| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| 1 | (a) | | 1500 ; | | **ACCEPT** 1400 **and** 300,000 for 1 max only |
| | | | 500 000 ; | 2 | |
| | | | | | |
| | (b) | | ability to see (two) objects (that are close together) as separate objects / AW ;<br>see detail ; | 2 | **ACCEPT** ability to distinguish two objects<br>**IGNORE** clarity / clear |
| | | | | | |
| | (c) | (i) | transports water (up plant) ; | | **ACCEPT** alternative wording for transport e.g. movement<br>**DO NOT ACCEPT** up **and** down<br>**DO NOT ACCEPT** water and sugars |
| | | | transports, minerals / ions, (up plant) ; | | **ACCEPT** alternative wording for transport<br>**IGNORE** ref nutrients / solutes<br>**DO NOT ACCEPT** sugars |
| | | | support (plant / stem / shoot) ; | 1 max | **ACCEPT** keeps plant upright |
| | | | | | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| 1 | (c) | (ii) | *Functions:*<br>**F1** (lignin), strengthens / thickens**,** the (xylem) wall **;**<br>**F2** waterproofing (wall) / AW **;**<br>**F3** (improving) adhesion of water (molecules) **;**<br>**F4** (spiral) pattern allows flexibility / stretching / movement**;**<br>**2 max** | | **ACCEPT** support only if in specific context of supporting the xylem wall<br>**ACCEPT** waterproofs cell<br>**DO NOT ACCEPT** adhesion **and** cohesion when used together<br>Flexibility / stretching must ref, *pattern* of lignin laid down i.e. spirals |
| | | | *Explanation:*<br>**E1** prevents collapse of xylem **;**<br>**E2** (water) under tension / at low pressure / negative pressure**;**<br>**E3** reduces (lateral) loss of water, through wall **;**<br>**E4** increases capillarity / AW **;**<br>**E5** prevents stem breaking / AW **;**<br>**2 max** | **3 max** | *Award mark(s) for function and explanation independently*<br>**DO NOT CREDIT** loss of water unqualified |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| 1 | (c) | (iii) | (pits) allow water to move**,** in / out / between, <u>vessel</u>(s) **;** | | **ACCEPT** lateral movement for 'out' |
| | | | to bypass blockage **;** | | **ACCEPT** bypass air lock |
| | | | supply water to other**,** tissues / (other types) cells / parts of plant **;** | | **ACCEPT** any named, tissue / cells |
| | | | | | e.g. to allow water to other tissues 1 mark |
| | | | | | to allow water out to other tissues 1 mark |
| | | | | **2 max** | to allow water out of vessel to other tissues 2 marks |
| | | | **Total** | **10** | |

| Question | | | Expected Answers | | Marks | Additional Guidance |
|---|---|---|---|---|---|---|
| 2 | (a) | | prokaryotic | eukaryotic | 4 | |
| | | | | as chromosomes / chromatin OR (genetic material) associated with, proteins / histones **;** | | **DO NOT ACCEPT** chromatid |
| | | | | (diameter of cell) 20 – 40 **μm ;** | | Figures must have correct units<br>**ACCEPT** any figure(s) in range 10 – 100 μm |
| | | | (ribosomes) 18**nm ;** | | | **ACCEPT** any figure(s) in range 10 – 20 nm<br>**ACCEPT** 70 S |
| | | | cell wall (present) **;** | | | **DO NOT ACCEPT** sometimes or usually present |
| | **(b)** | **(i)** | flagellum / cilium / microtubule / microfilament / undulipodium **;** | | **1** | **ACCEPT** plurals |
| | **(b)** | **(ii)** | (*movement <u>inside cells</u> of*)<br><br>chromosomes / chromatids (in cell division) **;**<br>(cytoplasm in) cytokinesis **;**<br>organelles / named organelle **;**<br><br>RNA (in protein synthesis) **;**<br>proteins **;** | | **2 max** | **DO NOT ACCEPT** mitosis / cell division<br><br>e.g. centriole / vesicle / lysosome / mitochondrion / chloroplast / ribosome<br><br>ensure that the proteins are being moved in cytoplasm by microtubules rather than by ER or in vesicles (mark given above) |
| | | | **Total** | | **7** | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| 3 | (a) | (i) | **A** <u>smooth</u> endoplasmic reticulum / SER<br>**B** nuclear, membrane / envelope **;**<br>**C** mitochondrion **;**<br>**D** nucleolus **;** | **4** | *mark first response on each line **only***<br><br>**ACCEPT** nucleus, membrane / envelope<br>**ACCEPT** mitochondria<br>**DO NOT ACCEPT** nucleous |
| | (a) | (ii) | (mitochondria) vary in shape **;**<br>longer than wide **;**<br><br>cut in different planes / angles / AW **;**<br><br><br><br>just divided / growing **;**<br>artefact / deformed during preparation of section **;** | **2 max** | <br>**ACCEPT** sausage shaped/long and thin<br>**ACCEPT** if shown by drawing<br><br>*need comparative statement*<br>**ACCEPT** C has been cut in longitudinal plane, E has been cut in transverse, section / plane<br>**ACCEPT** one cut horizontally, other cut vertically<br>**ACCEPT** in different positions / one viewed from above the other from the side |
| | | | | | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| | **(a)** | **(iii)** | *correct answer = two marks*<br><br>3.75 / 3.8 **;;**<br><br><br><br>*if answer incorrect **ALLOW** one mark for correct working* | **2** | **ACCEPT** if 3.75 or 3.8 is seen anywhere in response (even if later rounded to 4)<br>**Max 1** if response is 4 with no working<br><br>*how to award one mark for working e.g.*<br><br>candidate shows correct calculation but wrong answer<br><br>actual length = $\frac{20 \times 15}{80}$<br>**OR**<br>candidate uses magnification (x4000) in calculation:<br><br>actual length = 15000 / 4000 **;**<br><br>length of C should be 15mm / 15000μm<br><br>**ACCEPT** ecf for working mark if length of C is not measured correctly but incorrect figure is used in calculation correctly |
| | **(b)** | | proteins moved to Golgi (apparatus / body) **;**<br>processed / modified / AW **;**<br><br>into <u>vesicles</u> **;**<br><br><br>(vesicle) moved to, plasma / cell surface, membrane **;**<br>(vesicles) <u>fuse</u> with membrane **;**<br><u>exocytosis</u> **;** | **3 max** | e.g. carbohydrate group add<br>**DO NOT ACCEPT** reprocessed<br><br>idea that product of processing is placed into vesicles for transport<br>**DO NOT ACCEPT** vacuole – but do not penalise more than once<br>**DO NOT ACCEPT** 'cell membrane' |
| | | | | **[Total: 11]** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 4 | (a) | | | | **Mark first three suggestions only**<br><br>**DO NOT CREDIT** ref to cell signalling / cell recognition |
| | | | **1** form / produce / make, compartments / organelles / named organelles (within a cell) / AW **;** | | **ACCEPT** vesicles as compartments<br>eg mitochondria, ER, nucleus, lysosomes, Golgi, chloroplast<br>**ACCEPT** compartmentalisation<br>**DO NOT CREDIT** 'to contain an organelle' |
| | | | **2** isolation / AW, of, contents (of organelle) / substance / named substance / reactions / metabolic pathways **;** | | eg of AW include hold / contain / store / separates<br>eg of named substance: (hydrolytic) enzymes, hormones / chemical messengers<br>**DO NOT CREDIT** separates cell contents |
| | | | **3** site for attachment of, enzymes / other named molecules / ribosomes **;** | | **IGNORE** ref to increasing surface area / ref to site for reactions to occur<br>eg of other named molecules : receptors / electron carriers / photosystems / pigments |
| | | | **4** provide selective permeability / described **;** | | eg controls what can enter and leave an organelle<br>**DO NOT CREDIT** in context of materials entering and leaving the cell |
| | | | **5** creation of, concentration gradients / specific environments / described **;** | 3 max | eg of specific environment = pH<br>**IGNORE** moves substances in vesicles |
| | (b) | (i) | | | |
| | | | cytoskeleton / microtubule / microfilament **;**<br>provide, pathways / tracks, (for movement) **;** | | **ACCEPT** guide the vesicles |
| | | | (vesicle) moves along, <u>microfilaments</u> / <u>microtubule</u> **;** | | Mp 3 or 4 scores 2 marks as they include mp 1<br>**IGNORE** moved by microtubules / microfilaments |
| | | | <u>microtubules</u>, extended / broken down **;** | | |
| | | | uses, ATP / (metabolic) energy **;**<br>AVP **;** | 2 max | eg ref to (protein) motor / dynein / kinesin |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | | (ii) | receptor found only on, correct / target, (named) organelle **;**<br>*idea that:* address protein provides a way of,<br>labelling / identifying / recognising, the vesicle **;**<br>protein / COPI / COPII, has a specific shape **;**<br>(shape of) receptor and (address) protein are<br>complementary **;** | 2 max | **DO NOT CREDIT** statements that relate to events outside a cell (eg protein is a complementary shape to the receptor on the surface of a target cell) as the question is in the context of vesicles moving *within* cells.<br><br>**ACCEPT** correct target organelle is identified for each vesicle<br><br>**ACCEPT** receptor fits the shape of the, protein / COPI / COPII |
| | (c) | | <u>exocytosis</u> **;**<br>vesicle fuses / merges **;**<br>(with), cell surface / plasma, membrane **;**<br><br>discharging / releasing, enzyme / contents (to exterior) **;** | 2 max | **IGNORE** bind / attach / join<br>**IGNORE** ref to, cell membrane / phospholipid bilayer, unqualified<br>**IGNORE** secretion alone as stated in question |
| | | | **Total** | **9** | |

| Question | | | Expected Answer | Mark | Additional Guidance |
|---|---|---|---|---|---|
| 5 | (a) | (i) | production of vesicles / packaging proteins **;**<br><br>modification of / processing of / adding carbohydrate to **,** proteins **;**<br><br>production of lysosomes **;** | **max 1** | **Mark the first answer.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**<br><br>**ACCEPT** lipids<br>**IGNORE** ref to transport / secretion / exocytosis / substances / materials<br>**DO NOT CREDIT** stores proteins<br><br>**ACCEPT** makes glycoproteins |
| | | | | | |
| | (a) | (ii) | allow movement (of substances) in or out of nucleus **;**<br><br>correctly named substance (entering or leaving nucleus) **;**<br><br>ref to correct destination of substance **;** | **max 2** | **IGNORE** messages / information / communication<br>**IGNORE** name of substance for MP 1<br>**IGNORE** ref to mechanism of movement<br><br>e.g. RNA / (m)RNA / (r)RNA (t)RNA / polymerase nucleotides / ribosomes / helicase / proteins / (steroid) hormones<br>**IGNORE** ref nutrients<br>**DO NOT CREDIT** if incorrect direction of movement described (e.g. RNA into nucleus **or** RNA in and out of nucleus)<br>**DO NOT CREDIT** DNA as named substance<br><br>***Note*** 'allows mRNA out of nucleus' = **two marks**<br><br>e.g. RNA to ribosomes or RER<br>helicase to DNA<br>polymerase to **,** DNA / gene<br>nucleotides to DNA<br>(steroid) hormones to **,** DNA / gene / chromosome |

| Question | | | Expected Answer | Mark | Additional Guidance |
|---|---|---|---|---|---|
| | (a) | (iii) | contain / release **,** lysins / lytic enzymes / hydrolytic enzymes / digestive enzymes **;** | | **DO NOT CREDIT** 'engulf'<br>**DO NOT CREDIT** 'lysosomes are digestive enzymes' |
| | | | digest / break down **,** organelles / foreign objects / toxins / cells / pathogens **;** | | **ACCEPT** destroy<br>**ACCEPT** ref to digestion of contents of phagocytic vesicle<br>**IGNORE** ref to (unwanted) substances / materials / food<br>**IGNORE** ref to acrosomes |
| | | | apoptosis / autolysis / described **;** | **max 1** | |
| | | | | | |
| | **(b)** | | *idea of* more than one (type of) tissue **;** | | **ACCEPT** named examples of tissues |
| | | | working together / performing a function(s) **;** | **2** | **ACCEPT** job or task |
| | | | | | |

| Question | Expected Answer | Mark | Additional Guidance |
|---|---|---|---|
| **(c)** | | | allow **F** marks even if **C** mark not quite accurate |
| | **C1** thin / **squamous**, **<u>epithelium</u>** **;**<br>**C2** thin **<u>endothelium</u>** (of capillary) **;** | | **C1/C2** **IGNORE** ref to alveolus / alveolar wall / capillary wall **,** without ref to epithelium / endothelium |
| | **F1** (provides) short **diffusion** distance / described **;** | | **F1** **ACCEPT** diffusion barrier **,** thin / one cell thick<br>**IGNORE** refs to speed or rate of diffusion<br>**IGNORE** ref to reduces diffusion distance alone – must be in context of short distance<br>**DO NOT CREDIT** ref to thin **,** cell walls / membranes |
| | **F2** ref to **surfactant** (from epithelial cells) **,** reducing surface tension / preventing alveoli collapsing **;** | | **F2** **IGNORE** ref to moisture |
| | **C3** blood / red blood cells / **erythrocytes** **;** | | **C3** **IGNORE** (named) blood vessel<br>**ACCEPT** blood supply / supply of blood |
| | **F3** transports (named) gas(es) **,** to / from **,** exchange surface / alveoli **;**<br>**C4** diaphragm / intercostals **, muscles ;** | | **F3** **IGNO** ref to lungs<br>**IGNORE** description of gas exchange |
| | **F4** (maintains / creates) **diffusion** / **concentration , gradient ;** | | **F4** This can be awarded in context of **F3** or **C4** |
| | **C5** **ciliated** epithelium / **goblet** cells / ciliated cells **;**<br>**F5** *idea of:* protection from / removal of **,** dust / bacteria / pollen / spores **;** | | **F5** **AC PT** trap **,** dust / bacteria / pollen / spores<br>**IGNORE** dirt / germs |
| | **C6** **cartilage ;**<br>**F6** hold airway open **;** | | |
| | **C7** smooth **muscle ;** | | ***continued*** |

| Question | Expected Answer | Mark | Additional Guidance |
|---|---|---|---|
| ***continued*** | | | |
| | **F7** constrict / control diameter of **,** airway / blood vessel **;**<br><br>**C8** elastic , fibres / tissue **;**<br>**F8** for recoil / aiding ventilation **;**<br><br>**C9** **macrophage** / **neutrophil** **;**<br>**F9** engulf / destroy pathogens<br>**or**<br>protect from infection **;** | **max 4** | **F7** **ACCEPT** narrows lumen<br><br>**C8** **IGNORE** elastin / elasticated<br>**F8** **ACCEPT** prevent alveoli bursting<br><br>**C9** **IGNORE** ref to white blood cell unqualified |
| | QWC **;** | **1** | Any **three** with correct spelling and a suitable context from:<br>**epithelium / epithelial**, **endothelium,**<br>**cartilage,** **diffuse / diffusion,**<br>**gradient,** **goblet,**<br>**ciliated,** **concentration,**<br>**squamous,** **macrophage,**<br>**neutrophil,** **surfactant,**<br>**muscle,** **erythrocyte** |
| | **Total** | **[11]** | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| **6** | **(a)** | | visible / can be seen / increase contrast **;**<br><br>named example of what is now visible (after staining) **;** | 2 | *First mark is for 'seeing' and the second mark is for 'recognising' what can now be seen.*<br><br>**ACCEPT** see detail<br>**IGNORE** ref to resolution<br><br>**ACCEPT** recognise different *types* of white blood cell<br>**ACCEPT** can (now) see**,** nucleus / organelles / named organelles<br>**IGNORE** recognise parts inside red blood cell<br>**IGNORE** can now see red blood cells (already visible)<br><br>'can now see red and white blood cells' = 2 marks |
| | | | | | |
| | **(b)** | **(i)** | 3D shape can be seen / greater depth of field **;**<br><br>can see**,** surface features / detail **;** | max 1 | **DO NOT CREDIT** shape alone<br><br>**ACCEPT** 'you can see what is on the surface'<br>**IGNORE** 'you see the surface better' because this needs further clarification i.e. features, shape, named structure |
| | | | | | |
| | | **(ii)** | smaller / named, organelle (becomes visible) **;**<br><br>shapes / details of organelles **;** | max 1 | **ACCEPT** named structure(s) such as lysosome, RER, mitochondrion, ribosome, Golgi , vesicle, nucleolus<br>**DO NOT CREDIT** nucleus or chloroplast (already visible) |
| | | | | | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| | **(c)** | | *This is a QWC question*<br>**1** fetal <u>haemoglobin</u> has a high<u>er</u> **<u>affinity</u>** (for oxygen) ( than adult haemoglobin) **;**<br><br>**2** (fetal Hb) takes up oxygen in low(er) **partial pressure** of oxygen **;**<br><br>**3 placenta** has low partial pressure of oxygen **;**<br><br>**4** at low partial pressure of oxygen / in placenta**,** adult (oxy)haemoglobin will **dissociate** / AW **;** | max 3 | **IGNORE** oxyhaemoglobin for haemoglobin<br>**ACCEPT** Hb for <u>haemoglobin</u> (but not HbO)<br><br>**ACCEPT** fetal Hb becomes *more* saturated at a *low(er)* partial pressure of oxygen<br>**ACCEPT** $ppO_2$ / $pO_2$ / oxygen tension / $O_2$ concentration, for partial pressure of oxygen<br><br>**ACCEPT** in placenta mother's haemoglobin, releases its oxygen / saturation drops |
| | | | **QWC** (two terms used in correct context and spelt correctly)**;** | max 1 | Any **two** terms from the following**:**<br>affinity, dissociate / dissociation, placenta,<br>partial pressure / oxygen tension, saturation / saturated |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| | **(d)** | **(i)** | curve to right of curve A **;**<br>appropriate sigmoid shape **;** | 2 | Curve should start at 0% on y axis and reach at least 80% on y axis |
| | | | | | |
| | **(d)** | **(ii)** | **1** (actively respiring tissue) needs / requires, *more* oxygen **;**<br><br>**2** for aerobic respiration / to release *more* energy **;**<br><br>**3** (actively respiring tissue produces) *more* $CO_2$ **;**<br><br>**4** haemoglobin involved in transport of $CO_2$ **;**<br><br>**5** less haemoglobin available to combine with $O_2$ **;**<br><br>**6** (Bohr shift) causes *more* oxygen to be released **;** | max 2 | *idea* of '*more*' should be clear as shown (MP 1,2,3,6)<br><br>**ACCEPT** make *more* ATP<br><br>**ACCEPT** produces *a lot* of $CO_2$ / as $CO_2$ levels rise<br><br>**CREDIT** detail to include carbonic acid dissociation / formation of haemoglobinic acid / HHb etc<br><br>**DO NOT CREDIT** oxygen released *more* quickly / quicker<br>**ACCEPT** oxygen released *more***,** readily / easily<br><br>'More $CO_2$ produced so more $O_2$ released' = 2 marks |
| | | | | | |
| | | | **Total** | **12** | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| 7 | (a) | (i) | collection / group**,** of cells (of one or more types) **;** | **2 max** | **IGNORE** ref similar cells |
| | | | (cells)**,** working together **OR** with**,** common / same**,** function **;** | | **ACCEPT** a group of cells with a function = 2 marks |
| | | | specialised (cells) **;** | | **DO NOT CREDIT** differentiated |
| | | | | | |
| | (a) | (ii) | squamous / ciliated **;** | **1** | **ACCEPT** endothelium / columnar<br>**DO NOT ACCEPT** cilia, goblet cell, ciliated *cells* |
| | | | | | |
| | (b) | | (organ is) a collection of tissues / named tissues **;** | **2** | Look for idea of more than one tissue<br>**ACCEPT** two or more correctly named tissues from: epithelium, elastic, glandular, smooth muscle, blood, nervous, cartilage, connective |
| | | | (working together) to enable gas exchange / AW **;** | | **DO NOT ACCEPT** perform a function unqualified – we want to know *what* function (can be named or described)<br>**DO NOT ACCEPT** respiration<br>**IGNORE** breathing |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| | **(c)** | **(i)** | (*release of energy*) mitochondria **;** | **1** | |
| | | **(ii)** | *(movement of cilia)* cytoskeleton **;** | **1** | **ACCEPT** mitochondria if not used in **(i)** |
| | | **(iii)** | *(secretion of mucus)* Golgi (vesicle) **;** | **1** | **ACCEPT** cytoskeleton if not used in **(ii)**<br>**ACCEPT** Golgi body / apparatus<br>**DO NOT ACCEPT** Golgi vessel |
| | | | **Total** | **8** | |