



CELL BIOLOGY

Practice questions

Name: _____

Class: _____

Date: _____

Time: **161 minutes**

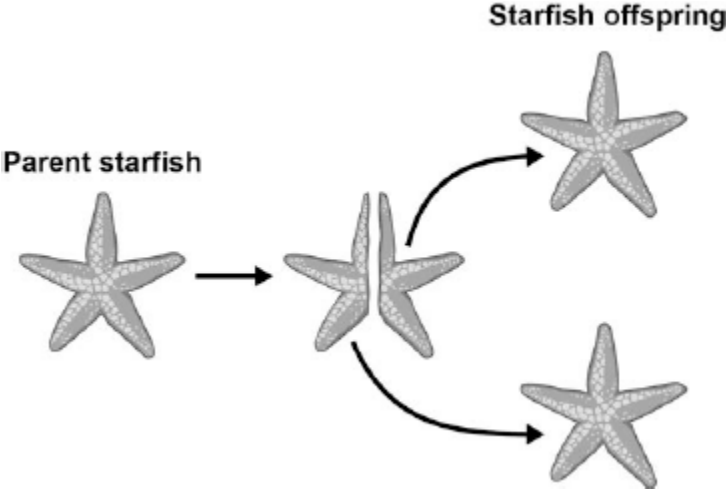
Marks: **159 marks**

Comments: **HIGHER TIER**

1

Starfish can split in half. Each half can then grow new arms to form offspring.

This process is shown in the figure below.



(a) What process produces the starfish offspring?

Tick **one** box.

- Asexual reproduction
- Fertilisation
- Selective breeding
- Sexual reproduction

(1)

(b) More cells are produced as the starfish grows more arms.

What process will produce more cells in the starfish as they grow?

(1)

(c) All the offspring produced are genetically identical.

What name is given to genetically identical organisms?

(1)

(d) Each body cell of the parent starfish contains 44 chromosomes.

How many chromosomes are in each body cell of the offspring?

(1)

(Total 4 marks)

2

Students used quadrats to estimate the population of dandelion plants on a field.

(a) Describe how quadrats should be used to estimate the number of dandelion plants in a field.

(4)

(b) The field measured 40 m by 145 m.

The students used 0.25 m² quadrats.

The students found a mean of 0.42 dandelions per quadrat.

Estimate the population of dandelions on the field.

Estimated population of dandelions = _____

(2)

(c) In one area of the field there is a lot of grass growing in the same area as dandelions.

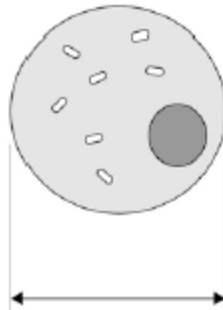
Suggest why the dandelions may **not** grow well in this area.

(4)

(Total 10 marks)

3 **Figure 1** shows a cell viewed through a light microscope.

Figure 1



The size of the real cell is 0.03 mm.

(a) Calculate the magnification of the microscope.

Use **Figure 1** to help you answer.

Magnification = _____

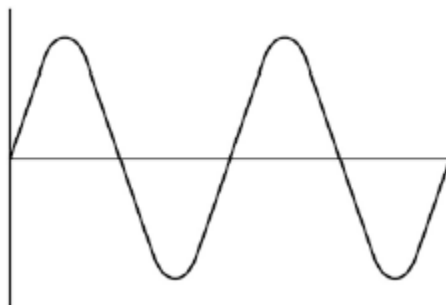
(2)

(b) A light microscope uses light waves to observe objects.

Light waves can be modelled using water waves.

Figure 2 shows a water wave.

Figure 2



Give **one** similarity between a light wave and a water wave.

(1)

(c) Write down the equation that links frequency, wave speed and wavelength.

(1)

(d) The wave in **Figure 2** has a wavelength of 75 cm.

The wave moves at a speed of 1.6 m / s.

Calculate the frequency of the wave.

Frequency = _____ Hz

(4)

(Total 8 marks)

4

(a) In humans there are two types of cell division: **mitosis** and **meiosis**.

The table below gives statements about cell division.

Tick (✓) **one** box in each row to show if the statement is true for mitosis only, for meiosis only, or for both mitosis **and** meiosis.

The first row has been done for you.

Statement	Mitosis only	Meiosis only	Both mitosis and meiosis
How cells are replaced	✓		
How gametes are made			
How a fertilised egg undergoes cell division			
How copies of the genetic information are made			
How genetically identical cells are produced			

(4)

(b) Stem cells can be taken from human embryos.

In therapeutic cloning, an embryo is produced that has the same genes as the patient.

(i) Name **one** source of human stem cells, other than human embryos.

(1)

(ii) Stem cells from embryos can be transplanted into patients for medical treatment.

Give **one** advantage of using stem cells from embryos, compared with cells from the source you named in part (i).

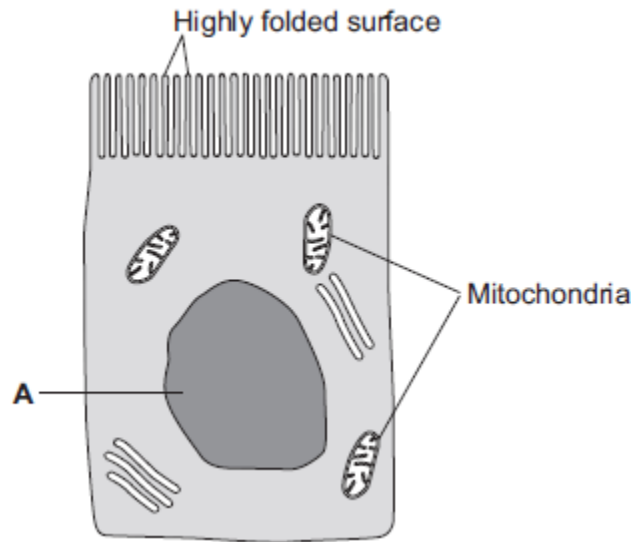
(1)

(Total 6 marks)

5

The image below shows an epithelial cell from the lining of the small intestine.

Direction in which
food is absorbed



- (a) (i) In the image above, the part of the cell labelled **A** contains chromosomes.

What is the name of part **A**?

(1)

- (ii) How are most soluble food molecules absorbed into the epithelial cells of the small intestine?

Draw a ring around the correct answer.

diffusion

osmosis

respiration

(1)

- (b) Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food.

(1)

- (c) Epithelial cells also carry out active transport.

- (i) Name **one** food molecule absorbed into epithelial cells by active transport.

(1)

(ii) Why is it necessary to absorb some food molecules by active transport?

(1)

(ii) Suggest why epithelial cells have many mitochondria.

(2)

(d) Some plants also carry out active transport.

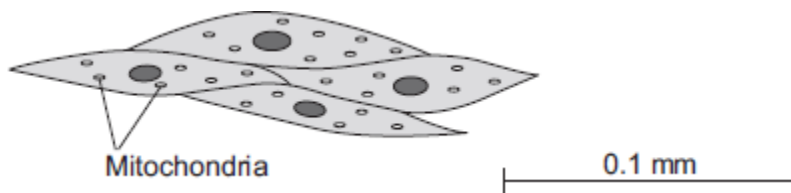
Give **one** substance that plants absorb by active transport.

(1)

(Total 8 marks)

6

The image below shows some muscle cells from the wall of the stomach, as seen through a light microscope.



(a) Describe the function of muscle cells in the wall of the stomach.

(2)

(b) **Figure above** is highly magnified.

The scale bar in **Figure above** represents 0.1 mm.

Use a ruler to measure the length of the scale bar and then calculate the magnification of **Figure above**.

Magnification = _____ times

(2)

(c) The muscle cells in **Figure above** contain many mitochondria.

What is the function of mitochondria?

(2)

(d) The muscle cells also contain many ribosomes. The ribosomes cannot be seen in **Figure above**.

(i) What is the function of a ribosome?

(1)

(ii) Suggest why the ribosomes **cannot** be seen through a light microscope.

(1)

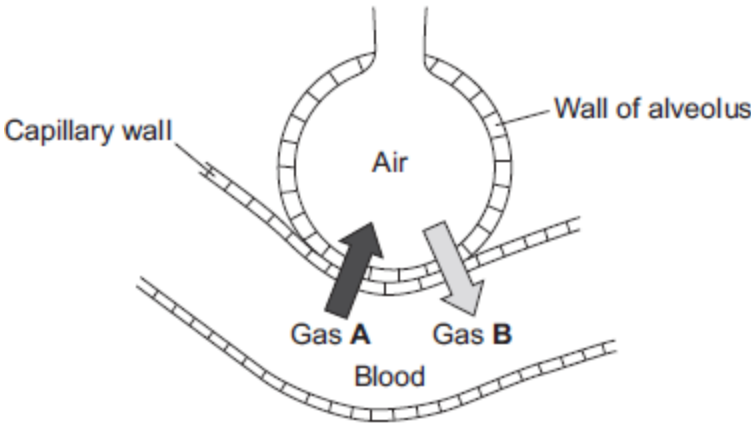
(Total 8 marks)

7

Gas exchange takes place in the lungs.

The diagram shows an alveolus next to a blood capillary in a lung.

The arrows show the movement of two gases, **A** and **B**.



(a) (i) Draw a ring around the correct answer to complete the sentence.

Gases **A** and **B** move by

- diffusion.
- osmosis.
- respiration.

(1)

(ii) Gas **A** moves from the blood to the air in the lungs.

Gas **A** is then breathed out.

Name Gas **A**.

(1)

(iii) Which cells in the blood carry Gas **B**?

Draw a ring around the correct answer.

- platelets** **red blood cells** **white blood cells**

(1)

(b) The average number of alveoli in each human lung is 280 million.

The average surface area of 1 million alveoli is 0.25 m².

Calculate the total surface area of a human lung.

Answer _____ m²

(2)

- (c) An athlete trains to run a marathon. The surface area of each of the athlete's lungs has increased to 80 m².

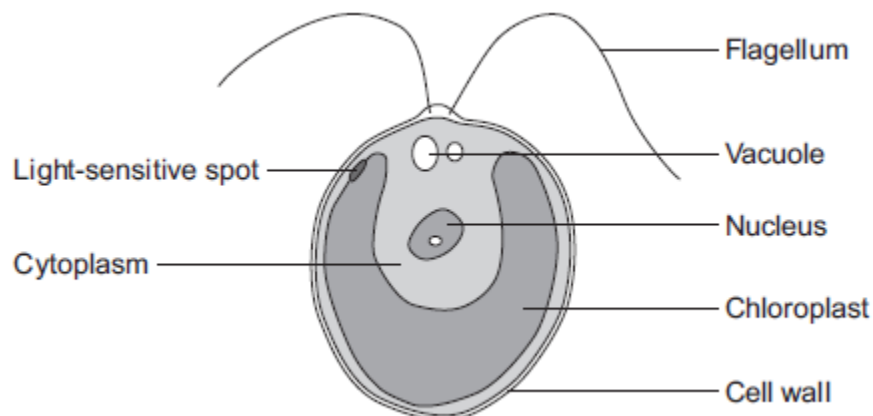
Give **one** way in which this increase will help the athlete.

(1)

(Total 6 marks)

8

The diagram below shows a single-celled alga which lives in fresh water.



- (a) Which part of the cell labelled above:

- (i) traps light for photosynthesis

(1)

- (ii) is made of cellulose?

(1)

- (b) In the freshwater environment water enters the algal cell.

- (i) What is the name of the process by which water moves into cells?

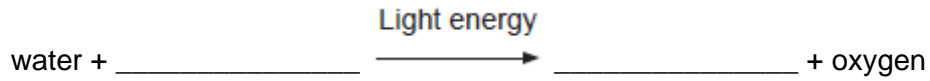
(1)

- (ii) Give the reason why the algal cell does not burst.

(1)

- (c) (i) The alga can photosynthesise.

Complete the **word** equation for photosynthesis.



(2)

- (ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

Suggest how this might happen.

(2)

- (d) Multicellular organisms often have complex structures, such as lungs, for gas exchange.

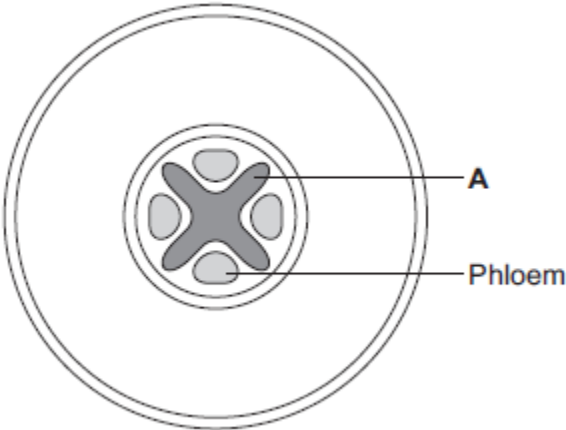
Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

(3)

(Total 11 marks)

9

The diagram below shows a cross-section of a plant root. The transport tissues are labelled.



(a) (i) What is tissue **A**?

Draw a ring around the correct answer.

- cuticle
- epidermis
- xylem

(1)

(ii) Name **two** substances transported by tissue **A**.

1. _____

2. _____

(2)

(b) Phloem is involved in a process called translocation.

(i) What is translocation?

(1)

(ii) Explain why translocation is important to plants.

(2)

(c) Plants must use active transport to move some substances from the soil into root hair cells.

(i) Active transport needs energy.

Which part of the cell releases most of this energy?

Tick (✓) **one** box.

mitochondria

nucleus

ribosome

(1)

(ii) Explain why active transport is necessary in root hair cells.

(2)

(Total 9 marks)

10

Some infections are caused by bacteria.

(a) The genetic material is arranged differently in the cells of bacteria compared with animal and plant cells.

Describe **two** differences.

(2)

- (b) Tuberculosis (TB) is an infection caused by bacteria.

The table below shows the number of cases of TB in different regions of southern England from 2000–2011.

Number of cases of TB per 100 000 people

Year	London	South East	South West
2000	37	5	3
2001	36	6	4
2002	42	6	6
2003	42	7	4
2004	42	7	5
2005	49	8	5
2006	44	8	3
2007	43	8	5
2008	44	8	5
2009	44	9	6
2010	42	9	5
2011	45	10	5

- (i) How does the number of cases of TB for London compare with the rest of southern England?

(1)

- (ii) Describe the pattern in the data for cases of TB in the South East.

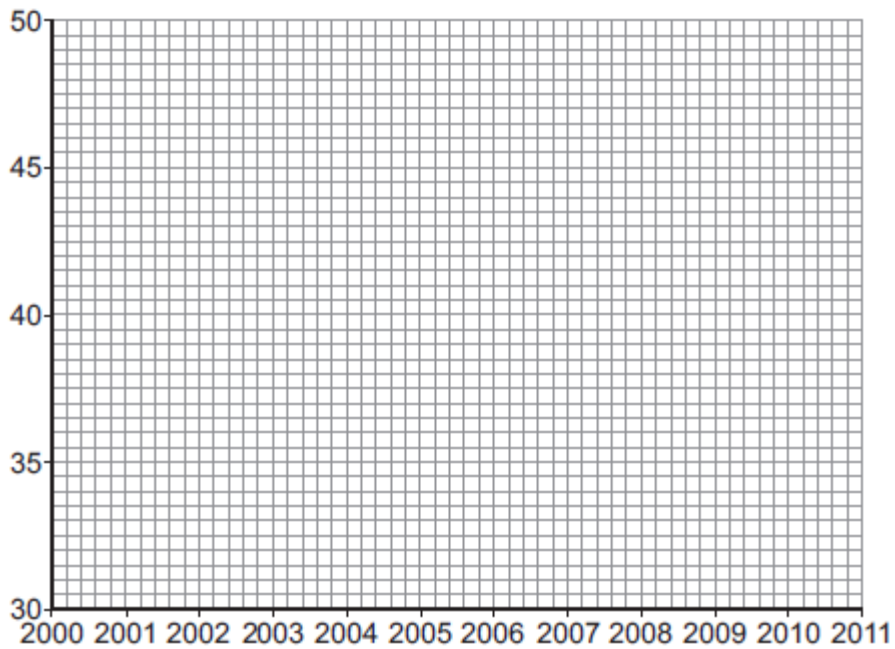
(1)

(iii) Describe the pattern in the data for cases of TB in the South West.

(2)

(c) (i) On the graph paper below:

- plot the number of cases of TB in **London**
- label both the axes on the graph
- draw a line of best fit.



(4)

(ii) Suggest why a student thought the value for 2005 in London was anomalous.

(1)

(d) People can be vaccinated against TB.

Suggest how a vaccination programme would reduce the number of people with TB.

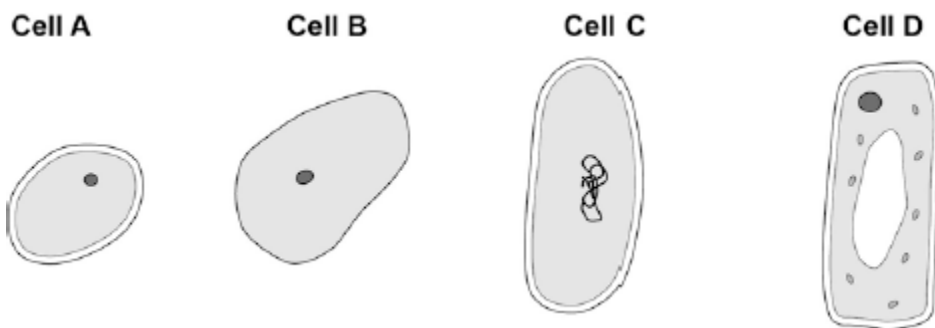
Details of how a vaccine works are **not** required.

(2)

(Total 13 marks)

11

The figure below shows four different types of cell.



(a) Which cell is a plant cell?

Give **one** reason for your answer.

Cell _____

Reason _____

(2)

(b) Which cell is an animal cell?

Give **one** reason for your answer.

Cell _____

Reason _____

(2)

(c) Which cell is a prokaryotic cell?

Give **one** reason for your answer.

Cell _____

Reason _____

(2)

(d) A scientist observed a cell using an electron microscope.

The size of the image was 25 mm.

The magnification was $\times 100\,000$

Calculate the real size of the cell.

Use the equation:

$$\text{magnification} = \frac{\text{image size}}{\text{real size}}$$

Give your answer in micrometres.

Real size = _____ micrometres

(3)

(Total 9 marks)

12

Plants need nitrate ions in order to make proteins.

A plant is growing in soil flooded with water.

Explain why the plant cannot absorb enough nitrate ions.

(Total 5 marks)

13

Different antibiotics destroy bacteria in different ways.

- Some antibiotics disrupt the bacterial cell membrane.
 - Some antibiotics disrupt the bacterial cell wall.
- (a) Antibiotics that disrupt the bacterial cell membrane often cause more side effects in humans compared with antibiotics that disrupt bacterial cell walls.

Suggest why.

(1)

- (b) Some antibiotics prevent ribosomes functioning.

Suggest how this damages the bacterium.

(1)

- (c) Drug manufacturers are spending less on research into new antibiotics.

One reason why is because new antibiotics are rarely prescribed.

Some people think that governments should pay drug manufacturers to develop new antibiotics.

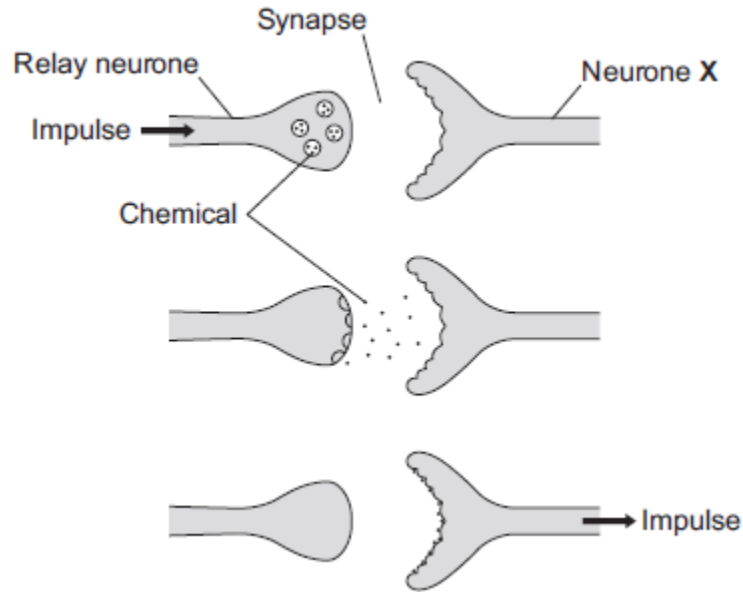
Suggest why.

(3)

(Total 5 marks)

14

The diagram below shows how a nerve impulse passing along a relay neurone causes an impulse to be sent along another type of neurone, neurone X.



(a) What type of neurone is neurone X?

(1)

(b) Describe how information passes from the relay neurone to neurone X. Use the diagram to help you.

(3)

(c) Scientists investigated the effect of two toxins on the way in which information passes across synapses. The table below shows the results.

Toxin	Effect at the synapse
Curare	Decreases the effect of the chemical on neurone X
Strychnine	Increases the amount of the chemical made in the relay neurone

Describe the effect of each of the toxins on the response by muscles.

Curare _____

Strychnine _____

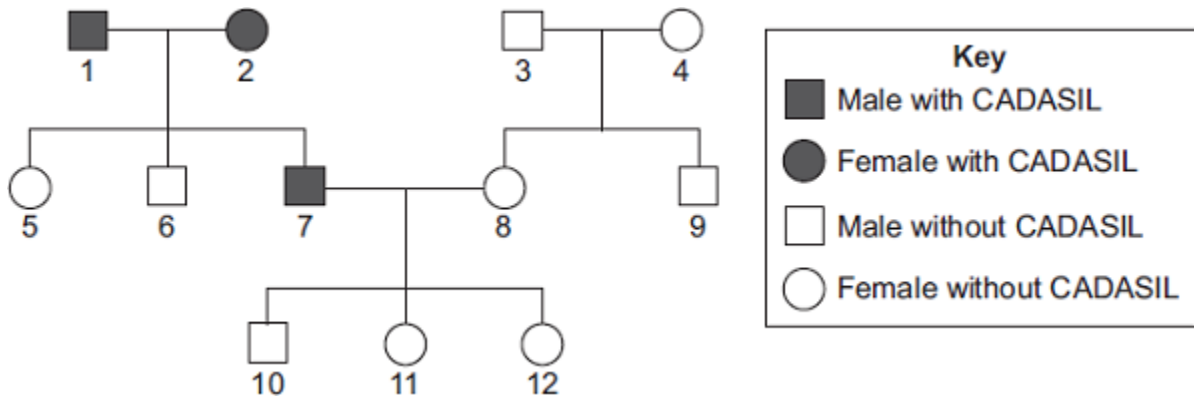
(2)
(Total 6 marks)

15

CADASIL is an inherited disorder caused by a dominant allele.

CADASIL leads to weakening of blood vessels in the brain.

The diagram shows the inheritance of CADASIL in one family.



(a) CADASIL is caused by a *dominant allele*.

(i) What is a *dominant allele*?

(1)

(ii) What is the evidence in the diagram that CADASIL is caused by a dominant allele?

(1)

(iii) Person 7 has CADASIL.

Is person 7 homozygous or heterozygous for the CADASIL allele?

Give evidence for your answer from the diagram.

(1)

(b) Persons 7 and 8 are planning to have another baby.

Use a genetic diagram to find the probability that the new baby will develop into a person with CADASIL.

Use the following symbols to represent alleles.

D = allele for CADASIL

d = allele for not having CADASIL

Probability = _____

(4)

(c) Scientists are trying to develop a treatment for CADASIL using stem cells.

Specially treated stem cells would be injected into the damaged part of the brain.

(i) Why do the scientists use stem cells?

(2)

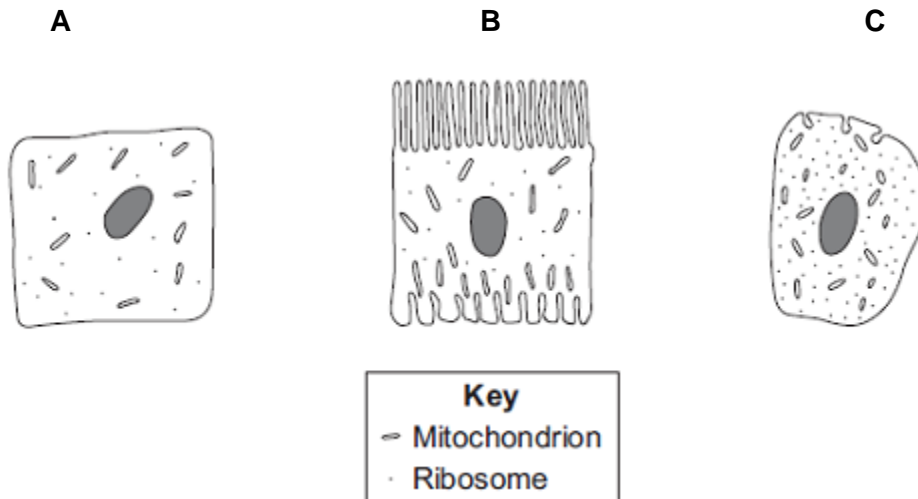
- (ii) Embryonic stem cells can be obtained by removing a few cells from a human embryo. In 2006, scientists in Japan discovered how to change adult skin cells into stem cells. Suggest **one** advantage of using stem cells from adult skin cells.

(1)

(Total 10 marks)

16

Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



- (a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or

out of the cell?

Give **one** reason for your choice.

(1)

- (b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

(1)

- (ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

(2)

(Total 4 marks)

17

- (a) Mr and Mrs Smith both have a history of cystic fibrosis in their families.
Neither of them has cystic fibrosis.

Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

(1)

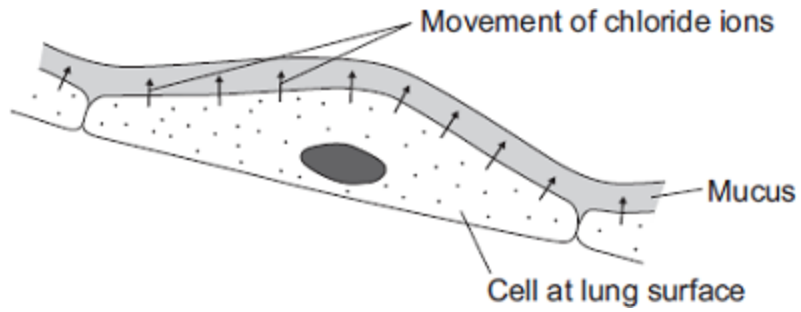
(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion to your evaluation.

(4)

(c) In someone who has cystic fibrosis the person's mucus becomes thick.

The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



The movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

(3)
(Total 11 marks)

18

The photographs show the flowers of two closely-related species of plant.

Species A



Species B



Images: © iStock/Thinkstock

The drawings show chromosomes from one cell in the root of each plant during cell division.

Species A



**One
chromosome**

Species B



**One
chromosome**

(a) The drawings show that each chromosome has two strands of genetic material.

(i) How does a chromosome become two strands?

(1)

(ii) Explain why each chromosome must become two strands before the cell divides.

(2)

(b) For sexual reproduction, the plants produce gametes.

(i) Name the type of cell division that produces gametes. _____

(1)

(ii) How many chromosomes would there be in a gamete from each of these two plant species?

Species A

Species B

(1)

(iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.

How many chromosomes would there be in each cell of one of the offspring

plants?

(1)

(c) (i) Look back at the information at the start of the question and the information from part (b).

What evidence from these two pieces of information supports the belief that **Species A** and **Species B** evolved from a common ancestor?

(2)

- (ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

The drawings showing the chromosomes of **Species A** and of **Species B** are repeated below.



The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

(2)
(Total 10 marks)

19

Plants exchange substances with the environment.

- (a) Plant roots absorb water mainly by osmosis.
Plant roots absorb ions mainly by active transport.

Explain why roots need to use the two different methods to absorb water and ions.

(4)

- (b) What is meant by the *transpiration stream*?

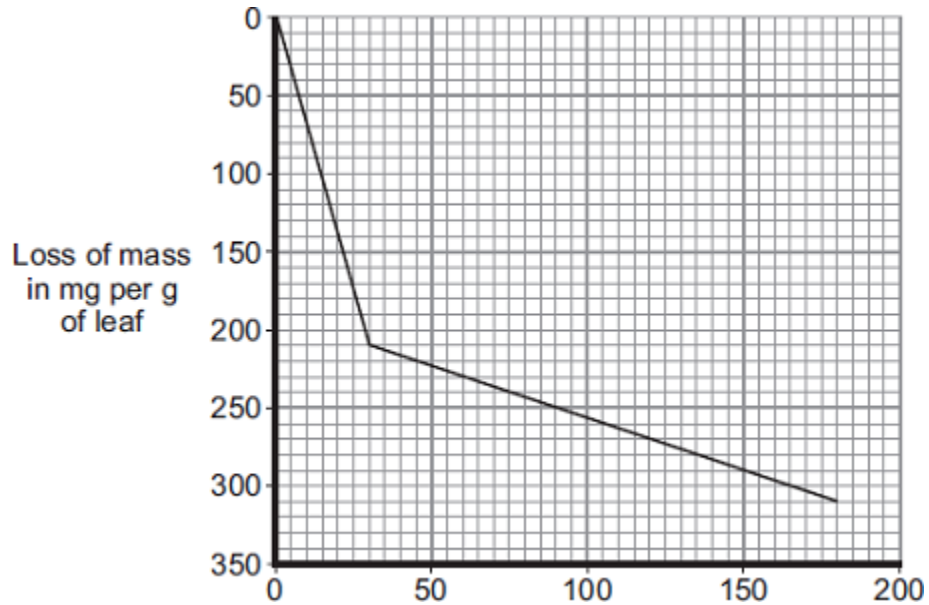
(3)

(c) Students investigated the loss of water vapour from leaves.

The students:

- cut some leaves off a plant
- measured the mass of these leaves every 30 minutes for 180 minutes.

The graph shows the students' results.



- (i) The rate of mass loss in the first 30 minutes was 7 milligrams per gram of leaf per minute.

Calculate the rate of mass loss between 30 minutes and 180 minutes.

Rate of mass loss = _____ milligrams per gram of leaf per minute

(2)

- (ii) The rate of mass loss between 0 and 30 minutes was very different from the rate of mass loss between 30 and 180 minutes.

Suggest an explanation for the difference between the two rates.

(2)

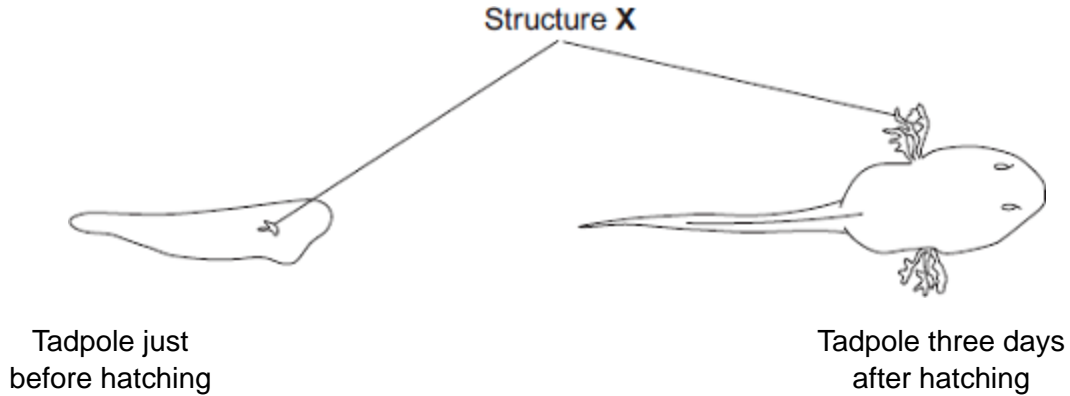
(Total 11 marks)

20

The young stages of frogs are called tadpoles. The tadpoles live in fresh water.

The drawings show a tadpole just before hatching and three days after hatching.

Structure **X** helps in the exchange of substances between the tadpole and the water.



- (a) Name **one** substance, other than food, that the tadpole needs to exchange with the water in order to grow.

(1)

- (b) Suggest how the changes in the tadpole shown in the drawings help it to survive as it grows larger.

You should **not** refer to movement in your answer.
To gain full marks you should refer to structure **X**.

(4)

(Total 5 marks)

Mark schemes

1	(a) asexual reproduction	1
	(b) mitosis	1
	(c) clones	1
	(d) 44	1
		[4]
2	(a) (placed) randomly <i>allow description of placement</i>	1
	sufficient number (of quadrats) used	1
	count (dandelions) in each quadrat	1
	use mean number of dandelions, area of quadrat and area of field to estimate population <i>accept (area of field / area quadrat) × mean number of dandelions per quadrat</i>	1
	(b) $(40 \times 145) / 0.25 = 23\ 200$	1
	$(0.42 \times 23\ 200 =) 9744$ <i>allow 9744 with no working shown for 2 marks</i> <i>allow ecf from correct attempt at the previous step) × 0.42 for 1 mark</i>	1

(c) **Level 2 (3–4 marks):**

A detailed and coherent explanation is given. Logical links between clearly identified relevant points are made to explain why dandelion growth may be limited.

Level 1 (1–2 marks):

Discrete relevant points are made. The logic may be unclear.

0 marks:

No relevant content

Indicative content

factors that may be considered:

competition for resources including:

- light
- water
- space
- mineral ions (allow nutrients / salts / ions from the soil)

reference to why growth may be limited:

- (light) energy for photosynthesis
- water as a raw material for photosynthesis / support
- surface area exposed to light
- sugar / glucose produced in photosynthesis
- (space) to grow bigger
- (space) for growth of root system
- (mineral ions) for growth
- (mineral ions / sugar) for production of larger molecules **or** named example

4

[10]

3

(a) $\text{magnification} = \frac{\text{image size}}{\text{real size}}$

= $29 \div 0.03$

= 967

allow 967 with no working shown for 2 marks

(b) they are transverse

(c) wave speed = frequency \times wavelength

allow $v = f \lambda$

(d) 75 cm = 0.75 m

$1.6 = f \times 0.75$

1

1

1

1

1

1

$$f = 1.6 \div 0.75$$

$$= 2.13 \text{ (Hz)}$$

allow 2.13 (Hz) with no working shown for 4 marks

1

1

[8]

4 (a)

	Mitosis only	Meiosis only	Both mitosis and meiosis
How cells are replaced	✓		
How gametes are made		✓	
How a fertilised egg undergoes cell division	✓		
How copies of the genetic information are made			✓
How genetically identical cells are produced	✓		

*if more than one tick per row then no mark
ignore first row*

1
1
1
1

- (b) (i) (adult) bone marrow
accept (umbilical) cord blood, skin, amniotic fluid / membrane 1
- (ii) cells will not be rejected by the patient's body (if they have been produced by therapeutic cloning)
allow easier to obtain linked to embryo stem cells
or
 (embryo stem cells) can develop into many different types of cells
allow doesn't need an operation linked to bone marrow
or
 (embryo stem cells) not yet differentiated / specialised or undifferentiated
accept embryo cells are pluripotent 1

[6]

- 5** (a) (i) nucleus 1
- (ii) diffusion 1
- (b) increases / larger surface area (for diffusion)
ignore large surface area to volume ratio 1
- (c) (i) sugar / glucose
accept amino acids / other named monosaccharides 1
- (ii) against a concentration gradient
or
 from low to high concentration 1
- (iii) (active transport requires) energy 1
 (from) respiration 1
- (d) minerals / ions
accept named ion ignore nutrients
do not accept water 1

[8]

- 6** (a) contract / shorten
ignore relax
do not allow expand 1

to churn / move / mix food

accept peristalsis / mechanical digestion

ignore movement unqualified

1

(b) 400

acceptable range 390-410

allow 1 mark for answer in range of 39 to 41

allow 1 mark for answer in range of 3900 to 4100

2

(c) to transfer energy for use

allow to release / give / supply / provide energy

*do **not** allow to 'make' / 'produce' / 'create' energy*

allow to make ATP

ignore to store energy

1

by (aerobic) respiration **or** from glucose

*do **not** allow anaerobic*

*energy released **for** respiration = max 1 mark*

1

(d) (i) to make protein / enzyme

ignore 'antibody' or other named protein

1

(ii) too small / very small

allow light microscope does not have sufficient magnification / resolution

allow ribosomes are smaller than mitochondria

ignore not sensitive enough

ignore ribosomes are transparent

1

[8]

7

(a) (i) diffusion

1

(ii) carbon dioxide

accept CO₂ / CO2

*do **not** accept CO²*

1

(iii) red blood cells

1

(b) 70

if no / incorrect answer then

70 000 000

or

280 x 0.25 gains 1 mark

ignore doubling the answer

2

(c) allows more gas / oxygen / CO₂
(exchange)

*do **not** accept air*

1

[6]

8

(a) (i) chloroplast

1

(ii) cell wall

1

(b) (i) osmosis

accept diffusion

1

(ii) cell wall (prevents bursting)

1

(c) (i) carbon dioxide

allow correct formula

1

glucose

allow sugar / starch

1

(ii) any **two** from:

- light sensitive spot detects light
- tells flagellum to move towards light
- more light = more photosynthesis

2

(d) (cell has) larger SA:volume ratio

1

short (diffusion) distance

allow correct description

1

(diffusion) via cell membrane is sufficient / good enough

or

flow of water maintains concentration gradient

1

[11]

9

(a) (i) xylem

1

(ii) water

1

minerals / ions / named example(s)

ignore nutrients

1

(b) (i) movement of (dissolved) sugar

*allow additional substances, eg amino acids / correct named sugar
(allow sucrose / glucose)*

allow nutrients / substances / food molecules if sufficiently qualified

ignore food alone

1

(ii) sugars are made in the leaves

1

so they need to be moved to other parts of the plant for respiration / growth / storage

1

(c) (i) mitochondria

1

(ii) for movement of minerals / ions

Do not accept 'water'

1

against their concentration gradient

1

[9]

10

(a) any **two** from:

- only one 'chromosome'
allow one strand of DNA
- circular
allow loop
- may have plasmids
- not in a nucleus / no nucleus

2

- (b) (i) any **one** from:
- London is much higher
or converse
 - more variable / wider range
allow 'on average it is 5 / 6 times greater'
- 1
- (ii) increases
Included figures must be correct
- 1
- (iii) overall slight increase
accept 'doesn't change much'
- 1
- variable / goes up and down
- 1
- (c) (i) both axes correctly labelled
- x = Year
- y = Number of cases
- 1
- correct points
- all correct = 2 marks*
- 1-2 errors = 1 mark*
- > 2 errors = 0 marks*
- 2
- suitable line of best fit
accept straight line or smooth curve
- 1
- (ii) doesn't fit the pattern / line of best fit
- 1
- (d) provides immunity / protection (to TB)
ignore 'stops people catching it'
ignore 'resistance'
- 1
- prevents TB spreading
accept ref to herd immunity
- 1

[13]

11

(a) D

1

any **one** from:

- has chloroplasts
- has a (large) vacuole
ignore has a (cell) wall

1

(b) **B**

1

does **not** have a (cell) wall

*allow has only a nucleus, (cell) membrane **and** cytoplasm*

1

(c) **C**

1

any **one** from:

- genetic material is not in a nucleus
allow no nucleus
- has a single loop of DNA

1

(d) real size = 25 / 100 000

1

0.00025

1

(conversion to) 0.25 (µm)

*allow 0.25 (µm) with no working shown for **3** marks*

1

[9]

12

(nitrate) ions are absorbed by active transport

1

(active transport) is the movement of ions against the concentration gradient

allow (active transport) is the movement of ions from a dilute to a more concentrated solution

1

(active transport) requires energy from respiration

1

(respiration) requires oxygen

1

no / little oxygen / air in water-logged soil

1

[5]

- 13 (a) human cells have cell membrane
or
human cells have no cell wall 1
- (b) can no longer synthesise proteins 1
- (c) antibiotics are being developed at a slower rate than emergence of new resistant strains 1
- resistant strains mean we cannot treat (common) infections 1
- reduce (future) cost of antibiotic resistant infections 1
- [5]
- 14 (a) motor
allow efferent / postsynaptic
*allow **another** relay (neurone)* 1
- (b) release of chemical (from relay neurone)
allow ecf for 'motor' neurone from (a)
allow release of neurotransmitter / named example 1
- chemical crosses gap / junction / synapse
allow diffuses across
allow chemical moves to X 1
- chemical attaches to X / motor / next neurone (causing impulse) 1
- (c) (curare) decrease / no contraction
accept (muscle) relaxes 1
- (strychnine) increase / more contraction
*if no other mark awarded allow 1 mark for (curare) decrease / no response **and** (strychnine) increase / more response* 1
- [6]
- 15 (a) (i) allele expressed even when other allele present **or** expressed if just one copy of allele is present **or** expressed if heterozygous
if present other allele not expressed 1

(ii) 2 affected parents have unaffected child **or** 1 and 2 → 5 / 6

or if recessive all of **1** and **2**s children would have CADASIL

1

(iii) heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL

1

(b) genetic diagram including:

accept alternative symbols, if defined

1

correct gametes:

D and **d**

and d (and **d**)

ignore 7 / 8 or male / female

1

derivation of offspring genotypes:

Dd Dd dd dd

*allow just **Dd dd** if ½-diagram*

allow ecf if correct for student's gametes

1

identification **of Dd** as CADASIL

or dd as unaffected

allow ecf if correct for student's gametes

1

correct probability: 0.5 / ½ / 1 in 2 / 50% / 1 : 1

1

(c) (i) stem cells can differentiate **or** are undifferentiated / unspecialised

1

can form blood vessel cells / brain cells

or

stem cells can divide

1

- (ii) ethical argument - eg no risk of damage to embryo or adult can give consent for removal of cells **or** adult can re-grow skin

more ethical qualified

ignore religion unqualified

or

if from a relative then less chance of rejection **or** if from self then no chance of rejection

or

skin cells more accessible

1

[10]

16

(a) **B**

*no mark for "B" alone, the mark is for B **and** the explanation.*

large(r) surface / area **or** large(r) membrane

accept reference to microvilli

ignore villi / hairs / cilia

accept reasonable descriptions of the surface eg folded membrane / surface

*do **not** accept wall / cell wall*

1

(b) (i) any **one** from:

- (salivary) amylase
- carbohydrase

1

(ii) many ribosomes

*do **not** mix routes. If both routes given award marks for the greater.*

1

ribosomes produce protein

accept amylase / enzyme / carbohydrase is made of protein

or

(allow)

many mitochondria (1)

mitochondria provide energy to build / make protein (1)

accept ATP instead of energy

1

[4]

17

(a) both parents **Aa**

*accept other upper and lower case letter without key **or** symbols
with a key*

allow as gametes shown in Punnett square

1

aa in offspring correctly derived from parents

or

aa correctly derived from the parents given

ignore other offspring / gametes

for this mark parents do not have to be correct

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

(b) (i) any **one** from:

*accept converse if clear, eg if you (only) took one it might have
cystic fibrosis / might not be fertilised*

- (more) sure / greater chance of healthy / non-cystic fibrosis egg / embryo / child

accept some may have the allele

reference to 'suitable / good embryo' is insufficient

- greater chance of fertilisation

1

(ii) **advantages**

*to gain 3 marks both advantage(s) and disadvantage(s) must
be given*

max 3

any **two** from:

ignore references to abortion unless qualified by later screening

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on to future generations

disadvantages

any **two** from:

- operation dangers / named eg infection
ignore risk unqualified
- ethical or religious issues linked with killing embryos
accept wrong / cruel to embryos accept right to life argument
ignore embryos are destroyed
- (high) cost of procedure
- possible damage to embryo (during testing for cystic fibrosis / operation)

plus

conclusion

a statement that implies a qualified value judgement

eg it is right because the child will (probably) not have cystic fibrosis even though it is expensive

or

eg it is wrong because embryos are killed despite a greater chance of having a healthy baby

***note:** the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage is made*
*do **not** award the mark if the conclusion only states that advantages outweigh the disadvantages*

(c) any **three** from:

- osmosis / diffusion
*do **not** accept movement of ions / solution by osmosis / diffusion*
- more concentrated solution outside cell / in mucus
assume concentration is concentration of solute unless answer indicates otherwise or accept correct description of 'water concentration'
- water moves from dilute to more concentrated solution
allow correct references to movement of water in relation to concentration gradient
- partially permeable membrane (of cell)
allow semi / selectively permeable

3

[11]

18

(a) (i) DNA replication / copies of genetic material were made

'it' = a chromosome

allow chromosomes replicate / duplicate / are copied

ignore chromosomes divide / split / double

1

(ii) one copy of each (chromosome / chromatid / strand) to each offspring cell

ignore ref. to gametes and fertilisation

1

each offspring cell receives a complete set of / the same genetic material

allow 'so offspring (cells) are identical'

1

(b) (i) meiosis

allow mieosis as the only alternative spelling

1

(ii) Species A = 4 **and** Species B = 8

1

(iii) sum of A + B from (b)(ii) e.g. 12

1

(c) (i) similarities between chromosomes

or

similarities between flowers described

e.g. shape of petals / pattern on petals / colour / stamens

1

can breed / can sexually reproduce

allow can reproduce with each other / they can produce offspring

1

(ii) any **two** from:

- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes
- some chromosomes unable to pair (in meiosis)
- (viable) gametes not formed / some gametes with extra / too many genes / chromosomes

or

some gametes with missing genes / chromosomes

2

[10]

19

(a) solution in soil is more dilute (than in root cells)

concentration of water higher in the soil (than in root cells)

1

so water moves from the dilute to the more concentrated region

*so water moves down (its) concentration gradient **or** water moves from a high concentration of water to a lower concentration*

1

concentration of ions in soil less (than that in root cells)

1

so energy needed to move ions

or

ions are moved against concentration gradient

the direction of the concentration gradient must be expressed clearly

accept correct reference to water potential or to concentrations of water

1

(b) any **three** from:

- movement of water from roots / root hairs (up stem)
- via xylem
- to the leaves
- (water) evaporates
- via stomata

3

(c) (i) 0.67/0.7

accept 0.66, 0.666666... or $\frac{2}{3}$ or 0.6

correct answer gains 2 marks with or without working

if answer incorrect allow evidence of $\frac{100}{150}$ for 1 mark

*do **not** accept 0.6 or 0.70*

2

(ii) during the first 30 minutes

any **one** from:

- it was warmer
- it was windier
- it was less humid
- there was more water (vapour) in the leaves

1

so there was more evaporation

ignore 'water loss'

or

stomata open during first 30 minutes **or** closed after 30 minutes (1)

so faster (rate of) evaporation in first 30 min **or** reducing (rate of) evaporation after 30 min (1)

1

[11]

20

(a) oxygen / O₂

allow O₂

do not accept O²

or

carbon dioxide / CO₂

allow CO₂

do not accept CO²

1

(b) any **four** from:

ignore references to tail used for locomotion

ignore reference to nostrils

- because structure X / gills has threads / filaments **or** is thin **or** tadpole has longer tail
- there is an increased surface area
- there is a shorter diffusion pathway
- therefore an increase in exchange
ignore food
- eyes (now visible in older tadpole)
- so that food / danger etc can be seen
accept reference to a good blood supply
accept increased water flow over gills / tail will increase diffusion of gases

4

[5]