

Mark schemes

Q1.**(d) (Similarity)**

1. Both have a phospholipid bilayer

OR

Both have fatty acid/hydrophobic tails pointing in/face each other

OR

Both have phosphate/polar/hydrophilic heads pointing out

OR

Both have protein;

Accept 2 marks max if 1. is not achieved

(Differences)

2. No channel/carrier proteins, whereas fluid mosaic does

OR

Protein layer outside (phospholipids), fluid mosaic is 'dotted';

Accept for 'no channel/carrier', no intrinsic

Accept only one type of protein whereas fluid mosaic has many (types)

3. Cholesterol is not present whereas it is present in fluid mosaic;
4. Glycoprotein is not present whereas it is present in fluid mosaic;
5. Glycolipid is not present whereas it is present in fluid mosaic;

Accept first answer refers to 1935 model unless otherwise stated

3 max

Q2.

- (b) 1. (Simple) diffusion of small/non-polar molecules down a concentration gradient;
*If no reference to 'small/ non-polar' for 1.
 accept this idea from 'large/charged' given in description of 2.*
2. Facilitated diffusion down a concentration gradient via protein carrier/channel;
Reject if active rather than passive
3. Osmosis of water down a water potential gradient;
4. Active transport against a concentration gradient via protein carrier using ATP;
5. Co-transport of 2 different substances using a carrier protein;
*For any answer accept a correct example
 For 'carrier protein' accept symport OR cotransport protein*

5

Q3.

- (a) 1. (ATP to ADP + Pi) Releases energy;
Reject 'produces/makes/creates energy'.
2. (energy) allows ions to be moved against a concentration gradient
 OR
 (energy) allows active transport of ions;
*For 'ions' accept Na⁺ or K⁺.
 Do not accept if this movement is of glucose not ions.*
- (b) 1. (Maintains/generates) a concentration/diffusion gradient for Na⁺ (from ileum into cell);
Accept '(Maintains/generates) a lower concentration of Na⁺ inside the cell compared with outside the cell'.
2. Na⁺ moving (in) by facilitated diffusion, brings glucose with it
 OR
 Na⁺ moving (in) by co-transport, brings glucose with it;
Accept 'co-transporter' for 'co-transport'.

2

2

- (c) 1. Folded membrane/microvilli **so** large surface area (for absorption);
*Reject references to 'villi'.
Accept 'brush border' for 'microvilli'.*
2. Large number of co-transport/carrier/channel proteins **so** fast rate (of absorption)
- OR
- Large number of co-transport/carrier proteins **for** active transport
- OR
- Large number of co-transport/carrier/channel proteins **for** facilitated diffusion;
3. Large number of mitochondria **so** make (more) ATP (by respiration)
- OR
- Large number of mitochondria **for** aerobic respiration
- OR
- Large number of mitochondria **to** release energy for active transport;
4. Membrane-bound (digestive) enzymes **so** maintains concentration gradient (for fast absorption);
Accept named examples of digestive enzymes.
- 2 max
- (d) 1. Phospholipids drawn with head and two tails;
2. Correctly positioned as a bilayer on either side of SGLT1;
*Some of every 'head' must extend into the hydrophilic region **and** some of every 'tail' must extend into the hydrophobic region.
Reject phospholipids drawn within the protein.*
- 2

Q4.

- (b) 1. Phospholipid (bilayer) allows movement/diffusion of non-polar/lipid-soluble substances;
1. and 2. Accept correct named examples
1. and 2. Ignore water
Accept phospholipid (bilayer) allows movement/diffusion of O₂/CO₂
Accept water-insoluble
2. Phospholipid (bilayer) prevents movement/diffusion of polar/charged/lipid-insoluble substances
OR
 (Membrane) proteins allow polar/charged substances to cross the membrane/bilayer;
Accept water-soluble
3. Carrier proteins allow active transport;
4. Channel/carrier proteins allow facilitated diffusion/co-transport;
Accept aquaporins allow osmosis
5. Shape/charge of channel / carrier determines which substances move;
6. Number of channels/carriers determines how much movement;
7. Membrane surface area determines how much diffusion/movement;
6. and 7. Accept correct reference to faster/slower/rate for 'how much movement'
Accept microvilli / Golgi (apparatus) / ER / rER
Accept surface area to volume for 'surface area'
8. Cholesterol affects fluidity/rigidity/permeability;
Accept cholesterol affects vesicle formation/ endocytosis/exocytosis/phagocytosis;

5 max

Q5.

- (a) 1. (Movement) down a gradient / from high concentration to low concentration;
Ignore along / across gradient
Reject movement from gradient to gradient
2. Passive / not active processes;
OR
 Do not use energy **from** respiration / **from** ATP / **from** metabolism;
OR
 Use energy **from** the solution;
Reject do not use energy unqualified

2

- (b) 1. Movement through carrier proteins;
OR
 Facilitated diffusion;
Between A and B
Accept MP1 in either section
Ignore co-transport / active transport
Accept channel proteins
2. Rate of uptake proportional to (external) concentration;
Between C and D
Accept description of proportional
3. All channel / carrier proteins in use / saturated / limiting;
Accept used up
Accept transport proteins

3

- (c) 1. Rate of uptake is proportional / does not level off (so diffusion occurring);
Accept as one increases the other increases
2. (Lipid-soluble molecules) diffuse through / are soluble in phospholipid (bilayer);

2

[7]

Q6.

- (a) 1. Method to ensure all cut surfaces of the eight cubes are exposed to the sucrose solution;
Credit valid method descriptions to fulfil mp1, 2 and 3 (no explanation is required).
2. Method of controlling temperature;
Accept 'at room temperature' for method
3. Method of drying cubes before measuring;
4. Measure mass of cubes at stated time intervals;
Accept time intervals between every 5 minutes with maximum of every 40 minutes.
Accept 'weigh the cubes at stated time intervals'

3 max

- (b) Yes or No (no mark)

Calculation of rate per mm^2 for both sets of data, accept answers in the range

1.6×10^{-5} to 1.8×10^{-5} **and**

1.5×10^{-5} to 1.6×10^{-5} ;;; Both correct = 3

One correct = 2

Neither correct – look below for max 2

Allow 1 mark for calculation of surface area of two (sets of) cubes 7350 (mm²) and 14700 (mm²)

Allow 1 mark for calculation of both rates of osmosis shown in first 40 minutes – between 0.12 and 0.13 **and** between 0.22 and 0.23

If surface area and/or rate of osmosis is incorrect then, allow 1 mark for (their) calculated rate divided by (their) calculated surface area

Accept answers not given in standard form or to any number of significant figures $\geq 2sf$ as long as rounding correct.

3 max

[6]

Q7.

- (a) 1. (If) too much water the concentration of pigment (in solution) will be lower / solution will appear lighter / more light passes through (than expected);

OR

(If) too little water the concentration of pigment (in solution) will be greater / solution will appear darker / less light passes through (than expected);

2. So results (from different temperatures) are comparable;

1. *Ignore reference to too much water so red pigment / solution too weak to measure*

2

- (b) (Take) readings (during the experiment) using a (digital) thermometer / temperature sensor;

1

- (c) Point-to-point line drawn between co-ordinates (with a ruler);

OR

Smooth s-shaped line of best fit;

Reject any extrapolations below 20 °C or above 80 °C

Any line should look smooth (not 'sketchy')

1

- (d) 1. Damage to (cell surface) membrane;
2. (membrane) proteins denature;
3. Increased fluidity / damage to the phospholipid bilayer;

2 max

[6]

Q8.

- (c) 1. Membrane folded **so** increased / large surface area;
OR
 Membrane has increased / large surface area **for** (fast) diffusion / facilitated diffusion / active transport / co-transport;
2. Large number of protein channels / carriers (in membrane) **for** facilitated diffusion;
3. Large number of protein carriers (in membrane) **for** active transport;
4. Large number of protein (channels / carriers in membrane) **for** co-transport;
1. *Accept 'microvilli to increase surface area'*
 1. *Reject reference to villi.*
- Note feature and function required for each marking point and reference to large / many / more.*
- List rule applies.*

2 max

Q9.

- (a) 1. Co-transport;
2. Uses (hydrolysis of) ATP;
3. Sodium ion and proton bind to the protein;
4. Protein changes shape (to move sodium ion and / or proton across the membrane);
3. *Accept 'Na⁺ and H⁺ bind to protein' but do not allow incorrect chemical symbols*

3 max

- (b) 1. Tenapanor / (Group)B / drug causes a significant increase;
OR
 There is a significant difference with Tenapanor / drug / between **A** and **B**;
2. There is a less than 0.05 probability that the difference is due to chance;
3. (More salt in gut) reduces water potential in gut (contents);
4. (so) less water absorbed out of gut (contents) by osmosis
OR
 Less water absorbed into cells by osmosis
OR
 Water moves into the gut (contents) by osmosis.
OR
 (so) water moves out of cells by osmosis.
1. and 2. *Reject references to 'results' being significant / due to chance once only.*
2. *Do not credit suggestion that probability is 0.05% or 5.*
2. *Accept 'There is a greater than 0.95 / 95% probability that any difference between observed and expected is **not** due to chance'*

4

- (c) 1. (Higher salt) results in lower water potential of tissue fluid;
 2. (So) less water returns to capillary by osmosis (at venule end);

OR

3. (Higher salt) results in higher blood pressure / volume;
 4. (So) more fluid pushed / forced out (at arteriole end) of capillary;

For 'salt' accept 'sodium ions'.

Do not allow mix and match of points from different alternative pairs

3. *Accept higher hydrostatic pressure.*

2

[9]

Q10.

21 – 25	<p>Extended abstract</p> <p>Generalised beyond specific context</p>	<p>Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question.</p> <p>Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.</p> <p>No significant errors or irrelevant material.</p> <p>For top marks in the band, the answer shows evidence of reading beyond specification requirements.</p>
16 – 20	<p>Relational</p> <p>Integrated into a whole</p>	<p>Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained.</p> <p>Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology.</p> <p>Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.</p>
11 – 15	<p>Multistructural</p> <p>Several aspects covered but they are unrelated</p>	<p>Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.</p> <p>Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology.</p> <p>Some significant errors and, or, more than one irrelevant topic.</p>

6 – 10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1 – 5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

The levels mark scheme for the essay contains a number of words and statements that are open to different interpretations. This commentary defines the meanings of these words and statements in the context of marking the essay. Many words and statements are used in the descriptions of more than one level of response. The definitions of these remain the same throughout.

Levels mark scheme word/statement	Definition
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. 'Several' here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the

and always clearly explained.	specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (e.g. importance) at <u>A-level standard</u> .

Please note that to obtain full credit, students must use information to show **the importance of diffusion in organisms**.

Specification Reference	Topic Area
3.1.7 and 3.1.8	water and inorganic ions
3.2.3	transport across membranes
3.3.2	gas exchange
3.3.3	digestion and absorption
3.3.4.1	mass transport in animals
3.3.4.2	mass transport in plants
3.4.2	DNA and protein synthesis
3.5.1	photosynthesis
3.5.2	respiration

3.5.4	nutrient cycles
3.6.1.1	plant responses to stimuli
3.6.1.2	receptors
3.6.2.1	nerve impulses
3.6.2.2	synaptic transmission
3.6.3	muscle contraction
3.6.4.1 and 4.2	control of blood glucose concentration
3.6.4.3	control of blood water potential

In order to fully address the question and reach the highest mark bands students must also include at least four topics in their answer, to demonstrate a synoptic approach to the essay.

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

[25]

Q11.

- (c)
1. Comparison: both move down concentration gradient;
 2. Comparison: both move through (protein) channels in membrane;
Accept aquaporins (for water) and ion channels
 3. Contrast: ions can move against a concentration gradient by active transport

3

[9]

Q12.

- (a)
1. Facilitated diffusion involves channel or carrier proteins whereas active transport only involves carrier proteins;
 2. Facilitated diffusion does not use ATP / is passive whereas active transport uses ATP;
 3. Facilitated diffusion takes place down a concentration gradient whereas active transport can occur against a concentration gradient.

Since 'contrast', both sides of the differences needed

3

(b) 3.3:1.

*Correct answer = 2 marks**If incorrect, allow 1 mark for 470–360 / 60 for rate in second hour*

2

- (c)
1. Group **A** – initial uptake slower because by diffusion (only);
 2. Group **A** – levels off because same concentrations inside cells and outside cells / reached equilibrium;
 3. Group **B** – uptake faster because by diffusion plus active transport;
 4. Group **B** fails to level off because uptake against gradient / no equilibrium to be reached;
 5. Group **B** – rate slows because few / fewer chloride ions in external solution / respiratory substrate used up.

4 max

[9]