1. 1500;

500 000;

ACCEPT *1400* ***and*** *300,000 for 1 max only*

[2]

2. ability to see (two) objects (that are close together) as separate objects / AW;

ACCEPT *ability to distinguish two objects*

see detail;

IGNORE *clarity / clear*

[2]

3. (i) transports water (up plant);

ACCEPT *alternative wording for transport e.g. movement*

DO NOT ACCEPT *up* ***and*** *down*

DO NOT ACCEPT *water and sugars*

transports, minerals / ions, (up plant);

ACCEPT *alternative wording for transport*

IGNORE *ref nutrients / solutes*

DO NOT ACCEPT *sugars*

support (plant / stem / shoot);

ACCEPT *keeps plant upright*

1 max

(ii) *Functions:*

F1 (lignin), strengthens / thickens, the (xylem) wall;

ACCEPT *support only if in specific context of supporting the xylem wall*

F2 waterproofing (wall) / AW;

ACCEPT *waterproofs cell*

F3 (improving) adhesion of water (molecules);

DO NOT ACCEPT *adhesion* ***and*** *cohesion when used together*

F4 (spiral) pattern allows flexibility / stretching / movement;

Flexibility / stretching must ref, pattern of lignin laid down i.e. spirals

Explanation:

E1 prevents collapse of xylem;

E2 (water) under tension / at low pressure / negative pressure;

DO NOT CREDIT *loss of water unqualified*

E3 reduces (lateral) loss of water, through wall;

E4 increases capillarity / AW;

E5 prevents stem breaking / AW;

Award mark(s) for function and explanation independently

2 max

(iii) (pits) allow water to move, in / out / between, vessel(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*

to allow water out of vessel to other tissues *2 marks*

3 max

[6]

4. (i) collection / group, of cells (of one or more types);

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*

2 max

(ii) squamous / ciliated;

ACCEPT *endothelium / columnar*

DO NOT ACCEPT *cilia, goblet cell, ciliated cells*

1

[3]

5. (organ is) a collection of tissues / named tissues;

look for idea of more than one tissue

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)*

DO NOT ACCEPT *respiration*

IGNORE *breathing*

[2]

6. (i) (*release of energy*) mitochondria;

1

(ii) (*movement of cilia*) cytoskeleton;

ACCEPT *mitochondria if not used in (i)*

1

(iii) *(secretion of mucus)* Golgi (vesicle);

ACCEPT *cytoskeleton if not used in (ii)*

ACCEPT *Golgi body / apparatus*

DO NOT ACCEPT *Golgi vessel*

1

[3]

7. partially / selectively;

DO NOT ACCEPT *semi*
ACCEPT *differentially*

(facilitated) diffusion **OR** osmosis;

plasma;

phospholipids;

cholesterol;

ACCEPT *plasma cell*

[5]

8. **1** (acting as) **antigens**;

2 identification / **recognition**, (of cells) as, self / non-self / AW;

ACCEPT *foreign for non-self*

3 **cell signalling** / described;

ACCEPT *description e.g. communication between cells / cell responds to, chemical / signal, from another cell*

4 **receptor** / binding site, for, **hormone** / (chemical) signal / (medicinal / named) drugs;

ACCEPT *description of attachment process for receptor / binding site*
DO NOT ACCEPT *molecule unqualified*
ACCEPT *binding site for foreign antigen*

5 ref. to **receptor** / binding site / trigger, on transport proteins / AW;

ACCEPT *ref to receptors on ion channels*

6 cell **adhesion** / to hold cells together (in a tissue);

ACCEPT *bind to other cells for cell adhesion*

7 attach to water molecules (to stabilise membrane / cell);

4 max for description

Look for <u>description</u> not list of functions
Do not credit repetition of same point

QWC:

three technical terms used and spelt correctly;

*Any **three** from:*
receptor, antigen, hormone, <u>cell</u> signal(ling), adhesion, recognition, <u>facilitated</u> diffusion, <u>active</u> transport

[5]

9. (a) timer **OR** scale / ruler;

1

(b) ***Mark the first three suggestions*** *irrespective of numbered points*

IGNORE reasons – just mark ***steps*** *in the process*

shoot is healthy;

ACCEPT *shoot not wilted*

assemble apparatus / cut shoot, under water;

cut last 2-3 cm off cut end / cut at an angle;

ACCEPT *cut end off shoot*

check there are no air bubbles in apparatus;

ACCEPT *make sure cut end of shoot is in contact with water once apparatus assembled*

apparatus, water tight / air tight / has no leaks;

ACCEPT *screw clip tight*

DO NOT ACCEPT *use Vaseline unqualified*

leaves dry;

DO NOT CREDIT *allow time for acclimatisation, equilibration*

3

(c) (i) 25.3;

IGNORE *any units*

1

(ii) to make results (more) reliable;

DO NOT ACCEPT *accurate* ***and*** *reliable (use of* ***both*** *terms) anywhere in the answer*

to help identify anomalies;

Look for idea of spotting the anomaly e.g. spot, notice, recognise, show, detect.

DO NOT CREDIT *prevents / take out / remove / accounts for, anomalies*

DO NOT CREDIT *'ensure there is no anomaly' unless qualified*

ACCEPT *outliers for anomalies*

ACCEPT *to identify other factors / (uncontrolled) variables that may be having an effect*

2

(iii) *Mark first response in each numbered section (1-2). If not all sections are used, return to the first section and mark further suggestions*

in afternoon:

Assume answer is for different conditions in the afternoon
***ACCEPT** ORA if stated 'in morning...'*
***IGNORE** ref to light / dark*

plant dying / less healthy / wilting;

ref to stomatal closure;

more humid / higher water (vapour) potential in air;

*Look for **comparative** statements – higher, greater etc*

less air movement / wind / draughts;

***DO NOT CREDIT** more **moisture** in air*

2 max

(iv) (potometer) measures (water) uptake;

not all water (taken up) is lost;

***ACCEPT** ref to figs e.g. 99% water taken up is lost*

***ACCEPT** the assumption that water loss is equal to water uptake is incorrect*

some water used (in photosynthesis / making cells turgid);

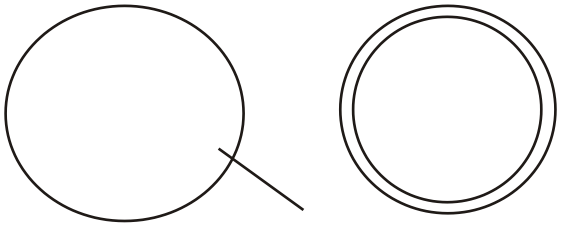
2 max

[11]

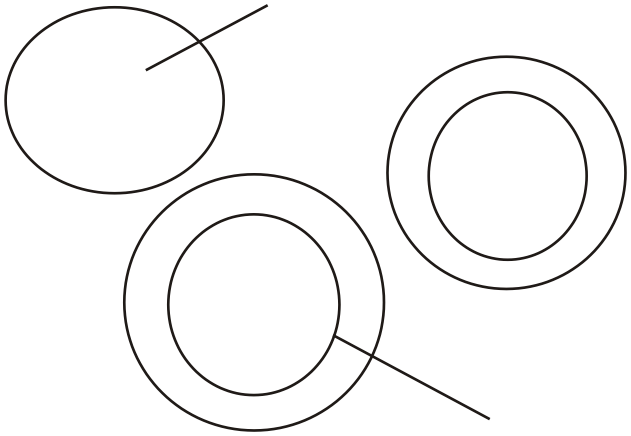
10. (i) vein with thinner wall than artery;

***CREDIT**: Correct position of endothelium as indicated by circle or label line*

*Must be clearly **thinner** than shown on artery*



DO NOT CREDIT:



1

(ii) *Arteries have*:

Assume answer refers to wall of artery.

***IGNORE** any ref to artery wall being thicker, unqualified, as this has already been stated in the question*

no valves;

endothelium / tunica intima, folded / AW;

more / thicker, muscle / elastic tissue / tunica media;

more / thicker, collagen / tunica externa;

***IGNORE** reasons for differences*

***ACCEPT** ORA if stated - 'vein is……'*

*Look for **comparative** statements*

***ACCEPT** tunica adventitia for tunica externa*

2

[3]

11. (i) contraction of ventricle, wall / muscle;

ACCEPT *ventricular systole*

DO NOT CREDIT *heart muscle unqualified*

DO NOT CREDIT *contraction of atria* ***and*** *ventricles*

DO NOT CREDIT *pump / squeeze / push / beat without ref to contraction*

1

(ii) more, (smaller) vessels / named vessels;

ACCEPT *divides into smaller vessels (implies more of them)*

(vessels) have larger, total lumen / cross sectional area;

ACCEPT *larger total surface area*

reduced resistance to blood flow;

DO NOT CREDIT *further from the heart*

arteries, stretch / expand;

loss of, fluid / plasma, from capillaries;

DO NOT CREDIT *loss of, blood / water*

DO NOT CREDIT *loss of fluid / plasma, unqualified or from other vessels*

2 max

(iii) *Assume 'it' refers to plasma:*

plasma / fluid, moves out of, capillary / blood;

DO NOT CREDIT *water / diffuses out*
ACCEPT *filters out*

enters / forms, tissue fluid;

(plasma) proteins, remain in capillary / too large to pass through capillary wall / AW;

(fluid moves) down pressure gradient;

hydrostatic pressure greater than, water potential / Ψ;

DO NOT CREDIT *ref to osmosis*

3 max

[6]

12. **X** = carbonic anhydrase;

ACCEPT *correct phonetic spelling*

DO NOT ACCEPT *anahydrase*

Y = carbonic acid / H_2CO_3;

If formula <u>only</u> given, it must be correct. Incorrect formula can be ignored if correct name given.

Z = hydrogen (ion) / H^+;

DO NOT CREDIT *H alone*

[3]

13. (a) (i) *First two points are marked independently*

diaphragm / **intercostal** muscles, contract:

DO NOT CREDIT *internal intercostal muscles contract*

diaphragm moves down / ribs move upwards <u>and</u> outwards;

DO NOT CREDIT *diaphragm flattens alone*

ACCEPT *movement of diaphragm pushes digestive organs down*

volume of **thorax** increased;

DO NOT ACCEPT *expands (for increased volume)*

pressure inside thorax falls;

DO NOT ACCEPT *size for volume*

ACCEPT *capacity for volume*

ACCEPT *lungs / chest (cavity), for thorax*

to below atmospheric pressure (so air enters lungs);

DO NOT CREDIT *pressure gradient alone - direction of gradient must be specified*

2 max *for mechanism*

QWC:

accept three technical terms used and spelt correctly;

*accept any **three** from: diaphragm, intercostal, volume, pressure, thorax, thoracic cavity*

3 max

(ii) it falls / goes down / AW;

ACCEPT *decreases in volume / volume gets smaller*

DO NOT CREDIT *empties, closes, flattens, deflates, becomes smaller*

DO NOT ACCEPT *amount for volume*

1

(iii) soda lime / sodium hydroxide / potassium hydroxide / calcium hydroxide;

ACCEPT *correct formulae*

NaOH / KOH / $Ca(OH)_2$

DO NOT ACCEPT *calcium oxide*

ACCEPT *limewater, lime soda*

1

(b) to ensure all air breathed comes from chamber

OR

to prevent, escape of air / entry of air, through nose;

ACCEPT *air may be breathed in or out through nose*

ACCEPT *ensures breathes through mouth*

make results <u>invalid</u>;

DO NOT ACCEPT *ref accuracy, reliability, false results*

DO NOT ACCEPT *invalid* ***and*** *accuracy / reliability (use of both terms) anywhere in the answer*

2 max

(c) *Note question relates to measuring* ***vital capacity***

use (medical grade) oxygen / fresh air;

ACCEPT *ensure there is enough oxygen / air*

disinfect mouthpiece;

ACCEPT *change / wash mouthpiece*

ref. to health of subject;

e.g. asthmatics

ref to correct functioning of equipment;

e.g. maintain constant temperature (so that volume of gases is not affected)

ensure, valve / hinge, is working

level of water correct

no leaks / airtight / lips sealed around mouthpiece

2 max

[9]

14. (i) **A** <u>smooth</u> endoplasmic reticulum / SER
B nuclear, membrane / envelope;
C mitochondrion;
D nucleolus;

*mark first response on each line **only***

***ACCEPT** nucleus, membrane / envelope*
***ACCEPT** mitochondria*
***DO NOT ACCEPT** nucleous*

4

(ii) (mitochondria) vary in shape;
longer than wide;

***ACCEPT** sausage shaped/long and thin*
***ACCEPT** if shown by drawing*

cut in different planes / angles / AW;

just divided / growing;
artefact / deformed during preparation of section;

need comparative statement
***ACCEPT** C has been cut in longitudinal plane, E has been cut in transverse, section / plane*
***ACCEPT** one cut horizontally, other cut vertically*
***ACCEPT** in different positions / one viewed from above the other from the side*

2 max

(ii) correct answer = two marks

3.75 / 3.8;;

*if answer incorrect **ALLOW** one mark for correct working*

***ACCEPT** if 3.75 or 3.8 is seen anywhere in response (even if later rounded to 4)*
***Max 1** if response is 4 with no working*

how to award one mark for working e.g.

candidate shows correct calculation but wrong answer

$$\text{actual length} = \frac{20 \times 15}{80}$$

OR
candidate uses magnification (× 4000) in calculation:

actual length = 15000 / 4000;

length of C should be 15mm / 15000µm

***ACCEPT** ecf for working mark if length of C is not measured correctly but incorrect figure is used in calculation correctly*

2

[8]

15. proteins moved to Golgi (apparatus / body);
processed / modified / AW;

e.g. carbohydrate group added
***DO NOT ACCEPT** reprocessed*

into vesicles;

(vesicle) moved to, plasma / cell surface, membrane;
(vesicles) fuse with membrane;
exocytosis;

idea that product of processing is placed into vesicles for transport
***DO NOT ACCEPT** vacuole – but do not penalise more than once*
***DO NOT ACCEPT** 'cell membrane'*

[3]

16. (a)

description	letter
an animal cell that has been placed in water	**N;**
an animal cell that has been placed in a strong sugar solution	**K;**
a plant cell that has been placed in water	**L;**
a plant cell that has been placed in a strong sugar solution	**M**

3

(b) water moves out of cell;
by osmosis;

cell has, higher / greater / less negative, water potential (than surrounding solution) / ORA;

note: this is explain not describe

ACCEPT Ψ *for water potential*
must be comparative – ***DO NOT ACCEPT*** *high alone*

(water moves) down water potential gradient/from high to low water potential;

DO NOT ACCEPT *across or along water potential gradient*
DO NOT ACCEPT *ref to water concentration anywhere*
IGNORE *ref to solute potentials*

3 max

[6]

17. *small, non-polar substances*
diffuse (through membrane / **phospholipid bilayer**);

ACCEPT *diffusion / diffuses*

large substances
(using), **transport / carrier**, proteins;

endocytosis / phagocytosis / described;

ACCEPT *protein pump*
DO NOT ACCEPT *channel proteins here*
ACCEPT *pinocytosis*

polar substances
through, pore / **channel**, proteins;
(using), transport / carrier, proteins;

general – must be used in correct context, each ***once only***
ref to **facilitated diffusion**;

ref to **active transport** / use of ATP;

apply only to large / polar substances

apply only to large / polar substances
DO NOT ACCEPT *ref to active transport with channel proteins*

4 max

QWC – technical terms spelled **AND** used in correct context;

(three from: phospholipid / bilayer / diffusion / facilitated diffusion / active transport / transport protein / carrier protein / channel protein / pinocytosis / endocytosis / phagocytosis)

if protein spelled incorrectly throughout, only penalise once

1

[5]

18. (i) a cell that is, unspecialised / not differentiated;
capable of, division / mitosis;
able to, differentiate / specialise / become other cell types;

DO NOT ACCEPT *replication*
ACCEPT *totipotent / pluripotent / omnipotent*

2 max

(ii) cambium / meristem / early embryonic cells;

ACCEPT *plants have no stem cells*

1

[3]

19. growth (of tissue / organism);
replace (cells) / repair (tissues);
<u>asexual</u> reproduction/cloning / producing genetically identical cells;
maintain chromosome number in all cells;

initially mark first response on each line
if not all lines used, go back and credit further correct points
DO NOT ACCEPT *growth of cells*
DO NOT ACCEPT *repair of cells*

ACCEPT *ref to maintain, haploid / diploid, number*

[3]

20. large / active, organisms have high(er), demand for oxygen / need to remove CO_2;
small(er), surface area to volume ratio / SA:V / surface area:volume;
surface area too small / distance too large / diffusion takes too long (to supply needs);

ACCEPT ORA *throughout*
IGNORE *ref to nutrients*

ACCEPT *diffusion too slow*
look for reason why diffusion not good enough

[2]

21. create / maintain, (steep), diffusion / concentration, gradient;

epithelium	short (diffusion) distance;
capillaries	delivers carbon dioxide (to be removed from blood) / carries oxygen away (from alveoli); short (diffusion) distance;
diaphragm / intercostal muscles	ventilation / supply of oxygen (to alveoli) / removal of carbon dioxide (from alveoli);

could give mark in any row as an additional mark – but only once

DO NOT ACCEPT *any vague reference to 'gases' throughout*

ACCEPT *short diffusion distance here even if given above*

ACCEPT *breathing in* ***and*** *out / AW*

[3]

22. diaphragm (contracts / flattens and) moves downwards;
intercostal muscles contract to move ribs, up / out;
increase volume of thorax;
reduce pressure inside thorax;
to below atmospheric pressure/creates pressure gradient / AW;

IGNORE *ref to internal / external*
ACCEPT *increase volume of lungs / chest*
ACCEPT *decrease pressure in lungs / chest*
must ensure the pressure gradient is in correct direction – lower in lungs

[4]

23. (i) a clear **X** placed on any part of trace where line is sloping down;

ACCEPT *label line with* ***X***
DO NOT ALLOW X *on tip of crest / trough*

1

(ii) 3 dm^3;

correct units ***must*** *be given*
ACCEPT *litres*

1

[2]

24. *single circulatory system:*
blood passes through the heart once for each, circulation / circuit / cycle, of the body; /

DO NOT ACCEPT *ref to cardiac cycle*
DO NOT ACCEPT *'blood passes through heart once' – it must be clear there is a circuit / return to heart*
ACCEPT *description e.g. heart to gills to body to hear*
ACCEPT *ref to no separate pulmonary and systemic systems*
ACCEPT *ref to lungs*

closed circulatory system: /
the blood is maintained inside vessels

ACCEPT *names of two types of vessel as alternative to 'vessels'*

[2]

25. (i) **T** SAN / sinoatrial node;
U AVN / atrioventricular node;
V bundle of His / Purkyne tissue;

ACCEPT *pacemaker*
DO NOT ACCEPT *sinoarterial / artrial node*
DO NOT ACCEPT *arterioventricular node*
ACCEPT *Purkinje*

3

(ii) **T** / SAN, creates / initiates / starts / originates, **excitation**;

ACCEPT *acts as pacemaker*
ACCEPT *impulse / action potential / depolarisation*
DO NOT ACCEPT *electricity / signal / message*
DO NOT ACCEPT *if response suggests that brain needed to trigger SAN*

wave (of excitation) spreads over **atrial**, wall / muscle;
ref to, AVN / **U**;
atria contract / atrial **systole**;
contraction is synchronised / AW;
delay at AVN;
(excitation spreads) down **septum**;

ref to, **bundle of His / Purkyne** fibres;
ventricles contract / ventricular systole, from, **apex** / bottom;

ACCEPT *EITHER in context of both atria OR both ventricles contracting together*
ACCEPT *Purkinje*

4 max

QWC – technical terms, spelled **AND** used in correct context

*any **three** from: pacemaker, sinoatrial node, atrioventricular node, excitation, atrial / atrium / atria, septum, Purkyne, bundle of His, ventricle(s) / ventricular, apex, systole.*

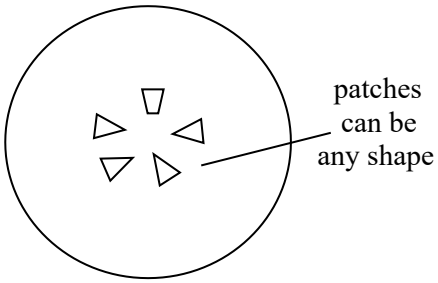
1

[8]

26. 3 – 5 discrete patches in ring (near centre);

if xylem drawn then phloem must be labelled

DO NOT ACCEPT *vascular bundles around edge*
DO NOT ACCEPT *if phloem occupies more than half total width*



[1]

27. **A** / labelled carbon can be observed in the phloem soon after being supplied to the plant;
B / the rate of flow of sugars in the phloem is higher than diffusion;
C / an insect such as an aphid feeds by inserting its proboscis (mouth parts) into the phloem;

mark first two letters only

[2]

28. *source*
site where, sucrose / sugars / assimilates, loaded (into phloem) / AW;

DO NOT ACCEPT *glucose / substance throughout*

ACCEPT *where, sucrose / sugars / assimilates, produced/created or converted from stored products*

DO NOT ACCEPT *terms 'loading' and 'unloading' in wrong context*

sink
site where, sucrose / sugars / assimilates, unloaded / removed (from phloem) / AW;

ACCEPT *where, sucrose / sugars / assimilates, stored or used (in metabolic processes)*

DO NOT ACCEPT *'required' or 'needed' instead of 'used'*

[2]

29. (sugars) cannot pass the cut / AW;

decrease water potential;
water moves into cells;

(damage triggers) increased cell division;
to produce cells to store sugars;

cut causes, gall / infection;

ACCEPT *sugars, stuck above cut / stuck at top of tree / can't move down / build up above cut*

[2]

30. (i) goblet / mucus (secreting) cell;
ciliated (epithelium);

DO NOT ACCEPT *'globlet'*
DO NOT ACCEPT *'cilia cell' 'ciliate'*

2

(ii) (A / goblet cells) release mucus / AW;
(mucus) traps, dust / particles / named particle;
ciliated cell / B / cilia, wave / waft / move, mucus;
to, top of trachea / back of mouth / AW;

ACCEPT *release / creates / produces / secretes*
DO NOT ACCEPT *excrete*

ACCEPT *bacteria / microorganisms / pathogens*
IGNORE *dirt / germs*
DO NOT ACCEPT *'combines with'*
ACCEPT *'hair like projections'*
DO NOT ACCEPT *'hairs'*
Idea of up and out of lungs

3 max

(iii) to constrict the bronchus / AW;

example of AW e.g. reduce diameter of bronchus
DO NOT ACCEPT *'ref to increasing diameter' – (note: if 'increase and decrease diameter' is used do not allow mark as it is contradiction)*
ACCEPT *'airways'*
ACCEPT *'control flow of air'*

1

[6]

31. (i) short, distance / path / AW;

(so that) diffusion / concentration, gradient is, high / steep;
high rate of, (gas) exchange / diffusion;

DO NOT ACCEPT *ref to number of cells / cell thickness or short space*
DO NOT ACCEPT *short gradient*
ACCEPT *high rate of movement of named gas in correct direction*
ACCEPT *'rapid' / fast / quick*
ACCEPT *ref to efficient, gas exchange / diffusion*
DO NOT ACCEPT *gas exchange occurs more 'easily'*

2 max

(ii) recoil / expel air / prevent bursting;

ACCEPT *exhale more completely / force air out*
DO NOT ACCEPT *'exhale' (if used alone)*
DO NOT ACCEPT *'contract'*
DO NOT ACCEPT *'stretch' on its own*
DO NOT ACCEPT *if response includes any ref to bronchus or smooth muscle*

1

[3]

32. (a) (i) **D** cholesterol;

E protein / glycoprotein / intrinsic protein / protein channel / protein pump / transport protein / carrier protein;

F phospholipid (bilayer) / phospholipid head;

ACCEPT *polypeptide chain*
DO NOT ACCEPT *amino acid chain*
DO NOT ACCEPT *extrinsic protein*
DO NOT ACCEPT *lipids / bilayer*

3

(ii) **D** stabilise the membrane OR maintain / affect / control / AW, fluidity OR reduces permeability to, polar / charged, particles;

E allow communication across membrane OR allow, polar / charged, particles to pass through membrane;

F to act as a barrier (to, polar / charged, particles) / select what enters or leaves cell;

mark independently of (a)(i) i.e. NO ecf

DO NOT ACCEPT *refs to rigidity / support / strength*
ACCEPT *reduces / affects, lateral movement of phospholipids*

ACCEPT *cell recognition / receptor site / cell signalling / cell attachment*

ACCEPT *(acts as) selectively permeable or partially permeable membrane*

ACCEPT *allows small / fat soluble molecules to pass through*
DO NOT ACCEPT *separates inside from outside*

3

(b) (i) communication between cells / AW;

cell, recognition / identification;
cells work together / coordination between action of different cells;
to trigger, response / reaction (inside the cell);

ACCEPT *example to illustrate the point, e.g. action of hormone / cytokines*

2 max

(ii) (receptor) specific shape / described;

<u>complementary</u> to (shape of), trigger / named trigger / communicating;

molecule;

(trigger / AW) binds / attaches to receptor;

ACCEPT *tertiary structure*
DO NOT ACCEPT *ref to active site*
ACCEPT *fits / idea of lock & key in correct context*
DO NOT ACCEPT *'matches'*

DO NOT ALLOW *joins / bonds / links / combines / fits*

2 max

[10]

33. (i) cell surface / plasma, membrane damaged;

pigment, released / leaks out;
pigment, absorbs / takes up, the light;

ACCEPT *description of damage e.g. proteins denatured / phospholipids separate / bilayer melts*
DO NOT ACCEPT *bilayer becomes 'more fluid'*
DO NOT ACCEPT *'cell membrane' unqualified*
ACCEPT *'cell contents' for pigment*
DO NOT ACCEPT *'no light transmitted' 'solution is opaque'*

2 max

(ii) Mark first response on each numbered line. Only return to extra points on first or second line if no response in line two or three

more samples at each temperature;

same / fixed, volume of water;
all samples same, size / surface area;
ref to further cutting to increase surface area;

pieces, rinsed / blotted, after cutting;
more (intermediate) temperatures;

same beetroot used / same part of beetroot used;

ACCEPT *repeats*
ACCEPT *collect average / mean results*

DO NOT ACCEPT *mass*
ACCEPT *any method of cutting to provide larger surface area*

ACCEPT *list of figures of additional temps between 0-100*

DO NOT ACCEPT *wider range of temperatures / more evenly spaced temperatures*

DO NOT ACCEPT *leave for longer*

DO NOT ACCEPT *idea of control*

3 max

[5]

34. (a) <u>transpiration;</u>
<u>xylem;</u>
<u>osmosis;</u>

stoma(ta) / stomatal pore;

DO NOT ACCEPT *'diffusion' alone*
ACCEPT *diffusion with osmosis used as qualification*
DO NOT ACCEPT *'pore' or 'guard cells'*

4 max

(b) (i) stomata (open to) allow, gaseous exchange / carbon dioxide in / oxygen out / AW;

(gaseous exchange) for photosynthesis;
(photosynthesis) essential for plant to, gain energy / make sugars;
some water lost through cuticle;

look for reverse argument
DO NOT ACCEPT *ref to air OR to get gases OR let gases in*
ACCEPT *'gases in <u>and</u> out'*

2 max

(ii) <u>xerophyte;</u>

DO NOT ACCEPT *cactus*

1

(iii) Allow the first point once as further explanation for A1 – A4 in addition to the linked explanation:
reduce water (vapour) **potential gradient / diffusion** gradient;

[A 1] hairy leaves;
trap **water vapour** / moisture;

[A 2] stomata, in pits / sunken;
pits trap, **water vapour** / moisture;

[A 3] rolled leaves / presence of **hinge cells**;
reduce **surface area** OR (rolled leaves) trap **water vapour** / moisture;

[A 4] high solute concentration in cells;
reduces water potential inside leaf cells;

[A 5] thick(er) **cuticle**;
(which is) waterproof / (relatively) **impermeable**;

[A 6] small leaves / **needles**;
smaller **surface area**;

[A 7] fewer **stomata**;
reduces **diffusion** (of water vapour);

[A 8] stomata close, during the day;
reduces **diffusion** (of water vapour);

[A 9] most **stomata** on lower surface;
less exposure to sun OR cooler OR reduces diffusion (of water vapour);

[A 10] more densely packed spongy mesophyll;
smaller surface area for evaporation (from mesophyll cell surface);

MARK FIRST <u>TWO</u> ADAPTATIONS <u>ONLY</u>
ALLOW *max 2 for adaptation [A] marks*

Explanation must be linked to an appropriate statement of adaptation. Allow an explanation mark even if adaptation mark not awarded.

DO NOT ACCEPT *'water' for 'water vapour' throughout*
DO NOT ACCEPT *'transpiration' for diffusion of water vapour throughout*

DO NOT ACCEPT *surface area to volume ratio*

ACCEPT *'spines'*
DO NOT ACCEPT *surface area to volume ratio*

4 max

QWC – technical terms used appropriately and spelt correctly;

Use three terms from:
cuticle, impermeable, water vapour, potential gradient, diffuse / diffusion, stoma(ta), needles, surface area, hinge cells, saturated

1

[12]

35.

prokaryotic	eukaryotic
	as chromosomes / chromatin OR (genetic material) associated with, proteins / histones;
	(diameter of cell) 20 – 40 **µm**;
(ribosomes) 18**nm**;	
cell wall (present);	

DO NOT ACCEPT *chromatid*

Figures must have correct units
ACCEPT *any figure(s) in range 10 – 100 µm*

ACCEPT *any figure(s) in range 10 – 20 nm*
ACCEPT *70 S*

DO NOT ACCEPT *sometimes or usually present*

[4]

36. (i) flagellum / cilium / microtubule / microfilament / undulipodium;

ACCEPT *plurals*

1

(ii) (movement <u>inside cells</u> of)

chromosomes / chromatids (in cell division);
(cytoplasm in) cytokinesis;
organelles / named organelle;

RNA (in protein synthesis);
proteins;

DO NOT ACCEPT *mitosis / cell division*

e.g. centriole / vesicle / lysosome / mitochondrion / chloroplast / ribosome

ensure that the proteins are being moved in cytoplasm by microtubules rather than by ER or in vesicles (mark given above)

2 max

[3]

37. Q, T, P, R;;;;

Allocate marks for the following pairs:
S – Q *Q – T* *T – P* *P – R*

[4]

38. (i) growth of cell / growth of organelles / increase number of organelles / synthesis of proteins;

DO NOT ACCEPT *'growth' unqualified*
DO NOT ACCEPT *refs to DNA replication*
IGNORE *ref. to respiration*
ACCEPT *named steps in protein synthesis*

1

(ii) mutation / faulty DNA produced / error in copying;
daughter cells will not receive identical genetic information;
proteins / (daughter) cells, not made / do not function;

ACCEPT *'daughter cells will not be clones'*
ACCEPT *'proteins / daughter cells function differently'*

2

[3]

39. haploid / half genetic information / chromosome number is n;

genetic information not identical / produces genetically different cells;

4 cells produced;

ACCEPT *use of comparative chromosome numbers as example*
DO NOT ACCEPT *identical / not identical without 'genetic'*
DO NOT ACCEPT *smaller cells*

[2]

40. (i) cardiac;

ACCEPT *myogenic*

1

(ii) (muscle) contraction / systole;

ACCEPT *atrial or ventricular systole*
DO NOT ACCEPT *atrial or systolic pressure*

1

[2]

41. (i) correct answer = two marks

75;;

if answer incorrect **ALLOW** one mark for correct working

60 / 0.8

2

(ii) pressure in **ventricle** is below (pressure in) **atrium**;
bicuspid / atrioventricular valve, open(s);
blood flows into (atrium and) ventricle;

ORA
ACCEPT *mitral*
DO NOT ACCEPT *pushed or pumped*
DO NOT ACCEPT *arterioventricular*

3 max

QWC – technical terms used appropriately and spelt correctly;

Use three terms in correct biological context from: ventricle / ventricular, atrium / atrial, bicuspid, mitral, atrioventricular, diastole

1

[6]

42. (i) 4

	eukaryotic cell	prokaryotic cell
cell wall		
nuclear envelope		✗;
Golgi apparatus	✓;	
ribosomes	✓;	
flagellum		sometimes present;

(ii) Golgi apparatus
repackage / transport, proteins;
add carbohydrate group to protein; *max 1*

ribosome
site of protein synthesis; 2

[6]

43. flagellum for movement;
chromosomes / DNA, in haploid nucleus / AW, for fertilising egg cell;
head / cap / acrosome, shaped for penetrating egg cell (membrane);
(many) mitochondria for energy / ATP, for movement; max 3

[3]

44. (i) group of cells;
of one or more types; **A** *'common origin'*
with intercellular material/connective tissue / AW;
(specialised) to perform particular function(s); **R** *job* max 2

(ii) *1 mark for any suitable named tissue e.g.*
xylem / phloem / epidermis / mesophyll / palisade / spongy mesophyll / chlorenchyma / etc./ meristem / cambium / suitable named tissue;

R leaf tissue / root tip / vascular tissue alone / xylem vessels / sieve tubes 1

[3]

45. (a) (i) **A** phospholipid;
B protein;
F cholesterol; 3

(ii) 7nm; **A** correct conversion to other units 1

(b) (i) hydrophilic / polar/AW, head;
hydrophobic / non-polar / AW tail;
AVP; e.g. ref. saturated and unsaturated fatty acids max 2

(ii) allow, small / charged, molecules through membrane; 1

(iii) stabilises membrane structure by forming hydrogen bonds with water molecules;
antigens for cell recognition;
binding sites, for, chemicals/ drugs / hormones / neurotransmitters/ antibodies /T cells;
receptors for cell signalling / triggers chemical reactions inside cell; max 3

[10]

46. (i) *award both marks for correct answer*
$\frac{3.14}{0.52}$;
6:1; 2

(ii) ratio for sphere **B** is three times smaller; ora
allow ecf if wrong calculation in (a)(i) 1

(iii) *any two from the following:*
living cells need to take in oxygen/ nutrients and remove (metabolic) waste;
ref. passive processes / diffusion;
rate of diffusion too slow if SA:V ratio too small; max 2

[5]

47. *credit any five descriptions from the following:*
many alveoli to produce large surface area;
barrier, thin / only two cells thick;
good blood supply / many capillaries;
to carry dissolved gases to and from the alveoli;
ventilation / air movement to refresh the air in the alveoli;
(contains) elastic tissue to stretch and recoil to help expel air;

[5]

48. (i) oxygen is used in respiration;
carbon dioxide is released (in respiration);
carbon dioxide is absorbed (by soda lime); 2

(ii) vital capacity; 1

[3]

49. (blood flows) twice through the heart / AW;

for one circuit / cycle (of the whole body) / AW; **A** *for one heart beat*
ref pulmonary and systemic systems / to lungs and to (rest of) body;
R *systematic* max 2

[2]

50. (i) **D** right atrium
E right ventricle
F left ventricle 3

(ii) provides more, force / pressure, to pump blood around body;
longer distance compared with distance right ventricle has to pump blood;
or right atrium;
AVP; e.g. detail of pulmonary circulation

accept letters D, E and F if used in place of names of chambers of heart max 3

[6]

51. iron / Fe;
four / 4;
Bohr, effect / shift;
carbonic anhydrase;
haemoglobinic acid; **A** *reduced haemoglobin* **A** *HHb*

[5]

52. (a) water uptake / AW; **R** *water used* 1

(b)
1 cut (healthy) shoot under water (to stop air entering xylem vessels);
2 cut shoot at a slant (to increase surface area);
3 check apparatus is full of water / is air bubble free / no air locks;
4 insert shoot into apparatus under water / AW;
5 remove potometer from water and ensure, airtight / watertight, joints around shoot;
6 dry leaves / AW; max 4
7 keep, condition(s) / named condition(s), constant;
8 allow time for shoot to acclimatise / AW;
9 shut screw clip;
10 keep ruler fixed and record position of air bubble on scale;
R *'move bubble to end' ideas*
11 start timing and, measure / calculate, distance moved per unit time / AW; max 3

[8]

53. (i) 103; **R** *decimals* 1

(ii) plant **A**

hairs around stoma;
trap, moisture / water vapour;
reduces the water potential gradient;
so transpiration rate is reduced; max 3

[4]

54. **1** (water moves) by osmosis;

2 down water potential gradient/from high Ψ to low Ψ;
(less negative to more negative)

3 sea water has low water potential/(soil) water potential decreased;
(more negative)

4 Ψ, gradient reduced/lower than inside, root/cells/plant;

5 plant, loses/can't absorb (as much), water;

6 cells, flaccid/lose turgor;

7 plasmolysis/described;

8 wilting/poor growth; in correct context 4 max

Credit suitable equivalent marking points if they state that internal and external ψ are equal

[4]

55. (i) fluid mosaic; **A** *Singer-Nicholson* 1

(ii) **A** phospholipid; **A** *layer* **R** *bilayer*

B cholesterol; **A** *(free) fatty acids/fat-soluble vitamins*

C glycolipid;

D carbohydrate; **A** *glycoprotein*/*glucose* <u>*residue*</u>/*glycocalyx* 4

[5]

56. *at surface*

S1 separate cell from environment;

S2 control, entry/exit (of molecules/ions/suitable substance);
A *selective/partial* **R** *semi-permeable*

S3 use of phospholipid layer (in allowing or preventing passage) of suitable example;

S4 reference to facilitated diffusion;

S5 reference to active uptake; **R** *channel protein*

S6 reference phagocytosis/pinocytosis/endocytosis/exocytosis;

S7 cell recognition/cell surface antigens;

S8 cell to cell attachment;

S9 receptor (for hormones/neurotransmitters etc.);

S10 AVP; microvilli increase surface area of cell
enzyme attachment
further role *max 6*

within

W1 compartmentalise/surrounds organelles;

W2 prevents disruption of, reactions/process; **A** *reaction more efficient*

W3 e.g. reaction/process, and organelle;

W4 reactions take place on membranes; **A** *named example of membrane*

W5 enzymes attached to membranes; **A** *named example*

W6 isolates/separates, DNA/nucleus;

W7 (nuclear pore) permits RNA to leave nucleus;

W8 (forms) ER/(Golgi) vesicles/lysosomes/other named organelle;
(*not the same e.g. as W3 or W6*)

W9 attachment of ribosomes;

W10 intracellular transport;

W11 protects cells from contents of lysosomes;

W12 (tonoplast) surrounds/controls content of, vacuole;

W13 AVP; increases (internal) surface area of organelle
attachment of pigments
formation of mesosomes
further role *max 6*

9 max

QWC – legible text with accurate punctuation, spelling and grammar 1

[10]

57. (i) mitochondrion; **A** *mitochondria* 1

(ii) (liver requires) a lot of, energy/ATP;
R *statements including 'produce/create/make, energy'* 1

[2]

58. (i) 46/23 pairs; 1

(ii) mitosis; **R** *any possible confusion with meiosis* 1

[2]

59. (a) (i) 5:1; 1

(ii) 7 [× smaller]/AW; 1

(b) 0.5; 1

(c) surface area relative to volume too small/AW;
diffusion too slow/AW; *idea of speed needed*
distance too great/some cells deep in body/not all cells in contact with environment/AW; **R** *large if unqualified*
insufficient/AW, oxygen/(named) nutrient, supplied/(named) waste removed;
idea of linking (named) areas; *look for 'from…' 'to…' with an implication of organs, not just 'all over body'*
(may be,) more (metabolically) active/AW/, homoiothermic;
R *just 'need more energy'* 3 max

[6]

60. (i) alveolus/alveolar air, sac/space; **A** *alveoli/air sac* **A** *squamous epithelium* 1

(ii) large surface area to volume (ratio)/AW; **R** *large area unqualified*
thin/one cell thick, wall/short diffusion distance/AW;
A *appropriate figures for width*
squamous epithelium;
permeable;
blood supply, qualified;
elastic tissue/recoil (after expansion);
surfactant; 3 max

error carried forward – mark (ii) independently. E.g. candidates who put 'capillary' in (i) – could still get points 1 to 4 in (ii)

[4]

61. **H**;
C/**G**; **A** *either or both*
E;
I;
D;
F; 6

[6]

62.

J	*name*	neutrophil/phagocyte; **A** *polymorph/granulocyte/eosinophil* **R** *monocyte/macrophage/basophile*	
	function	phagocytosis/engulfing/AW;	
K	*name*	lymphocyte/agranulocyte; **A** *any named lymphocyte, plus correct role*	
	function	produce/release, antibodies;	

error carried forward
if white cells wrongly named, credit function related to given cell
if no names given – credit correct functions for J/K
*if **erythrocyte** given, score **0*** 4

[4]

63.

1	haemoglobin/haem, carries oxygen/AW;
2	detail of no. of oxygen molecules carried;
3	small size/large SA:V ratio, so haemoglobin never far from cell surface/AW;
4	flexible/elastic/stretchy/changes shape/AW;
5	small size/'stretchiness'/AW, allows red cells to, fit/squeeze, into capillaries;
6	biconcave/AW [**A** '*dimpled'*], gives, increased/AW, surface area relative to volume (for diffusion);
7	no nucleus to maximise room for, haemoglobin/oxygen/AW;
8	contain carbonic anhydrase;

9 describe, the reaction catalysed by carbonic anhydrase/role in maintenance of diffusion gradient/AW;

10 transport of carbon dioxide as carbamino-haemoglobin/CO_2 combines with Hb;

11 ref buffering effect;

12 AVP; e.g. further detail of oxygen carriage
variable oxidation state of Fe
idea that small size allows them to be close to tissue or cells
lack of, other/named, named organelles, also increases room for Hb/O_2 max 6

QWC – legible text with accurate spelling, punctuation and grammar; 1

[7]

64. (i) potometer; **R** '*transpirometer'* 1

(ii) transpiration is the loss of water, vapour/by evaporation;
(apparatus) measures water uptake;
to replace loss;
assumes all uptake is lost/AW; ora some may be used
explanation of how some uptake may be used e.g. used to regain turgor/used in photosynthesis;
uptake by detached shoot may not be same as whole plant/AW; 3 max

(iii) cut shoot under water/insert into apparatus under water/AW;
cut shoot at a slant;
no, airlocks/bubbles/AW in, plant/apparatus, **or** airtight/watertight, joints;
dry off leaves/AW; use a healthy/undamaged/AW, shoot; **A** *fresh*
allow time to acclimatise/AW;
keep (named) condition(s) constant; **R** *'control' conditions if unqualified*
measure per unit time;
AVP; e.g. reference to scale, qualified – note position/fix scale
R *'set at 0'*
qualified reference to reservoir

R *repeat readings – gives reliable results not valid readings* 4 max

[8]

65. (i) 1 temperature increased;
more KE/energy/AW;
more evaporation/faster diffusion; **R** *transpiration max 3*

2 light (intensity) increased; **A** *sunlight* but **R** *'sun'* but ecf
stomata opened (wider);
allowed more water vapour out/AW;
must be linked to stomatal point above
temp increase linked to light; *max 3*

3 humidity dropped/air less saturated/AW;
internal spaces c. 100% saturated/AW;
steeper water potential gradient/AW; **A** *diffusion gradient*
R *concentration gradient max 3*

4 wind (increased);
removed, saturated air/diffusion shells/AW;
steeper water potential gradient/AW;
A *diffusion* **R** *conc gradient max 3*

Score the first two explanations given to a max of 4 4 max

(ii) 1 **P** has, many/more, leaves;
(so total) area (of leaves) greater;
(so) more, area for transpiration/evaporation/stomata;

or

2 **P** has more stomata;
idea that stomata are (main) site/AW, of transpiration/evaporation;

or

3 **Q** has a stated xerophytic modification;
R *Q is a xerophyte, if unqualified*
R *Q has smaller/AW leaves*
explanation of modification; needs how it reduces transpiration
e.g. hairs – wind barrier/stops water vapour removal
sunken stomata – traps water vapour/AW
thick cuticle/wax/AW reduces loss/AW **R** *stops all loss*
curled leaves – trapping water vapour idea 2 max

Apply ora throughout.

[6]

66. prevents osmosis;
no net movement of water/AW;
prevents bursting/lysis/crenation/AW; 2 max

[2]

$ $**67.**(a) (i) *Each of the following to be labelled with a clear label line.*

*Allow **P** and **E** as letters inside the appropriate cell.*

P / palisade mesophyll cell;
E / lower epidermal cell;
C / cuticle; 3

(ii) *award two marks if correct answer (150) is given*
incorrect answer (or no answer) but correct working = 1 mark

(×) 150;; **R** units

A in the range 147 – 153 ***answer should not exceed 1 d.p.***

if answer incorrect or to too many d.p., then allow 1 working mark for ÷ 0.7 (mm) or equivalent 2

(b) *if describing organ, max 1*

made up of, more than one / two / a few, types of cell;
A named cell types (vessel / fibre / parenchyma)
working together / AW;
with a, specific / particular / same, function / role / purpose / job;
A named function
A transport minerals
R transport nutrients 2 max

[7]

68. *credit comparative statements on the same line ~ must refer to both*

do not credit ref to size of cell
ignore vacuoles / slime layer

prokaryotic	***eukaryotic***	
no, nucleus / nucleolus / nuclear membrane / nuclear envelope **A** free DNA	nucleus / nucleolus / nuclear membrane / nuclear envelope **A** DNA enclosed	;
circular DNA **A** loop	linear DNA	;
no, histones / (true) chromosome **A** naked DNA	histones / chromosome **A** DNA + protein	;
no membrane-bound organelles	membrane-bound organelles/ named e.g. (*Allow up to 2 marks*)	;
cell wall	may have cell wall	;
peptidoglycan / murein, cell wall	cellulose cell wall (if present)	;
ribosomes, 18 nm / 70S / smaller	ribosomes, 22 nm / 80S / larger	;
plasmids	no plasmids (except inside organelles)	;
AVP e.g. no cytoskeleton, flagellum not 9+2, pili, fimbrae, capsule, mesosome	AVP e.g. cytoskeleton, flagellum 9+2, no pili, no fimbrae, no capsule, no mesosome	;

3 max

[3]

69. (a) **R** *"I" and "II" throughout*

(i) prophase; 1

(ii) interphase / S phase; 1

(iii) telophase; *ignore cytokinesis* 1

(b) **1** attach to spindle;

2 by centromere;

3 centromere, divides / splits; **R** breaks

4 spindle fibres shorten / AW;

5 chromosomes / chromatids, pulled to, poles / centrioles / different ends of cell / different ends of spindle;
nucleus / 1 of each pair

6 centromere leading;

7 detachment from spindle fibres;

8 (start to) unravel / uncoil / decondense / lengthen / AW; 4 max

[7]

70. (a) (i) produce / secrete / release, mucus;
prevent collapse of / hold open / support, airways;
A provide shape of bronchus
R gives wall, structure / strength 2

(ii) cilia, destroyed / damaged; **R** cilia not working
(epithelium replaced by) scar tissue / scarring;
(smooth) muscle becomes thicker;
mucous glands enlarge / larger goblet cells / more goblet cells;
R more mucus secreted
inflammation of connective tissue;

AVP; idea of tumour if it describes a structural change max 2

(b) stretch, as air is inhaled / allow alveoli to expand during inhalation;
to increase lung volume / surface area;
prevents alveoli bursting;
(elastic fibres) recoil, as exhale; **R** contract
more, complete / rapid, expulsion (from the alveoli); **A** expel more air max 2

(c) tidal volume is reduced / less air inhaled and exhaled / residual volume is larger / air trapped in alveoli / vital capacity smaller;
more difficult to exhale;
(as) alveoli cannot, stretch / recoil;
rapid / shallow, breathing / breathlessness / wheezing;
alveoli may burst;
leaves gaps in tissue / larger air spaces / AW;
less surface area (for gaseous exchange);
blood / haemoglobin, less well oxygenated / less carbon dioxide removed;

R *less able to do exercise / need to use oxygen* max 4

[10]

71. (i) coronary; 1

(ii) high concentration of, cholesterol / LDL, in blood;
endothelium / lining damaged;
deposition (fat / cholesterol) in wall of artery; **R** "on artery"
ref to plaque / atherosclerosis / atheroma; max 2

[3]

72. (i) ref to suitable drug; e.g. anticlotting, blood pressure reducing, diuretic
bypass operation;
stents fitted;
angioplasty / balloon on catheter;
AVP; e.g. name of drug
extra detail about a named drug or one of above procedures max 2

(ii) avoid, saturated / animal, fats; **A** cholesterol
eat, unsaturated fats / polyunsaturated fats / plant oils / fish oils;
qualified ref to, more / regular, exercise;
avoid smoking;
avoid stress;
eat more, fruit / vegetables / antioxidants; **A** moderate intake of red wine
reduce weight;
reduce alcohol intake;
eat more soluble fibre;
ref to vitamin D production / exposure to sunlight; max 2

[4]

73. (a) the heart / ventricle / cardiac muscle (involved);
peaks coincides, with, systole / contraction; **R** pump
troughs coincide, with, diastole / relaxation / AW;
stretch-recoil effect / AW;
must *link to rise / fall not just a general statement* 2 max

(b) distance (from heart) qualified, e.g. further / around the body / AW;
friction / resistance to flow / AW;
less / no, stretch-recoil effect / AW;
increasing volume of, arterioles / capillaries;

A surface area of capillaries / large capillary bed / many capillaries / branching

R large SA:V ratio 3 max

(c) stop damage (to capillaries);
A stop bursting **R** **'**can't cope' **A** **'**can't withstand'
lack of (much) elasticity / thin / delicate / fine / one cell thick /
no collagen / no muscle; *ora* for artery wall
slows flow rate;
allows time (for);
exchange / AW; **A** one named substance moved, but **R** "food"
oedema risk reduced / high pressure might force out more tissue fluid; 2 max

(d) valves prevent backflow / AW;
action of (skeletal) muscle; **R** if muscle in vein wall implied
residual pressure / AW;
large lumen provides little resistance / AW;
negative pressure in, chest / thorax / heart; **A** respiratory pump
gravity effect (from areas above heart); 2 max

[9]

74. (a) **C**;
E; 2

(b) large surface area (to volume) / many;
low water potential; **A** ref to low solute potential
R refs to water concentration
A refs to (high) solute concentration
thin <u>wall</u> / short diffusion path;
uncutinised / permeable / unlignified / AW;
rapid, growth / replacement; 2 max

(c) **1** osmosis in correct context;
look for across membrane, or, into / out of, cell / root

2 moves down a water potential gradient / from high to low water potential;
R along / across **R** concentration / diffusion gradients

3 most negative / lowest, in the xylem;

4 (uptake of) ions / minerals / solutes, into xylem / root hair;
in context of WP gradient

5 tension in xylem / transpiration pull / cohesion-tension;
relate to pathway in root

6 (moves) via the cell walls;

7 (moves) via, cytoplasm / vacuoles;

8 passage via the plasmodesmata; *look for linking cytoplasm / through wall*

9 Casparian strip / suberin / waxy / fatty / AW, blocks, cell wall route / apoplast; **A** waterproof

10 water, crosses membrane / enters, cytoplasm / vacuole / symplast;

11 AVP; e.g. pits in xylem / passage cells /aquaporins / protein channels / capillarity in cell wall (spaces) max 6

credit points from diagram

QWC – legible text with accurate spelling, punctuation and grammar; 1

(d) *1 for feature and 1 for role in each section **except lignin** but max 2 for features and max 2 for functions*
apply AW throughout

lignin / AW;
(allows) adhesion / waterproof / stops collapse (under tension);
A two functions

rings / spirals / thickening / AW; **A** thick wall / rigid sides
prevents collapse (under tension); **R** strong / support / stops bursting

no cytoplasm / lack of contents / hollow / (empty) lumen / AW;
R "dead" unqualified
less resistance to flow / ease of flow / AW / more space (linked to lack of contents);

lack of end walls / continuous tube; **A** long tube idea
less resistance to flow / ease of flow; **A** continuous columns idea

pits / pores, inside walls; **A** holes **R** gaps
lateral movement / get round air bubbles / supplies(water) to cells or tissues / water in or out; **R** "just let things in and out" unqualified

develop as a continuous water-filled column / AW;
allows tension to pull water up / AW;

narrow lumen / AW;
idea of more capillary rise; 4

[15]

75. (a) **F** = sinoatrial node / SAN / pacemaker;
G = pulmonary vein; 2

(b) (i) atrium / **X**, (only) has to pump, to ventricles / short distance;
ora for ventricles **A** ref to gravity effect / negative ventricle pressure

left ventricle / **Y**, has to pump to, body / systemic circulation, and,
right ventricle / **Z**, has to pump, to, lungs / pulmonary system;

comparison of Y and Z

left ventricle / **Y**, pumps, further / great(er) pressure;
ora right ventricle / **Z** **A** to all / whole body *idea* as distance

left ventricle / **Y**, pumps against great(er) resistance;
ora right ventricle / **Z** 3 max

(ii) (Purkyne fibres) conduct wave of excitation / AW;
R *impulse, signal, pulse*
to the, base / apex, of heart;
so contraction occurs upwards / AW;
both ventricles contract together;

ora for answers written in terms of what does not happen 2 max

(c) blood passes to left atrium / deoxygenated and oxygenated blood mixes in

atria; **R** 'between atria' – must imply direction in first alternative

not the reverse (due to flap);
(so) blood, in left ventricle / aorta, not fully oxygenated / AW;
deoxygenated blood / less oxygen, delivered to brain;
A carbon dioxide build up in brain
reduced (aerobic) respiration in brain / anaerobic respiration;
R *no respiration*
(possible link with), lactic acid / lactate, build up; **R** *waste*
oxygen shortage in brain (might) lead to raised blood pressure (causing migraines) / AW;
AVP; e.g. ref to oxygen debt 3 max

[10]

76. (a) 78%; **A** 79% 1

(b) (i) **1** fetus gains oxygen, from mother / across placenta;

2 partial pressure of oxygen in placenta low;

3 2-5 kPa; **A** any figure within range

4 maternal (oxy)haemoglobin releases oxygen;
R if stealing / taking oxygen from mother is given

5 fetal haemoglobin has a high(er) affinity for oxygen;
A binds more strongly

6 maintains a diffusion gradient / AW; *max 4*

(ii) *accept answers written in terms of adult haemoglobin*

7 oxygen would not be released readily enough / AW;

8 (because) affinity of fetal haemoglobin would be, too / very / so, high;
***only accept** higher/high if linked to oxygen release*

9 ref to idea that adult (females) will need difference with their fetuses in due course; 5 max

[6]

77. carbonic anhydrase;
carbonic acid / H_2CO_3;
hydrogencarbonate / HCO_3; **A** bicarbonate
haemoglobinic acid; **A** HHb
oxygen / O_2; 5

[5]

78. (i) to take account of variation / AW;
reliable or representative / smaller SD or % uncertainty;
ignore "accurate", "precise"
so result not skewed by, anomalies / extreme or unusual results;
to ensure statistical significance; 2 max

(ii) permanent record;
avoid, heating effect / light, of microscope lamp;
stomata size may change (under microscope);
photograph can be enlarged;
measuring can be done at leisure;
AVP; e.g. system or method of measuring 2 max

[4]

79. (i) mitochondrion; **A** mitochondria 1

(ii) aerobic respiration;
ATP production; **A** provides ATP
energy release; **A** provides energy **R** produce / create / make / etc
AVP; e.g. Krebs cycle / regenerate NAD
oxidative phosphorylation
protein synthesis
lipid synthesis
oxidation of fats
ornithine / urea, cycle 2 max

(iii) (energy / ATP needed) for, movement / wafting (of cilia);
R flagellum / molecules 1

(iv) *award two marks if correct answer (5) is given*
award one mark for calculation

5;;
if answer incorrect, allow 1 mark for
100 +/– 2 (mm) *or* 10 +/– 0.2 (cm) ÷ 20000 2

[6]

80. low resolution; *ora*
(close) points not easily distinguished;
wavelength (of visible light) is too long;
max resolution of light microscope =, 200 nm / 0.2 μm; **A** anything close
no more detail visible than seen at, ×1500 / ×1000;

A comparative statements
R reverse arguments for points 2 – 5 2 max

[2]

81. (i) endocytosis / phagocytosis; **A** bulk (transport)

R pinocytosis / exocytosis 1

(ii) enzymes / named enzymes / lysins;
acid / low pH;
digestion; **A** breaking down
breaking, peptide / glycosidic / ester, bond; **R** if in wrong context
hydrolysis;
soluble / named, products; 3 max

[4]

82. (rough) ER has ribosomes; **R** produces
for, protein synthesis / translation;
ER transports protein through cell;
forms vesicles;
for transport to / forming, Golgi;
(in Golgi) modification of protein / glycosylation; 2 max

[2]

83. (a) *look for shading in **A***
do not credit if more than 1 chromosome shaded

corresponding homologous chromosome correctly shaded on **A**;
i.e. bottom one 1

(b) *mark (i) and (ii) independently*

(i) metaphase; **R** ref to metaphase I or II 1

(ii) (individual) chromosomes align at,
metaphase plate / equator / centre (of cell);
join to, spindle / microtubules;
by centromeres;

ref to bivalents / homologous pairs = max 1 2 max

(c) **C**;
A; 2

[6]

84. (a) (i) **K**; 1

(ii) (vacuole in cell **K**) has less water in it (than cell **L**); *ora*
(vacuole / cell **K**) has lost more water (than cell **L**); *ora*
lower, water potential / Ψ, outside cell **K**; *ora* 1

(iii) (cell wall is) freely permeable / permeable to salt (solution);
R partially permeable 1

(b) (i) –1300 kPa; credit if clearly indicated as candidate's choice 1

(ii) arrow drawn from –800 to –950;
arrow drawn from –800 to –1000;
arrow drawn from –1000 to –1250;

a continuous arrow from –800 to –1000 to –1250 = 2

additional arrow(s) = –1 for <u>each</u> arrow that goes from low Ψ to high Ψ but do not award less than 0 for (b)(ii) 3

[7]

85. many, air spaces / alveoli;
large surface area; **R** ref to surface area to volume ratio
thin wall of, alveolus / capillary; **A** one cell thick **R** 'thin wall' on its own
good blood supply / large capillary network;
air passage / bronchiole;
capillary close proximity to alveolus;

R refs. to cilia, mucus, elasticity 3 max

[3]

86. (i) *award two marks if correct answer (0.55 – 0.65) is given*
incorrect answer (or no answer) but correct working = 1 mark
ecf rules apply for 1 mark max

working; (marks on graph or calculation)
0.55 – 0.65; 2

(ii) vital capacity; 1

[3]

87. (a) (i) 6:1;;
working. 3.14 divided by 0.52 2

(ii) ratio for B is smaller / decreased / AW; *ora*
by two thirds / AW;
volume increases more rapidly than area / AW; *ora*

ecf if wrong calculation in (a) (i) 2 max

(b) *answers must relate to developing a transport system*

diffusion not adequate / AW / *ora*;
as not enough area (relative to volume); *ora*
distance too great / cells deep in body / AW; *ora*, **R** large unqualified
mass flow system needed;
transport / blood (vascular), systems, link, the parts of the body / named parts;
e.g. of substance needing to be transported; **R** 'gases' / 'waste' / 'food'
ref to activity / high metabolic rate, of mammals; 3 max

(c) alveoli
lung
villi
gut
small intestine **A** intestine
capillary bed / capillaries / AW
skin qualified e.g. elephant's ears
cerebral cortex / brain
kidney (tubule)
liver
AVP; 1

[8]

88. **C**;
B;
G;
G;
C / **D**; **A** *if both put down*
B / **C**; **A** *if both put down* 6

[6]

89. cardiac;
myogenic;
sinoatrial node / SAN; **A** pacemaker
stop / prevent / AW; **R** delay
atrio-ventricular node / AVN;
bundle of His / Purkyne fibres *or* tissue; 6

[6]

90. contractions / heart, not coordinated / irregular / AW;
less / no blood, leaves heart / goes to lungs / goes to body;
cells / (named) tissue(s) / (named) organ(s) / heart muscle, deprived of oxygen;
ref to pressure;
AVP; e.g. ref to lack of P/R/T on ECG 2 max

[2]

91. **G**;
I; 2

[2]

92. (i) evap*ora*tion of water / water vapour lost (from plants);
diffusion,
into atmosphere / out of leaf / down a water potential gradient /
via stomata;
A high to low water potential references

stop if / when candidate says transpiration is 'upward movement of water in plant' 2 max

(ii) linked to gas exchange / AW; **A** refs to **both** oxygen and carbon dioxide unqualified carbon dioxide for photosynthesis;
open stomata;
large area; *can apply to leaf area or pore area*
moist mesophyll to (relatively) dry air / water potential gradient / AW;
AVP; e.g. ref to some cuticular transpiration inevitable / AW
link open stomata to daytime when it is hottest / AW 3 max

(iii) hairs trap water vapour; **R** water unqualified / water particles **A** molecules
reduces water potential gradient / stops wind removing vapour /
more humid air around leaf; *ecf* for water
so less transpiration / AW;
AVP; e.g. ref reflective nature of hairs in context
ref to need of xerophytes to conserve water in dry habitat 2 max

[7]

93. **1** in the xylem <u>vessels</u>; **A** tracheids

2 down a, water potential / Ψ, gradient;
R 'along' **A** refs to high to low water potential

3 most negative, at the leaf / in the atmosphere;
ora must refer to water potential

4 transpiration sets up a gradient / AW; *any valid gradient*

5 (places) water (in xylem) under, tension / suction / negative pressure / pull / hydrostatic pressure gradient / AW;

6 cohesion;

7 description of cohesion;

8 ref to hydrogen bonding;

9 (continuous) water columns / AW;

10 <u>mass flow</u>;

11 root pressure, in context / described;

12 adhesion described / capillarity;

treat refs to osmosis and descriptions of passage through root as neutral 6 max

QWC – legible text with accurate spelling, punctuation and grammar; 1

[7]

94. (a) (i) Bohr; 1

(ii) (steep part) corresponds to pO_2 in, tissues / cells / organs;
cells / tissues / organs, need (much) oxygen;
change / drop, in pO_2 gives, large change / drop in saturation (of haemoglobin) / much release of oxygen / AW;
R refs to increase in pO_2
data from diagram to support; 2 max

(iii) ref to (more), H ions / carbonic acid; **A** formula
(forms) haemoglobinic acid; **A** HHb
(haemoglobin), releases more <u>oxygen</u> / has lower affinity for <u>oxygen</u> / has lower saturation of <u>oxygen</u>;
at a certain partial pressure of oxygen;
data from diagram to support; *must be comparative*
AVP; e.g. ref to effect of CO_2 on, brain / heart, related to oxygen delivery 2 max

(b) more heat (in exercising muscle) / increase in body temperature / AW;
(as) respiration releases some energy as heat / AW;
ATP to ADP releases some energy as heat / AW;
(muscle) temperature rises, above normal body temperature / to 45 °C;
(so) more oxygen release (from haemoglobin / RBCs) / AW; 2 max

[7]

95. (i) **A**, **B** and **E** ; 1

(ii) *apply ora throughout*
produced by, sexual reproduction / fusion of gametes / fertilisation ;
ref to random mating ; *random fertilisation = 2 marks*
contain chromosomes from two individuals / diploid organisms ;
more <u>alleles</u> ; 2 max

(iii) **C** and **D** are haploid organisms ;
haploid cells have, one set of chromosomes / half the number of chromosomes ;
meiosis requires pairing of homologous chromosomes ;
ref to maintaining chromosome number when gametes fuse / gametes must be haploid ; 2 max

[5]

96. (i) nucleus / nuclear envelope / nuclear membrane; 1

(ii) (made up of) one type of / (squamous) epithelium**,** cell(s);
A *same* **R** *similar alone*
(group of) cells performing the same function(s); **A** *task / job* 1 max

(iii) large surface area;
permeable;
thin / short, diffusion path;
moist;
good blood supply / close to blood;
well ventilated / in contact with respiratory medium; 2 max

[4]

97. *award two marks if correct answer (14 000) is given*
incorrect answer (or no answer) but correct working = 1 mark
ecf rules apply for one mark max
14 000;;

R *units in the answer*

allow 14666.67 *or* rounded correctly (e.g. 15 000) *(for 22 mm)*
13333.33 *or* rounded correctly (e.g. 13 000) *(for 20 mm*)

A *1 mark for* 20 / 21 / 22 mm ÷ 1.5 *or* equivalent
or ecf (*for measurements 15 – 25 mm*) 2

[2]

98. *active transport*

1 against concentration gradient / described; **A** *up*

2 uses**,** energy / ATP;

facilitated diffusion

3 down concentration gradient / described; **A** *with* **R** *along / across*

4 no**,** energy / ATP**,** required; **A** *passive*

protein carrier (in either or undefined)

5 attaches on one side of the membrane;

6 protein**,** moves / turns / changes shape;

7 releases on other side of the membrane;

channel protein (facilitated diffusion only)

8 forms**,** pore / passage**,** through centre of the protein;

9 hydrophilic conditions / water lined;

10 <u>phospholipid</u> (bilayer) prevents**,** diffusion / passage / entry**,** of (some), molecules / ions; **R** *substances*

11 polar / water soluble / not lipid soluble / too big / suitable named e.g.;

12 appropriate use of protein <u>in both</u>;

13 ref to specificity of protein to substance transported;

14 AVP; (for extra detail of transport mechanism) 7 max

QWC - legible text with accurate punctuation, spelling and grammar; 1

[8]

99. prophase;
centromere; **A** *kinetochore*
R *centrosome*

membrane / envelope;
chromosomes / centromeres; **A** *chromatids*
R *homologous chromosomes / bivalents*

anaphase;
poles / ends; **A** *centrioles / asters*
R *sides*

cytokinesis; **R** *telophase / cytokinin*
genetically;

[8]

100.

	pathogen;
	degenerative;
	aerobic; **R** *aerobic respiration*
	tidal;
	pandemic;

[5]

101. (i) stem; 1

(ii) **B**; 1

[2]

102. (a) sucrose; 1

(b) (i) **P** = companion (cell);
Q = sieve (tube) element / sieve tube cell; **R** sieve tube / sieve cell 2

(ii) *ecf - do not penalise sieve tube here*

1 sieve elements / **Q**, end to end *or* sieve plates perforated / sieve pores, for ease of flow / AW;

2 companion cells / **P**, metabolically active / have many mitochondria / produce ATP / release energy / AW; **R** make energy

3 (active) loading into, companion cell / **P**; **A** into, sieve elements / **Q**

4 ref to proton pump;

5 ref to co-transporter;

6 role of plasmodesmata (between **P** and **Q**); **R** pores

7 sieve element / **Q**, has few organelles / AW, for, ease of flow / more sucrose / AW;

8 ref to, unloading mechanism / (hydrostatic) pressure gradient;

9 ref to one role for sieve plate e.g. electro-osmosis or stops 'bulging'; 3 max

[6]

103. source when root converts, starch / insoluble carbohydrate, into sugars / AW;
sink when root **either** stores starch / (named) carbohydrate / assimilate **or** uses carbohydrate for, respiration / growth / AW;
high hydrostatic pressure makes it a source **and** low hydrostatic pressure a sink;
when loading it is a source **and** when unloading a sink;
treat refs to (potato) tubers as neutral 2 max

[2]

104. (a) *award two marks if correct answer (7) is given*
incorrect answer (or no answer) but correct working = 1 mark

7;;
max 1 if not to nearest whole number **R** answers in cm

calculation mark for showing division by 12 2

(b) **1** ref to tunica, intima / interna, tunica media and tunica, externa / adventitia;

2 thick wall, stops bursting / withstands pressure idea;

3 (relatively) narrow lumen to maintain pressure;

4 elastic tissue / AW, allowing stretching / AW;

5 elastic arteries near heart;

6 elastic recoil;

7 to even out surges of pressure / to maintain flow / AW;
A push idea

8 collagen provides (main) strength / AW;

9 (smooth) endothelium (of tunica intima) to reduce friction / AW;
A epithelium *or* lumen lining / AW **R** epidermis

10 tunica media / AW, has (smooth) muscle and elastic tissue;
collagen is ***neutral***

11 to prevent bursting / withstands pressure / AW;
look for link to tunica media

12 (smooth) muscle maintaining pressure;
A ref vasoconstriction / 'blood shunts'
R pumping action

13 AVP; e.g. idea that circular cross section allows max blood volume for minimum wall contact / AW 6 max

QWC – clear, well organised using specialist terms; 1

award QWC mark if three of the following are used
tunica (qualified once)
lumen
elastic / elastin
collagen
recoil
smooth muscle
endothelium
vasoconstriction

[9]

105. water potential; **A** symbol **R** other gradients
apoplast / apoplastic; **A** apoplasm **R** anoplast
endodermis / Casparian strip; **A** starch sheath **R** stele
Casparian strip / suberin / AW; *only credit Casparian strip once*
symplast / symplastic; **A** vacuolar / symplasm / synplast

***A** endodermis in point 4 if point 3 is blank or neutral*

if more than one response in a gap, take first on list for points 1, 3 and 4.

*For apoplast and symplast look for single term i.e. **R** if put apoplast / symplast*

[5]

106. (a) (i) 4

	blood in aorta	tissue fluid	lymph	blood in vena cava
red blood cells		none;		
white blood cells	many / high ; **R** *some*			
glucose concentration			low; **A** *none / some*	
pressure				low;

(ii) *glucose*

carried / transported, in the blood;
passes through capillary walls to tissue fluid / AW;
used up / stored, in tissues / AW (so little in lymph);
ref, respiration / glycogen;
high in vena cava as (absorbed) from gut / sent from liver / AW; 3 max

pressure

high in aorta as comes from, heart / ventricles / AW;
increased, resistance / friction / AW, (causes drop);
increased volume of capillary bed / AW, (causes drop);
lost during formation of tissue fluid / AW;
low in, lymph / vena cava as, no mechanism for raising it /
long distance from heart;
R 'low in veins as it is returning to the heart' 3 max
4 max

(b) carbon dioxide (diffuses) into red blood cells; **R** blood only
carbonic anhydrase;
carbon dioxide reacts with water;
to form, carbonic acid / H_2CO_3 / HCO_3^-;
R *if linked with incorrect reaction*
carbonic acid, dissociates / AW, to give HCO_3^-;

accept from equations $CO_2 + H_2O \rightarrow H_2CO_3$
$H_2CO_3 \rightarrow H^+ + HCO_3^-$ 3 max

[11]

107. (i) **T** = coronary, artery / arteries;
U = right ventricle; **A** cardiac muscle 2

(ii) oxygen / glucose, will not reach, (heart / cardiac) muscle; **A** less

reduced / no, respiration;

(possible) coronary / heart attack / myocardial infarction / (possible) death;
A fibrillation / irregular beat / AW 2 max

[4]

108. (i) blood enclosed in vessels / AW; 1

(ii) ventricles not separated / one ventricle / partial or no septum /
three chambers / left and right sides not separated; *ora* for mammal
single vessel from heart; *ora* for mammal **A** aorta
oxygenated and deoxygenated blood not (fully) separated;
ora for mammal
blood passes twice through heart for complete circulation /
systemic and pulmonary systems / to lungs and body;
If only one animal described max 2 3 max

(iii) blood will not be fully oxygenated / Hb less fully saturated /
deoxygenated and oxygenated blood mixed / AW;
still carrying carbon dioxide;
lower pressure *or* less, force / push / AW; 2 max

[6]

109. (a)

lugworm curve	*human curve*
steeper ;	shallow / gentle / sigmoid ;
higher saturation at, low / same pp oxygen ;	
has max (saturation) at 2 kPa ;	max at 13.5 - 14 kPa ;
reaches 100% (saturation) ;	(only) reaches 98% ;
	(max 1 of above differences)

lugworm haemoglobin has a high affinity for oxygen ;
low oxygen in, lugworm habitat / water / ora ;
lugworm haemoglobin, stores oxygen / only releases oxygen when pp O_2 very low ;
two haemoglobins have different, structures / amino acid sequences ; 2 max

(b)

differences (max 5)

D1 ref to lugworm gills **and** mammal, alveoli / lungs ;
D2 ref to internal **and** external, exchange surfaces ;
D3 less oxygen in, water / sand ; **A** ora
D4 lugworm haemoglobin adapted to, water / sand/ low O_2 environment ; **A** ora
D5 lugworm has no red blood cells / ora ;
D6 detail of mammalian red blood cells ;
D7 lung ventilation tidal / lugworm, throughflow / unidirectional / AW ;
D8 AVP ; e.g. ref. water loss from lungs

similarities (max 5)

S1 **both** (gas exchange surfaces have) large surface area ;
S2 **both**, thin / have short diffusion distance ;
S3 **both** well-vascularised ;
S4 **both** moist ;
S5 ref to diffusion of, oxygen / carbon dioxide / gases ;
S6 (blood carries) oxygen to tissues ;
S7 haemoglobin transports oxygen ;
S8 **both** move medium over gas exchange surface ;
S9 AVP ; 7 max

QWC – legible text with accurate spelling, punctuation and grammar ; 1

[10]

110. *mark two columns separately first. If letter and part of cell both incorrect, look to see if the part of the cell corresponds to this letter. If so, allow 1 mark ecf*

function	part of cell	label
controls activities of the cell	*nucleus*	*A*
carries out aerobic respiration	mitochondrion / mitochondria;	D;
attaches to mRNA in protein synthesis	ribosome(s) / <u>rough</u> ER / <u>R</u>ER;	C;
produces secretory vesicles	Golgi;	B;
contains digestive enzymes	lysosome(s);	E;

8

[8]

111. (i) long;
thin cell wall;
lack of, waterproof layer / cuticle;
large surface area; **NOT** if cilia / villi / microvilli / tails / etc
present in large numbers;
(membrane) proteins / carriers / channels / aquaporins;
many mitochondria;
AVP; (adaptation of part of the cell) 1 max

(ii) *if candidate gives a list or a choice, all must be correct*

active transport / diffusion / facilitated diffusion / described;
A pinocytosis
NOT passive transport / osmosis / bulk transport 1

(iii) lower <u>water potential</u> inside / ora;
movement, down water potential gradient / from high Ψ to low Ψ;
through, channel proteins / partially permeable membrane / aquaporins / AW;
walls freely permeable;
osmosis; 2 max

[4]

112. *only award marking points 1, 6, 9, 14 and 16 if descriptions of the stages are correct- do not award simply for identifying the stages – ignore ref to centrioles*

prophase

1 C;
2 chromosomes / chromatids, condense / coil / shorten and thicken;
3 become visible;
4 consist of two chromatids;
5 joined by a centromere; **A** kinetochore **NOT** centrosome

metaphase

6 A;
7 chromosomes align at, equator / metaphase plate;
8 attached to spindle by centromeres;

anaphase

9 B;
10 centromere splits;
11 chromatids separate;
12 move to opposite poles;
13 by, contraction / shortening, of spindle;

telophase

14 E;
15 chromosomes uncoil;

interphase

16 D; **A** for a description of early prophase
17 DNA replication;
18 transcription / formation of mRNA;
19 AVP; *these must relate to behaviour of chromosomes*
20 AVP; e.g. spindle made of microtubules
chromatin becomes chromosomes (in prophase)
ora in interphase
centromere leads chromatid to pole
gene switching during interphase 9 max

QWC – clear well organised using specialist terms; 1

award the QWC mark if three of the following are used in correct context, but Q = 0 if names or names of stages of mitosis are used inappropriately

chromatin	equator / metaphase plate
chromatid	DNA replication
centromere	transcription
spindle	

[10]

113. (i) X = (smooth) muscle; **A** involuntary muscle / non striated muscle

Y = (ciliated) epithelium;

(ii) Z = (branch of) blood vessel / artery / vein / arteriole / venule; **R** capillary 3

[3]

114. *cartilage*

1 in, trachea / bronchi;
2 holds airway open / prevents collapse;
3 prevents bursting (of trachea / bronchi as air pressure changes);
4 low resistance to air movement;

ciliated epithelium / cilia

5 move mucus;
6 ref to how movement brought about;
e.g. metachronal rhythm / wave / sweep / waft

goblet cells

7 secrete mucus;
8 trap, bacteria / dust / pollen / particles;
9 remove particles from lungs;

blood vessels

10 supply, oxygen / nutrients (to tissues of lung);
11 surround alveoli / good blood supply to alveoli;
12 deliver carbon dioxide / pick up oxygen;
13 ref to wall of capillary being thin;
14 ease of / rapid, gaseous exchange *or* short diffusion pathway;

smooth muscle

15 adjust size of airways (in, exercise / asthma);

connective tissue / elastin / elastic tissue

16 stretch (inhalation);
17 prevents alveoli bursting;
18 recoil; **R** contract
19 helps exhalation / forces air out (of lungs);

squamous epithelium / described

20 alveolus wall thin;
21 ease of / rapid, gaseous exchange *or* short diffusion pathway;
22 AVP; e.g. ref to large surface area of numerous alveoli
23 AVP; ref to macrophages removing pathogens 8 max

QWC – legible text with accurate spelling, punctuation and grammar; 1

[9]

115. 3 to 5 armed star of xylem with phloem more or less between;
R if star too close to the edge
xylem and phloem correctly labelled;

ecf - if stem drawn, credit correct xylem and phloem labels 2

[2]

116. lack of contents / no cytoplasm / hollow / lumen / continuous / AW;
A lack of end walls
less resistance to flow / more space linked to idea of lack of contents / AW;
treat large as neutral

thickening / rings / spirals / lignin (in the wall); *treat cellulose as neutral*
prevents collapse / gives support / adhesion of water;
R strength / rigid, unqualified **R** ideas on resisting positive pressure

pits / AW; **A** pores / holes (in side walls)
allow lateral movement / AW; **R** 'let things in or out' unqualified 4 max

[4]

117. (i) *source* – leaf / storage organ / named storage organ; **A** root qualified
sink – root / tuber / storage organ / (young) growing region / leaf qualified / flower / bud / fruit / seed;
R individual cells but **A** tissue <u>areas</u> such as mesophyll 2

(ii) *max 2 if no reference to diagram*

water will enter source;
by osmosis;
down / AW, a <u>water potential</u> gradient;
increase in (hydrostatic) pressure;
as source / sink cannot expand / AW;
force / AW, solution along (tube to sink);
AVP; e.g. explanation of mass flow 4 max

[6]

118. (i) ATP involved / respiration involved / many mitochondria in companion cells / reduced by metabolic inhibitors / oxygen dependent / temperature dependent / loading against a concentration gradient / AVP;

if evidence not given here look for it and credit it in part (ii) 1

(ii) loading, into companion cell / from transfer cell / into sieve tube / into phloem – implied;
H ions / protons, pumped out of, companion cell / sieve tube / phloem;
diffuse back in with sucrose;
protein carrier / co-transporter;
possible active unloading by reverse mechanism;

AVP to cover alternative mechanisms;;;
e.g. electro-osmotic theory
K^+ pump
via companion cell
electrochemical gradient
sieve pores provide a capillary bed / AW 3 max

[4]

119. iron / Fe; **A** Fe^{++}
four / 4;
Bohr, effect / shift;
carbonic anhydrase;
haemoglobinic acid; **A** reduced haemoglobin **A** HHb 5

[5]

120. (i) (blood flows) twice through the heart / AW;
for one circuit / cycle (of the whole body) / AW; **A** for one heart beat
ref pulmonary **and** systemic systems / to lungs **and** to (rest of) body;
R systematic 2 max

(ii) *read whole answer and look for any two linked ideas from*
- *size*
- *activity*
- *SA:V ratio*

ora if answered in terms of Paramecium

size
(mammals) larger / AW;
cells deep in the body;
regions requiring materials separated by a distance / need to get materials to all parts / AW;

diffusion too slow / AW;

activity
(mammals) more (metabolically) active / AW;
need more materials / more rapid supply / more removal of wastes;

SA:V ratio
(mammals) surface area:volume ratio reduced / AW;
diffusion alone not effective / AW; *must be linked to SA:V* max 4

[6]

121. *look at and credit any annotations on diagram*
if sequence gets lost do not award the marking points that follow and are directly linked, but give any general ones

1 atrial systole / atria contract;

2 blood passes into ventricles;

3 veins / blood vessels, entering heart closed / AW;

4 atrioventricular / alternative names, valves open;

5 ventricular systole / ventricles contract;

6 blood to, the arteries / named arteries;

7 (via) open, semilunar / AW, valves;

8 atrioventricular valves shut to stop backflow;

9 relaxation / diastole, of ventricles (and atria);

10 semilunar / AW, valves shut to stop backflow;
may be mentioned at X – only credit once

11 ref to **X**,**Y** and **Z**; **X** = 1-4 **Y** = 5-8 **Z** = 9-10 6 max

QWC – legible text with accurate spelling, punctuation and grammar; 1

[7]

122. (a) (i) *award two marks if correct answer (15) is given*

15;; ignore signs

if answer incorrect give one mark for indication that 15.5 ***and*** *0.5 read off graph*
if 15 obtained by wrong calculation = 1 2

(ii) qualified ref to distance from heart e.g. further;
friction / resistance (to flow);
ref to increasing volume of e.g. capillaries;
A surface area of capillaries
idea of dissipation of energy in elastic recoil; 2 max

(iii) stop damage to, capillaries / arterioles / AW; **A** stops bursting
ref to, lack of (much) elasticity in these vessels / thin walls / AW;
ora for nature of artery wall
max one mark if only veins mentioned
slows flow rate;
to allow (time for) exchange; 2 max

(b) (i) C; **R** more than one letter i.e. a 'list' 1

(ii) *feature and role must match. Correct features are stand alone marks. Look at the given role to see if it informs the feature.*

thin wall / single cell layer / AW; **R** membrane / thin cell wall
A *statement which gives one cell thick, treating thin cell wall as neutral in this case*
short pathway / ease of access to tissue fluid AW, rapid / easy, diffusion;

smooth, (inner) surface / endothelium; **A** epithelium
R refs to smooth muscle
reduced friction / smooth flow / reduced turbulence / reduced resistance / AW;

(small) gaps / pres / holes, between endothelial cells / in wall / AW;
allows nutrients / named nutrients / fluid / AW, out, / (most) cells / proteins cannot pass;
R refs to plasma **A** refs to, phagocytes / AW, passing

narrow / small (diameter) / figure quoted / AW;
idea of contact with many cells / short diffusion distance / rapid diffusion / reduced rate of flow qualified;

large, total surface area / cross-sectional area;
allows more exchange / slows flow for exchange / close to all the cells in the body;
R easier / more efficient ideas unless qualified 4 max

[11]

123. **A** mitochondrion; **A** cristae / matrix

B nuclear envelope / nuclear membrane; **A** nucleus

C nucleolus; **A** heterochromatin

D (cell) wall; **A** middle lamella 4

[4]

124. (a) (i) fructose; 1

(ii) glucose; 1

(iii) (passive) diffusion; 1

(iv) *ignore ref to, movement of sugars / solute potential*

1 surrounding solution higher concentration (of solutes) than cell contents; *ora*

2 cell has higher water potential; *ora*

3 water moves out of cell;

4 (so) volume decreases;

5 (water has moved) by osmosis; *only award in relation to water*

6 down water potential gradient / from high Ψ to low Ψ; 4 max

(b) active transport / facilitated diffusion / bulk transport / endocytosis / etc.;
A using channel proteins, etc
NOT osmosis 1

[8]

125. *mark first two answers unless neutral*
e.g. cell division / cell replication / produces identical cells

produces, genetically identical cells / clones; **A** same genes
asexual reproduction;
maintains, chromosome number / ploidy / AW;
growth (of organism); **NOT** 'of cells'
replacement of cells / repair (of tissues); **NOT** 'repair of cells' 2 max

[2]

126. *ignore refs to early and late stages*
NOT *ref to I and II* 1

(i) telophase;

(ii) metaphase; 1

(iii) prophase; 1

(iv) anaphase; 1

(v) anaphase; 1

[5]

127. (i) glycoprotein; 1

(ii) (cell) recognition / antigen;
attachment / receptor; **NOT** carrier
holds enzymes;
AVP; e.g. stabilises membrane in aqueous environment 1 max

[2]

128. (i) cut shoot under water;
insert into apparatus under water / AW;
full of water / no extra bubbles / no airlocks; *applies to plant / apparatus*
cut shoot at a slant;
dry off leaves / AW;
ensure, air- / water-, tight joints / AW;
use a, healthy / AW, shoot **:**
allow time to acclimatise / AW;
keep, condition(s) / named condition(s), constant;
measure per unit time / AW;
shut screw clip;
ref to scale; e.g. note where bubble is at start / keep ruler fixed
R '*move bubble to end' ideas* 4 max

(ii) water uptake / AW; **R** water used 1

[5]

129. (a) (i) 103; **R** decimals 1

(ii) ***R*** *refs to water or water particles*

1 boundary layer / saturated air / water vapour / AW, around, leaf in still air / **A**;
2 (which) fan / wind, removes / reduces;
ecf wrong ref to water
3 ref steeper water potential gradient;
R concentration gradient
4 (therefore) faster / greater / more / AW, evaporation / diffusion;
must be linked to above 3 max

(b) set up in same, (environmental) condition(s) / named condition;
calculate the rate per unit area of leaf / idea of getting same area of leaf in both;
detail of how this could be done; e.g. draw round all leaves on graph paper
replicates;
both picked at same time / same degree of turgidity / AW;
run for the same time / AW; 2 max

[6]

130. (a) (i) 29; 1

(ii) fetus gains oxygen from, maternal blood / mother / AW;
across placenta;
partial pressure / AW, of oxygen in placenta is low;
2-4 kPa;
both in the fetal and maternal parts / AW;
maternal haemoglobin releases oxygen;
fetal haemoglobin has a high(er) affinity for oxygen;
ref to maintaining diffusion gradient;
oxygen needed for, respiration / energy release / AW;
R energy production 4 max

(b) *accept answer written in terms of adult haemoglobin*

affinity (of fetal haemoglobin) would be too high;
would not release oxygen readily enough / AW;
ref to idea that adult females will need difference with their fetuses in due course;
ref to high partial pressure of oxygen in lungs allowing loading with Hb with lower affinity; 2 max

[7]

131. (i) **A** = pulmonary artery;
B = bicuspid valve; **A** atrioventricular / AV, valve *mark first on list* **R** 'arterio…' 2

(ii) arrows correctly positioned on left side only; 1

(iii) **1** wave of excitation / impulse / AW, stops;
2 at the AVN / no transmission to heart apex / AW;
3 no ventricular, contraction / systole;
4 fibrillation / described e.g. heartbeat, unco-ordinated / irregular / no rhythm;
5 blood not squeezed, upwards / out of ventricles / AW;
A ref to pressure change
6 atrial contraction continues; 2 max

(iv) *credit answers written in context of what would happen if there was a hole*

stops oxygenated and deoxygenated blood mixing;
ensures, (fully) oxygenated blood gets to the body / deoxygenated blood to lungs;
ref to possible drop in blood pressure if hole present;
ref to allowing different pressures being maintained on each side / AW;
AVP; e.g. prevention of rise in heart rate if two sides not separated 2 max

[7]

132. **S1** three named layers;

S2 (tunica intima / inner layer / AW) endothelium;
S3 (tunica intima / inner layer / AW)) squamous (epithelial) cells;

S4 (tunica media / middle layer / AW), thin / narrow / AW;
S5 (tunica media / middle layer / AW), muscle and elastic tissue;
R large amounts
refs to collagen neutral
S6 (tunica externa) collagen; **R** if muscle mentioned here

S7 valves;
S8 large / wide, lumen;
max 4 S marks *credit S marks from labelled diagrams*

F9 smooth, endothelium / epithelium / lining / AW, reduces friction;
R if smoothness related to muscle
F10 credit one reference to, thinness / strength, of wall withstanding low pressure;
F11 ref to thinness of wall to allow skeletal muscle to squeeze vein;
F12 valves to prevent backflow / AW;
F13 ref to, wide lumen / walls distending, to accommodate large volume of blood;
F14 detail of this e.g. relationship between large volume and slow flow rate;
max 3 F marks 6 max

QWC – legible text with accurate spelling, punctuation and grammar; 1

[7]

133. water moves down a water potential gradient / AW;
by osmosis;
(ref to roots being below –50 kPa means) water will enter (the root); 2 max

[2]

134. *function must match adaptation, adaptation can stand alone*
assume answer is about water vapour unless clearly wrong e.g. water droplets

covered in hairs;
reflect heat *or* water vapour, trapped / not blown away;

thick, waxy layer / cuticle / AW;
reduces loss (via the epidermis) / reflects heat; **R** no loss
if cuticle related to reflective nature, 'thick' not needed

small / AW, leaves; **A** no leaves (e.g. cacti) / needles / spines / spikes **R** thorns
reduced surface area for loss / reduces number of stomata;
R *ref to spines etc related to preventing consumption by herbivores*

sunken stomata / AW; ***A*** *substomatal chamber hairs as an alternative here*
water vapour, trapped / not blown away;

rolling up of leaves / curled leaves;
less surface area / stomata on inside *or* water vapour, trapped / not blown away;

small air spaces in the mesophyll;
quickly become fully saturated / reduced area for loss;

stomata, shut in day / open at night / AW;
day hotter / night cooler;

AVP; e.g. reduced stomatal number plus reason
AVP; timed leaf fall
rosette of leaves close to ground 4 max

[4]

135. diffusion / down a (concentration) gradient;
dissolves in the water film / goes into solution / AW;
crosses, cell(s) / named cell / cytoplasm / plasma / membrane(s) / wall of alveolus *or* capillary; 2 max

[2]

136. (a) *two from*

biconcave / AW;
large surface area to volume (ratio);
optimum oxygen uptake / fast diffusion; ora for oxygen release at tissues
max 2 for this feature

small / about 7μm (diameter) / about same size as capillary / AW;
all haemoglobin close to surface / fast diffusion / short diffusion path / capillaries can be small to get close to all tissues / (RBC) close to capillary wall for exchange / AW;

no nucleus / no *or* few organelles;
maximum space for, oxygen carriage / haemoglobin;

elastic / flexible / pliable, membrane;
allows them to go along capillaries;
4 max

(b) large nucleus / very little cytoplasm / non-granular cytoplasm / about the same size as red blood cells but with a nucleus;
A from a diagram
R nucleus unqualified / bean-shaped nucleus / lobed nucleus

only accept first answer if more than one feature listed,
BUT *'large' alone is not a feature, so* ***R*** *e.g. large bean-shaped nucleus* 1

[5]

137. *award two marks if correct answer (50) is given*

if measurement incorrect but in the range 25 –35 mm,
allow one mark for a correct calculation

$^{30}/_{0.6}$ / $^{3(cm)}/_{0.6(mm)}$ / $^{3(cm)}/_{0.06(cm)}$; **A** +/– 1mm

50; **A** 48 – 52 **R** if units given 2

[2]

138. (i) **J** allows passage of, polar substances / water soluble substances / ions / suitable e.g. (allow water); **R** large molecule alone
allows facilitated diffusion; 1 max

K cell recognition / antigen / receptor / cell adhesion / binds to water molecules to stabilise membrane;
R enzyme / receptor <u>cell</u> / effect at a distance 1

L allows passage of lipid soluble substances (**A** water / O_2 / CO_2) / prevents passage of water soluble substances;
forms, barrier / boundary / AW; 1 max

M regulates, fluidity / stability;
restricts movement;
influences permeability of membrane;
storage; 1 max

(ii) 7 nm; 1

[5]

139. <u>membrane</u>, folding in / engulfing / invaginates / AW;
fuses with itself / pinches off;
formation of, vesicle / vacuole; **A** completely surrounded by membrane
fate of vesicle; e.g. moves through cytoplasm / fate of contents
ref. fluid nature (of membrane) / requires energy;
A active / ATP **R** active transport
triggered by binding of molecule (to receptor site);
ref. to uptake of solid <u>and</u> liquid (not name alone); 3 max

[3]

140. ref. change in external Ψ;
correct linking Ψ to salt concentration;
correct ref. <u>osmosis</u> in, loss / gain;
consequence;
time / no problem, when $\Psi_i = \Psi_o$ (isotonic) *or* way to overcome problem; 2 max

[2]

141. (i) *look for prokaryote feature*

no nucleus / no nuclear membrane / no nucleolus / DNA free (in cytoplasm); **R** DNA moving
naked DNA / DNA not associated with proteins / no chromosomes;
circular / loop, DNA;
no, membrane-bound organelles / e.g.;
smaller / 18nm / 70S, ribosomes;
no ER;
cell wall, not cellulose / polysaccharide and, amino acids / murein;
AVP; e.g. mesosomes / plasmids 1 max

(ii) glycosidic (link) and peptide (bonds) (in correct context);
condensation;
ref. OH groups;
ref. NH_2 and OH group;
water, removed / produced / by-product;
enzyme;
AVP; e.g. energy required 3 max

(iii) iron / Fe; *ignore pluses / minuses* 1

(iv) *treat enzyme as neutral*

nitrogenase;
leghaemoglobin;
haemoglobin; 2 max

(v) (nitrogen) fixation; **A** reduction 1

(vi) type of inhibition (competitive / non-competitive / reversible / irreversible);
basic mode of action (e.g. binds to active site);
detail;
consequence (e.g. prevents, substrate / nitrogen, from binding); 2 max

[10]

142. (a) (i) alveolus / alveoli; **R** air sac 1

(ii) *no mark for diffusion alone*

down a gradient / from high to low (concentrations);
oxygen at high(er) concentration in lung / ora;
dissolves in / crosses, water film;
(aqueous) path short / short diffusion path;
reverse gradient for carbon dioxide;
ref. to random molecular movement involved in diffusion;
ref. to maintenance of a steep gradient; 3 max

(b) (generally) larger / correct ref. to size;
surface area decreased relative to volume / ora;
lung / alveoli, gives increased area (for gas exchange);
need for more oxygen;
due to, high (metabolic) activity / much respiration / more energy need;
cannot exchange across outer surface / no alternative surface;
high demand for carbon dioxide removal / AW; 2 max

[6]

143. (a) (i)

tissue fluid	*blood*
no red blood cells **R** Hb	red blood cells;
few / no, (plasma) proteins	(plasma) proteins;
a few white blood cells **R** none	full range / more, white blood cells;
no platelets	platelets;
always low pressure	pressure higher / variable;
some fats	more fats;
not in vessels / AW	contained in vessels;

qualified ref. to differences in dissolved gas levels;

AVP; e.g. qualified ref. to, difference in, speed of flow / water potential / ion content
functional difference, such as exchange medium v. transport medium; 3 max

(ii) lymphatic / lymph; **A** lacteal 1

(b) **1** pressure high at **R** / AW;

2 ref. to heart action causing (hydrostatic) pressure;

3 greater than, osmotic effect / water potential effect / AW;
A solute potential

4 capillary wall, is leaky / has pores / AW;

5 lets, fluid / water / plasma / liquid, through and dissolved substances / named substance(s);

6 red blood cells / proteins / some WBC's, cannot get out because too large;

7 pressure low(er) at **S**;

8 ref. to osmotic effect / water potential effect; **A** solute potential

9 due to plasma proteins;

10 return of fluid / AW, at **S** / AW;

11 valves / pores, at **T** / lymph vessel / AW; **R** semi lunar valve

12 allow, fluid / water / liquid, into lymph vessel / out of tissue fluid;

13 allow proteins out of tissue fluid; 6 max

QWC – clear, **well organised using specialist terms** 1

(c) fluid / AW collects; **R** if suggests collection in cells
(tissue) swells / AW; **R** turgid **R** if implies cells swell
oedema;
especial danger, in lungs / pulmonary oedema;
ref. to build up of proteins (from tissues);
AVP; e.g. loss of blood volume 2 max

[13]

144. (a) stem; 1

(b) phloem; **R** sieve tube, phloem vessel, single cell type 1

(c) **C**; 1

(d) *feature and role must match for 2 marks*
mark for feature may be awarded even if role is incorrect
both marks may be given in right hand column.

Feature	*how it helps*
*either **D** or **E***	
living;	allows active process / AW; stops escape of metabolites;
hydrogen pump / co-transporter;	(role in) loading / AW;
plasmodesmata / connections between sieve tube and companion cell;	allow exchange /AW;
D / companion cell	
(many) mitochondria	provide, energy / ATP;
much respiration / metabolically active;	
nucleus;	controls functioning of both cells;
E / sieve tube	
clear of most organelles / organelles at edge / little cytoplasm / AW; **R** empty (*if specific organelles given, need at least 2*)	less resistance / ease of transport / AW / more space for transport;
long / elongated / AW;	less resistance / ease of transport / AW;
sieve plate / (sieve) pores;	connects elements / lets materials through / AW; **A** reduces resistance
joined end to end;	continuous / long distance, transport;
bi-directional flow;	allows sugar to go to sink both up and downward / AW; 6 max

[9]

145. *mark for transpiration / evaporation is not freestanding, in each case it must be related to the feature in each section*

(a) transpiration / evaporation / AW, occurs via stomata; **R** water loss
(generally) warm(er) in day;
more evaporation / transpiration will occur (in context);
ref. to steeper water potential gradient;
shutting, stops / reduces, this loss;

ora for open at night 2 max

(b) small surface area;
less transpiration / evaporation / AW (in context);
R water loss **R** no transpiration
fewer stomata / AW;
protection against grazing / AW; 2 max

(c) hairs trap, water vapour / moisture in air; **R** just moisture
prevent wind effect / AW;
reduces water potential gradient;
less, transpiration / evaporation / AW (in context);
R water loss **R** no transpiration
correct ref. to condensation of water vapour; 2 max

[6]

146. (i) 10 – 12;
1 – 4;

if range given, both figures must be within the range 2

(ii) to the left and sigmoid;
start and finish at the same points as the maternal curve;

if curve drawn on right can still give start and finish points if reasonably sigmoid 2

(iii) to allow, fetus / fetal haemoglobin, to get oxygen (at placenta);
at, low / same, partial pressure of oxygen;
maternal haemoglobin releases oxygen / AW;
ref. to higher affinity of fetal haemoglobin (allows it to pick oxygen up); 3 max

[7]

147. (i) ref. carbon dioxide (diffusion / AW, from tissues) to <u>red</u> blood cells;
carbon dioxide reacts with water;
to give carbonic acid;
ref. to carbonic anhydrase;
carbonic acid, dissociates / AW, releasing, H^+ / hydrogen ions;

direct reaction of carbon dioxide to H^+ and HCO_3^- = 2 marks 3 max

(ii) H^+ / hydrogen ions, combine with / AW, haemoglobin;
R 'mops up' unqualified
forms <u>haemoglobinic</u> acid / HHb;

accept words or symbols throughout 1 max

[4]

148. organ(s); 1

[1]

149. resolution / resolving power; 1

[1]

150. (a) *treat references to 'replication' or 'chromosome number' as neutral*

makes cells / cell division; **A** nuclei
<u>genetically</u> identical / clone;

growth; **R** 'of cell'
repair (of tissues); **R** 'of cell'
asexual reproduction; max 3

(b) (i) *treat 'growth' and 'cytokinesis' as neutral*

sreplication of DNA;
centrioles replicate;
production of (named) organelles;

protein synthesis; **A** named e.g.
RNA / nucleotide, synthesis;
respiration / active transport / named e.g. of usual cellular activity;

AVP; e.g. semi-conservative
chromosome = 2 chromatids max 3

(ii) clockwise arrow head drawn; 1

(c) *ignore refs. to late or early stage - except in (i)*
any ref. to I or II = 0
invalid choice = 0

(i) (early) anaphase; **A** (late) metaphase 1

(ii) prophase; 1

(iii) telophase; 1

(iv) anaphase; 1

(v) metaphase; 1

[12]

151. *if only ticks, assume blank boxes =* ✘
If only crosses, assume blank boxes = ✓
reject hybrid ticks

✘	4;
4	✘;
4	✘;
4	✘;

4

[4]

152. *nucleus / DNA*
1 controls, activities of cell / transcription / named activity / cell division;
2 contains genetic information that can be transmitted to next generation;

nucleolus
3 produces, ribosomes / rRNA;

smooth ER
4 makes / transports, lipids / steroids / hormones; **A** named plant e.g.

rough ER / ribosomes
5 protein synthesis;

rough ER

6 transport of proteins;

Golgi

7 processes, molecules / proteins; AW

8 use in secretion;

9 lysosome formation;

lysosome

10 hydrolytic / digestive, enzymes;

11 breakdown, organelles / cell / ingested material;

mitochondria

12 formation ATP / suitable energy ref.;

13 aerobic respiration;

plasma (cell surface) membrane

14 controls exchange between cell and environment / selectively permeable;
R water

15 receptors for, cell recognition / attachment;

16 fluid to allow, endocytosis / exocytosis;

cell wall

17 gives, cell shape / strength / support;

18 prevents bursting (when water enters cell by osmosis);

19 fully permeable;

chloroplast

20 photosynthesis;

21 chlorophyll / pigment, absorbs light;

vacuole / tonoplast

22 reservoir of, salts / sugars / waste / pigment / other e.g.;

23 ref. to, turgor / support / controlling Ψ;

starch grain / amyloplast

24 storage;

cytoplasm

25 site of chemical reaction(s) / correct e.g.;

26 AVP;

27 AVP;

for further detail of function

e.g. protein, channels / carriers, to transport, ions / polar substances
phospholipid (bilayer) transports lipid soluble substances
ref. waterproofing cell wall (lignin / suberin)
mitochondria involved in lipid synthesis
addition of carbohydrate to protein to form glycoprotein
plasmodesma max 9

QWC - clear, **well organised answer**, **using specialist terms**; 1

[10]

153. lower, water / solute, potential inside cell / converse;

water enters;
(enters) by osmosis / down Ψ gradient;

increase in pressure;
membrane cannot withstand pressure / no cell wall to prevent bursting; max 3

[3]

154. (i) 4; **R** incorrect units 1

(ii) *ignore refs. to size, oxygen, genetic differences*

each rbc has (slightly) different, water potential / solute concentration / AW;
R water concentration
each, rbc / membrane, has (slightly) different, strength / elasticity;
R thickness of membrane
ref. different ages of cells; max 1

[2]

155. (i) active, transport / uptake; 1

(ii) oxygen required for, uptake / respiration / ATP production;
A release / provide, energy
R make / produce, energy 1

(iii) passively / by diffusion;
residual ATP;
anaerobic respiration;
AVP; max 1

[3]

156. (i) *award two marks if correct answer (77) is given – must be rounded up*
award one mark for calculation – 2.3 / 3.0 or 76.7 if answer incorrect

2.3 ÷ 3.0 / 76.7;
77; 2

(ii) forced expiratory volume decreases / AW;
returns to initial value / fluctuates / AW;
figs to show a change with correct units / e.g. 2.3 dm^3 s^{-1} to 1.5 dm^3 s^{-1};
A ecf from (i)

vital capacity remains constant;
at 3.0 dm^3; max 3

[5]

157. (a) cilia, beat / waft; **R** 'hairs' **A** ciliated epithelium, sweeps / AW
move mucus;
particles / bacteria / dust / spores / pathogen / microbe, in mucus;
treat 'dirt' as neutral
(moves) away from alveoli / upwards / towards trachea / towards throat / towards mouth / out of lungs / out of bronchioles / AW; max 3

(b) (i) *mark (i) and (ii) together to max 3 – look for annotations*

ref to (secretion / release of) histamine;
mucus is not moved / AW;
<u>more</u> goblet cells;
(goblet cells secrete / produce) more mucus / excess mucus;
fewer cilia (per cell); **A** stunted, damaged, destroyed **R** dead

(ii) thicker / more, (smooth) muscle; **A** larger / expands **R** swollen, swells
(muscle) contracts; **R** constricts, spasm **A** 'muscle tenses'
connective tissue, swells / enlarges / fills with fluid;
lining of bronchiole thrown into deeper folds / AW; max 3

[6]

158. (a) (i) osmosis;
down water potential gradient / from high to low water potential / implied;
ref to partially / differentially / selectively, permeable membrane; 2 max

(ii) lose water; **R** less uptake
metabolism affected / (may) die / AW; **R** in context of salt uptake
plasmolysis / flaccid / less turgid / description;
R shrivelled, dehydrated

AVP; e.g. adaptive responses qualified, such as encysting / mobilise solute / refs to altering water potential to reduce water loss 2 max

(b) *credit answers explaining why* Chlamydomonas *does not need a water transport system*

distance in tree is greater / AW;
e.g. roots far from aerial parts / AW;
not all tissues / cells in contact with water / AW;
diffusion too slow / AW;
AVP; e.g. outer layers waterproofed / ions carried in water / *Chlamydomonas* has large surface area:volume

R refs to greater quantities needed 3 max

[7]

159. (i) loss, of water vapour / by evaporation;
diffusion into, atmosphere / air / environment / out of plant;
via stomata *or* from, leaves / aerial parts;
max 1 if response starts with 'transpiration is the upward movement of water' 2 max

(ii) *Descriptions*
1 increases then decreases / peaks / higher by day / lower by night;
2 correct ref to figures to support e.g. highest at 1400 / lowest at midnight / ref to one rate with units;

Comparisons
3 (rate of) transpiration greater, in day/ when hotter / 6 to 16 hours; ora
4 (rate of) transpiration less, at night / when cooler / 16 to 6 hours; ora
5 rates equal at 6 and 16 hours;
6 both peak, at the same time / at 14 hours / accept midday; / AW;
7 both lowest at, same time / midnight;
8 transpiration rise is steeper; ora
9 transpiration fall is steeper; ora
10 any one figure quote for rate with units that supports comparison points above; 4 max

(iii) *award two marks if correct answer (58) is given – must be rounded up*
58 (%);;
max 1 if not whole number, award calculation mark for getting 14 hours
ecf If wrong time period read, but correct % calculated from it = 1 mark 2

[8]

160. loss of water from mesophyll;
cell walls;
more drawn from, cytoplasm / cell / AW;
cohesion of water molecules;
hydrogen / H, bonds;
water under tension / ref to hydrostatic pressure gradient implied;
A water 'pulled' / 'drawn' **R** sucked
via, symplast / apoplast / vacuoles / description / AW;
(water from) xylem / xylem vessels;
ref to water potential gradient; 4 max

[4]

161. (a) (i) arrows through correctly; **R** if both sides shown 1

(ii) **X** = vena cava;
Y = bicuspid / atrioventricular / AV / mitral (valve); **R** tricuspid 2

(iii) when ventricle / heart, relaxes; **A** diastole;
pressure lower (in ventricle implied); ora
valves stop back flow / AW; **R** incorrect qualification 2 max

(b) (i) A = 2;
C = 16;
D = 9; 3

(ii) A / atrium, only pushes, to ventricle / short distance / AW;
A effect of gravity
C / left ventricle, pushes all round body / to systemic system / AW;
D / right ventricle (only) pushes to lungs / to pulmonary system / AW;

qualification for C **or** D e.g. greater distance / resistance *or* more, force / pressure; ora for right ventricle

allow ecf if C & D wrong way round in (b) (i) 3 max

(c) **1** cardiac muscle is myogenic / description;
2 SAN / sinoatrial node / pacemaker;
3 (in wall of) right atrium;
4 wave of electrical activity / impulse / depolarisation / excitation /AW;
5 spreads across atria / causes atria to contract;
6 stopped / AW (by, fibres / septum), between atria and ventricles;
7 delay allows atrial systole to be completed (before ventricular systole);
8 atrioventricular node / AVN;
9 impulse passes down / to, Purkyne (Purkinje) fibres / bundle of His;
10 contraction from base upwards;
11 both ventricles contract together / AW;
12 AVP; e.g. external nervous control in response to, temp / CO_2 / etc
delay of 0.1 s at AVN
hormone control 6 max

QWC – legible text with accurate spelling, punctuation and grammar; 1

[18]

162. (i) (equivalent to) concentration / AW, of oxygen in, atmosphere / air / tissues;
proportion of atmospheric pressure produced by oxygen / AW;
at high altitude, atmospheric pressure is lower; ora **A** 'air is thinner'
therefore pO_2 is lower / 15 kPa v 21 kPa; ora

fourth point can only be given in context of point 2 or 3.
It cannot be given for just stating partial pressure is lower / quoting the figures unqualified 2 max

(ii) haemoglobin / rbc / blood less saturated with oxygen / less oxygen carried in blood / AW;
altitude sickness;
hypoxia / anoxia; **A** shortage of oxygen to tissues
changes in, breathing pattern / heart rate / pulse rate;
dizziness / weakness / disorientation / hallucinations / headaches / AW;
(possible) death / coma;
brain damage / lung damage / fluid accumulation or oedema in these organs / ref to arteriole / capillary dilation in these organs;
AVP; e.g. ref to alkalaemia / described / alkaline urine / raised blood pH 4 max

[6]

163. more haemoglobin;
get more oxygen round body;
more / longer, aerobic respiration (when exercising); ora for anaerobic
reduces, lactate / lactic acid; **A** delays oxygen debt;
more, ATP / energy release; **R** producing / making energy
enhanced performance / AW; **A** exercise for longer or harder
increased carbon dioxide removal;
ref to indetectability (as a natural product); 2 max

[2]