sheet for question 1 before attempting this question.**

    (a) Explain why the rate of uptake by GLUT transporters levels off at high glucose concentrations. **1**

    _____

    _____

    (b) **Refer to Figure 2 in the supplementary sheet for question 1.**

    Figure 2 shows GLUT3 has the lowest K_M for glucose.

    Explain how this supports the conclusion that GLUT3 has the highest affinity for glucose. **1**

    _____

    _____

    (c) The rate of glucose transport at a given glucose concentration can be calculated using the formula:

    $$V = \frac{V_{max} \times [G]}{K_M + [G]}$$

    V = rate of glucose transport

    [G] = glucose concentration (mmol per litre)

    GLUT2 transporters, found mainly in liver and pancreatic cells, have a K_M of 17 mmol per litre. At this concentration of glucose the rate of transport by GLUT2 is 0·02 mmol/min.

    The physiological range of blood glucose concentration in a healthy individual after fasting ranges from approximately 3·9 to 5·5 mmol per litre.

    (i) Calculate the rate of glucose transport by GLUT2 when the blood glucose concentration is 5·5 mmol per litre. **2**

    Space for calculation

    _____ mmol/min

1. (c) (continued)

(ii) Increases in blood glucose concentration lead to increased insulin production by the pancreas. Glucose uptake by GLUT2 is important for this response because as glucose entry via GLUT2 increases the pancreas synthesises more insulin.

Suggest why the high K_M of GLUT2 is important in this mechanism for sensing glucose concentration.

1

_____

_____

(d) Release of insulin into the bloodstream leads to a rapid increase in the transport of glucose into muscle and fat cells via GLUT4.

Explain why this normal response to insulin does not happen in individuals with type 2 diabetes.

2

_____

_____

_____

_____

(e) **Refer to Figure 3 in the supplementary sheet for question 1.**

Describe the trend shown in Figure 3.

1

_____

_____

(f) Blood serum caffeine levels in people who regularly consume caffeine are typically around 6 μmol per litre.

Using Figure 3 predict, with justification, whether this level of caffeine consumption would be likely to have a large effect on the transport of glucose by GLUT1.
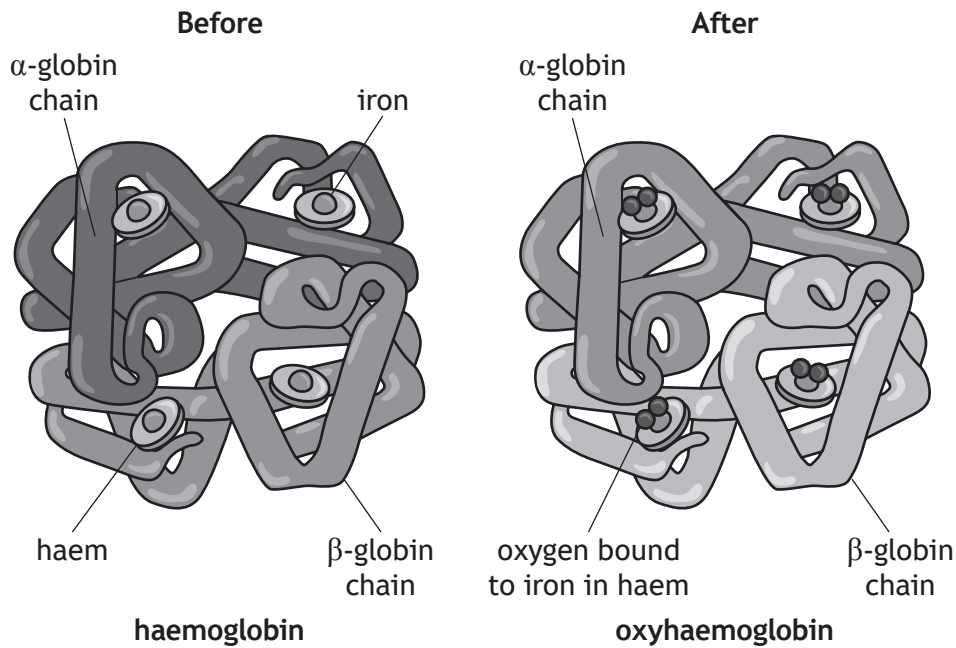
1

_____

_____

[Turn over

2. (a) The figure represents the four subunits (two α, two β) of a haemoglobin molecule before and after binding with oxygen molecules.

Before

α-globin chain   iron

haem   β-globin chain

haemoglobin

After

α-globin chain

oxygen bound to iron in haem   β-globin chain

oxyhaemoglobin

(i) Name the process whereby binding of oxygen to one subunit of haemoglobin alters the affinity of the remaining subunits. **1**

_____

(ii) Tissues with higher metabolic rates require more oxygen. These tissues produce more carbon dioxide, which dissolves in tissue fluids to form carbonic acid.

Explain how this increases oxygen delivery at these tissues. **1**

_____

_____

(iii) Haem is a non-protein component important in the function of haemoglobin.

State the term used to describe such a component. **1**

_____

2. (continued)

(b) During one stage in its life cycle, the human parasite *Plasmodium* enters a red blood cell. In order to obtain amino acids that it requires, it digests haemoglobin using a mixture of protease enzymes. This releases the product haem, which is toxic to the parasite. Haem is then converted into non-toxic haemozoin by another enzyme called HDP.

Stage 1   **Stage 2**

Haemoglobin $\xrightarrow{\text{Proteases}}$ Haem (toxic) $\xrightarrow{\text{HDP}}$ Haemozoin (non-toxic)
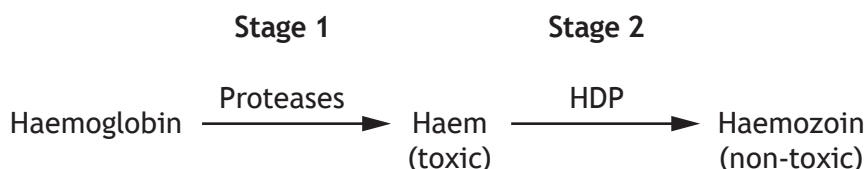
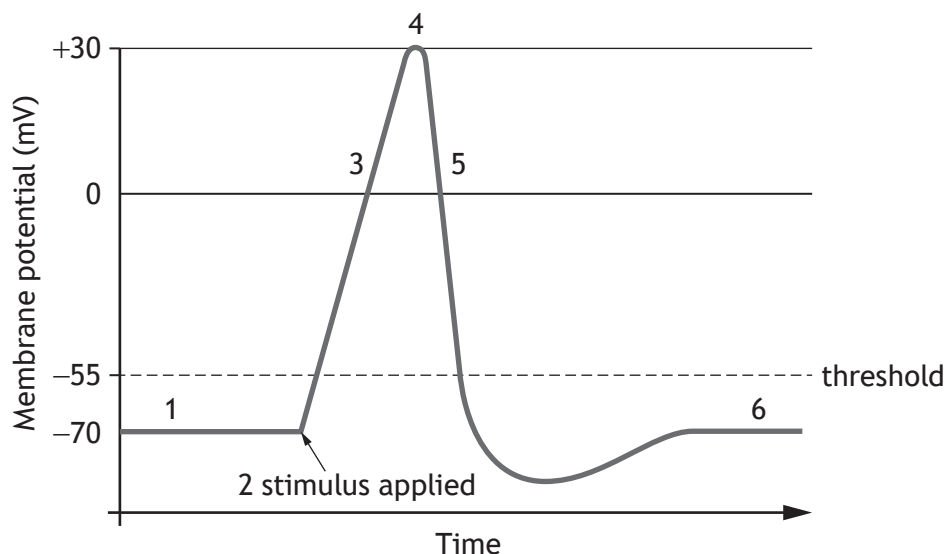(i) Name the human disease caused by *Plasmodium*.   **1**

_____

(ii) Chloroquine is one of a number of drugs used to treat this disease.

Suggest how drugs such as chloroquine, that target Stage 2, may provide an effective treatment.   **2**

_____

_____

_____

_____

[Turn over

3. The diagram shows stages in the transmission of a nerve impulse.

1   Membrane potential before nerve impulse initiated

2   Binding of a neurotransmitter to a ligand-gated sodium ion (Na^+) channel

3   Voltage gated Na^+ channels open

4   Voltage gated Na^+ channels become inactivated

5   Voltage gated potassium ion (K^+) channels open

6   Membrane potential after nerve impulse has passed

(a)   (i)   State the term that describes the membrane potential at points 1 and 6.   **1**

_____

   (ii) Use the diagram to calculate the change in membrane potential between points 1 and 4.   **1**

   Space for calculation

_____

3. **(a)** **(continued)**

(iii) Use the information in the diagram to explain the importance of K^+ channels in nerve transmission. **2**

_____

_____

_____

(b) Tetrodotoxin is a poison found in some fish, such as the pufferfish, which has its effect at stage three of the process shown in the diagram.

Suggest a possible mechanism for the toxicity of this substance. **1**

_____

_____

[Turn over

4. The neurotransmitter gamma-aminobutyric acid (GABA) binds to $GABA_A$ receptors in nerve cells. $GABA_A$ receptors are a family of structurally related transmembrane ion channels. One proposed structure of a $GABA_A$ receptor is shown in the diagram.

region S

extracellular

phospholipid bilayer

intracellular
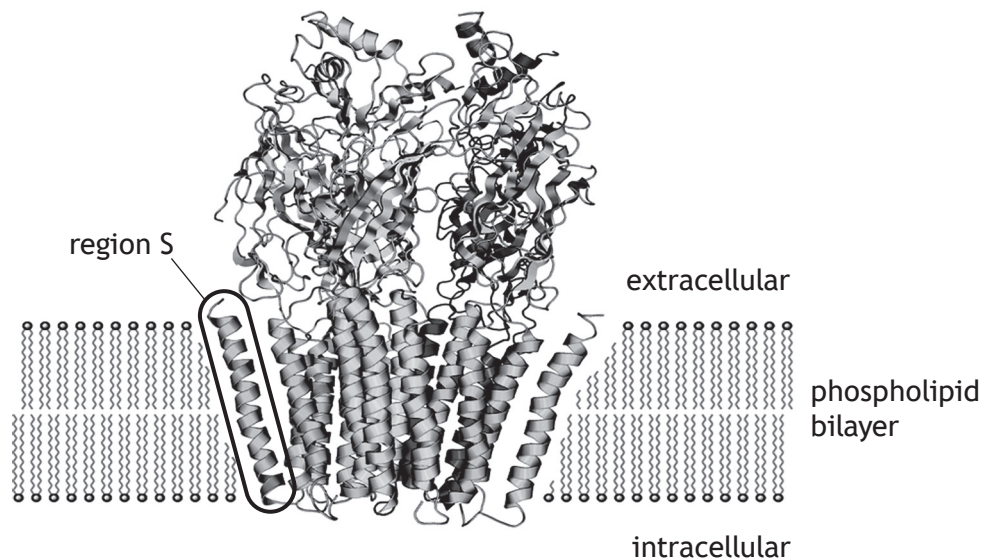
(a) (i) All $GABA_A$ receptors consist of five subunits.

Name the level of protein structure describing several connected polypeptide subunits. **1**

_____

(ii) Region S has some of the R groups in contact with the bilayer.

Predict the class of R groups to which these amino acids belong. **1**

_____

4. (continued)

(b) It has been suggested that different forms of the $GABA_A$ receptor subunit can arise as a result of alternative RNA splicing.

Explain how alternative RNA splicing could result in the production of variant forms of $GABA_A$ receptor subunits.

2

_____

_____

_____

_____

(c) Suggest what happens to the receptor protein when GABA binds to it. **1**

_____

_____

(d) The drug diazepam increases the effect of GABA molecules by binding to a secondary (allosteric) binding site on $GABA_A$ receptors.

State the term used to describe the effect of diazepam on $GABA_A$ receptors.

1

_____

[Turn over

5. Microtubules are found in all eukaryotic cells.

(a) Name the globular protein of which microtubules are composed. **1**

_____

(b) Name the structure from which microtubules radiate. **1**

_____

(c) The formation and functioning of mitotic spindle fibres depends on the action of specific enzymes such as *cytoplasmic dynein*.

The role of cytoplasmic dynein in mitosis was investigated. Preparations of purified antibodies that inhibit cytoplasmic dynein's action were injected into cultured mammalian cells at different stages in mitosis. Comparable cells were injected with a buffer solution containing no antibodies.

The figure shows a cell undergoing microinjection.
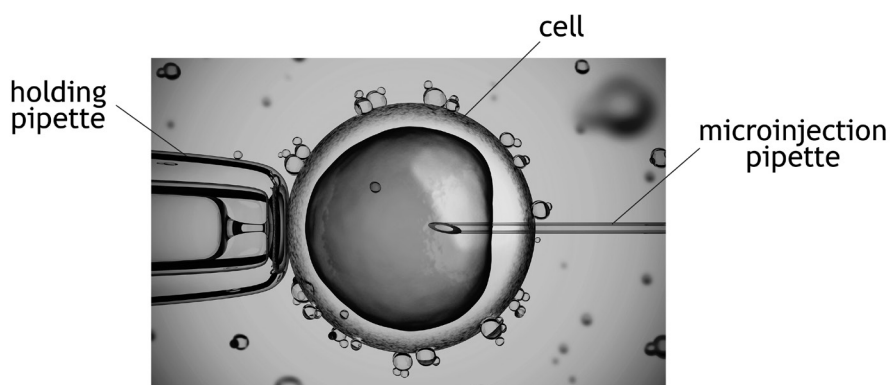
The following results were obtained.

- Mitosis was blocked in 73% of the cells injected with the antibody at $12\,mg/cm^3$ during prophase.

- Injection of buffer alone had no effect on mitosis.

- Lower concentrations of antibodies ($6\,mg/cm^3$) had no obvious effect on mitosis.

- Cells injected with antibody during metaphase or anaphase completed mitosis with no detectable differences compared to cells injected with buffer alone.

5. (c) (continued)

(i) State the purpose of injecting cells with buffer solution only. **1**

_____

(ii) Give a valid conclusion for this experiment. **1**

_____

_____

(d) Once mitosis is complete, the cytoplasm separates to give two daughter cells.

State the term used to describe this process. **1**

_____

[Turn over

6. The following customer comment was used to promote a product intended to treat cats that suffered from cancer.

'My cat was diagnosed with bone cancer three years ago. Her leg was amputated, and I was told that she would only live for another six months. I saw advertising for *Vivafel* and immediately started her on this product. She has been in remission and healthy ever since. I thoroughly recommend this product and the effect it has on cancer in cats.'

(a) (i) What is the conclusion that appears to have been drawn by the cat's owner? **1**

_____

_____

(ii) Apart from being based on one cat, give **one** reason why this conclusion is invalid. **1**

_____

_____

(b) Suggest why the results of the treatment are unlikely to be caused by a placebo effect, in which even a dummy treatment can bring about some improvement. **1**

_____

_____

6. **(continued)**

(c) Trials to test the effectiveness of the drug Vivafel were set up using living cats.

(i) Describe **one** way to ensure that these trials were ethical.   **1**

_____

_____

(ii) State an appropriate null hypothesis for these trials.   **1**

_____

_____

[Turn over

7. Where it is impractical to measure every individual in a population, a representative sample of the population must be obtained.

Discuss the principles and strategies that should be employed in the collection of representative samples.

4

[Turn over for next question

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8. Giraffes are the tallest terrestrial animals, growing up to 5 m tall. Approximately half of a giraffe's height is due to its long neck. Modern giraffes have evolved from ancestors with much shorter necks.

The figures represent two different hypotheses regarding the evolution of the giraffe's long neck.

Competing browsers hypothesis   Necks for sex hypothesis

Charles Darwin suggested that the long necks evolved by natural selection: longer necks allowed animals to feed higher up trees with less competition — the 'competing browsers' hypothesis.

This hypothesis was not thought to be consistent with all the evidence available and a rival hypothesis, 'necks for sex', has been put forward. This suggests long necks have evolved as a result of sexual selection through male–male rivalry, where male giraffes fight for access to females by standing side by side and hitting each other with their heads.

(a) Use the competing browsers hypothesis to explain how long necks evolved by natural selection.

2

8. (continued)

(b) Long necks evolved around 13 million years ago when much of the African forest was replaced by grassland with a greatly reduced number of trees.

Explain how this supports the competing browsers hypothesis. **1**

_____

_____

(c) (i) Explain how long necks could have evolved through sexual selection. **1**

_____

_____

(ii) A study published in 2013 concluded that there was no sexual dimorphism in neck length in giraffes.

Suggest how this finding would cast doubt on the necks for sex hypothesis. **1**

_____

_____

[Turn over

9. New Zealand mud snails, *Potamopyrgus antipodarum,* are widely distributed in freshwater streams and lakes in New Zealand. Snail populations consist of females that reproduce asexually by parthenogenesis together with females that reproduce sexually by cross fertilisation with males.

(a) State **two** disadvantages of sexual reproduction. **2**

1 _____

_____

2 _____

_____

(b) New Zealand mud snails are commonly infected with parasitic worms of the genus *Microphallus*. Sexual reproduction is more common in the snails when the prevalence of parasites is high.

Explain how this observation supports the Red Queen hypothesis. **2**

_____

_____

_____

_____

(c) The New Zealand mud snail has become invasive by spreading beyond its native habitat to colonise areas of Europe and North America.

Suggest why invasive populations are found to be composed entirely of parthenogenic females. **1**
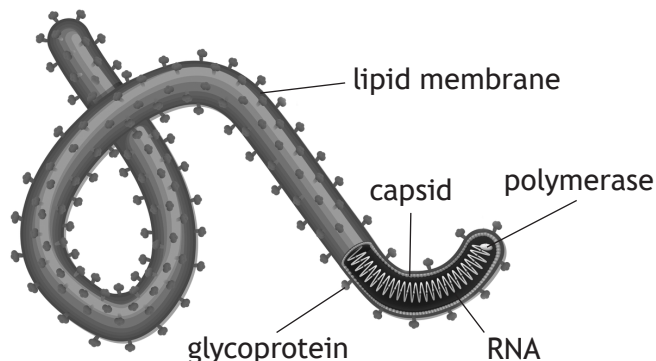
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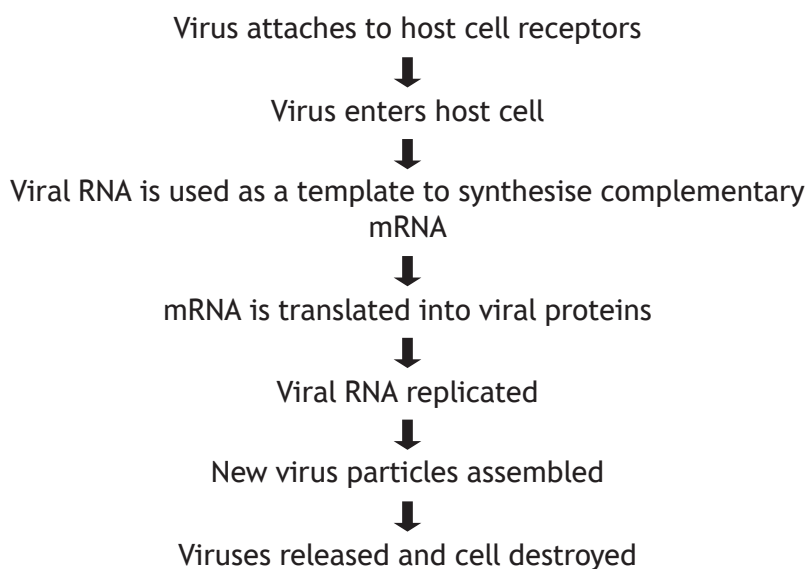**[Turn over for next question**

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10. The figure shows an Ebola virus, cause of Ebola virus disease (EVD), prevalent in a number of West and Central African countries. The virus is transmitted to people from wild animals and outbreaks may then occur through human to human transmission.

(a) Ebola viruses have a diameter of 8×10^{-2} μm.

Give this measurement in nanometres (nm). (1 nm = 10^{-3} μm) **1**

Space for calculation

(b) The flow diagram shows some stages in the replication of this virus.

Virus attaches to host cell receptors

⬇

Virus enters host cell

⬇

Viral RNA is used as a template to synthesise complementary mRNA

⬇

mRNA is translated into viral proteins

⬇

Viral RNA replicated

⬇

New virus particles assembled

⬇

Viruses released and cell destroyed

Explain why the Ebola virus **cannot** be regarded as a retrovirus. **1**

10. **(continued)**

(c) EVD symptoms result from viral disruption of immune cell function such as the loss of lymphocytes by apoptosis.

State the cause of cell death during apoptosis. **1**

_____

(d) The genes coding for some Ebola virus proteins have a high rate of mutation.

Why would this make development of a vaccine more difficult? **1**

_____

_____

(e) EVD has a very high mortality rate. Some researchers have suggested that new treatments should not be assessed by clinical trials that use negative control groups.

State whether you agree or disagree with this suggestion.

Justify your answer. **1**

_____

_____

_____

(f) Apart from medical treatments, suggest **one** measure that could be effective in controlling or preventing outbreaks of EVD in the tropical regions of Africa. **1**

_____

_____

[Turn over for next question

11. Answer **either A or B** in the space below and on *page 27*.

    A   Discuss the concept of niche under the following headings:

        (i) realised and fundamental niche;   **3**

      (ii) features of parasite niches.   **6**

    OR

    B   Discuss the formation of variable gametes during meiosis under the following headings:

        (i) the activity of homologous chromosomes;   **7**

      (ii) meiosis II.   **2**

SPACE FOR ANSWER FOR QUESTION 11

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National
Qualifications
2018

X707/77/11

Biology
Supplementary Sheet

TUESDAY, 15 MAY

9:00 AM – 11:30 AM

Supplementary sheet for question 1

SQA

©

B/HTP

1. The diffusion of glucose across the plasma membrane of mammalian cells is facilitated by a family of related proteins called GLUT transporters. GLUT transporters have a specific binding site for glucose which alternately faces inside and outside the cell. The orientation of the binding site is brought about by a change in conformation as shown in Figure 1.
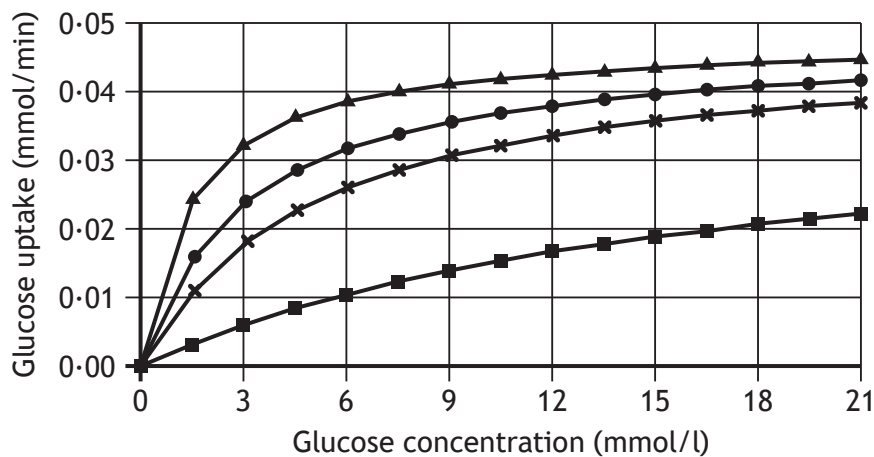
Figure 1
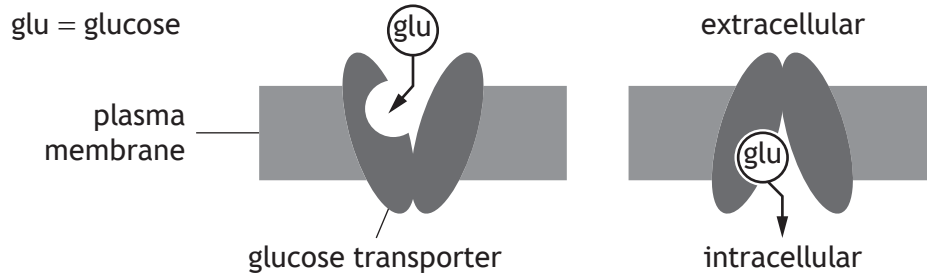
Several studies have measured the changes in rates of glucose uptake by GLUT transporters as the concentration of glucose is increased.

Results for four different GLUT transporters are shown in Figure 2.

For each type of GLUT transporter, the rate of transport levels off to a maximum value that is termed V_{max}. The glucose concentration at which the rate of transport is **half** V_{max} is defined as the K_M of the transporter. K_M values for four types of GLUT are shown in Figure 2.

Figure 2

Key

GLUT3 ($K_M = 1\cdot4$ mmol/l) GLUT1 ($K_M = 3\cdot0$ mmol/l)

GLUT4 ($K_M = 5\cdot0$ mmol/l) GLUT2 ($K_M = 17\cdot0$ mmol/l)

1. **(continued)**

Studies have suggested that the chemical caffeine is an inhibitor of glucose transport by GLUT1.

Figure 3 shows data obtained from a recent study of the effect of increasing caffeine concentration on the uptake of glucose by GLUT1. The uptake of glucose in these experiments was measured per litre of intracellular fluid.

Figure 3
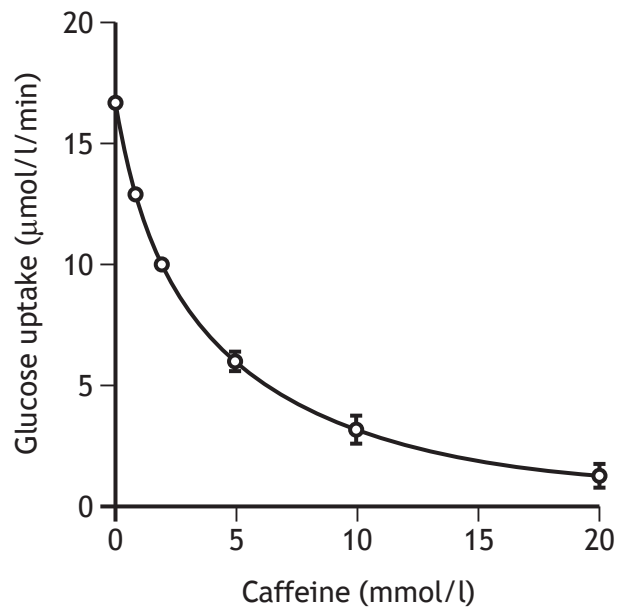
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