**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 description 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, cell signal(ling), adhesion,  
recognition, facilitated diffusion, active 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



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 / H2CO3;

If formula only 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 and 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 invalid;

**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** smooth 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  
actual length =



**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);  
asexual 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 CO2;  
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 dm3;

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;

complementary 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) transpiration;  
xylem;  
osmosis;

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 and out’

2 max

(ii) xerophyte;

**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 TWO ADAPTATIONS ONLY**  
**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 inside cells 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 max2

(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; max3

[10]

**46.** (i) *award both marks for correct answer*;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; max2

[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* max2

[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; max3

[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* *residue*/*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/CO2  
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/O2 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 wall / 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” unqualifiedless resistance to flow / ease of flow / AW / more space (linked to  
lack ofcontents);

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 / H2CO3;hydrogencarbonate / HCO3; **A** bicarbonatehaemoglobinic acid; **A** HHboxygen / O2; 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 each 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 vessels; **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** mass flow;

**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 pO2 in, tissues / cells / organs;cells / tissues / organs, need (much) oxygen;change / drop, in pO2 gives, large change / drop in saturation  
(of haemoglobin) / much release of oxygen / AW;  
**R** refs to increase in pO2  
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 oxygen / has lower affinity for  
oxygen / has lower saturation of oxygen;at a certain partial pressure of oxygen;data from diagram to support; *must be comparative*AVP; e.g. ref to effect of CO2 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 alleles ; 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** phospholipid (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 in both;

**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 gradientsapoplast / apoplastic; **A** apoplasm **R** anoplastendodermis / Casparian strip; **A** starch sheath **R** steleCasparian 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 / H2CO3 / HCO3–; **R** *if linked with incorrect reaction*carbonic acid, dissociates / AW, to give HCO3**–**;

accept from equations CO2 + H2O → H2CO3  
H2CO3 → H+ + HCO3– 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  
O2 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 O2  
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) / rough ER / RER; | 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 water potential 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** chromosomesuncoil;

*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 tolarge 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 areas such as mesophyll 2

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

water will enter source;by osmosis;down / AW, a water potential 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 cell / effect at a distance 1

**L** allows passage of lipid soluble substances (**A** water / O2 / CO2) /  
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.** membrane,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 and liquid (not name alone); 3 max

[3]

**140.** ref. change in external ;correct linking  to salt concentration;correct ref. osmosis in, loss / gain;consequence;time / no problem, when i = 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. NH2 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, osmoticeffect/ water potentialeffect / 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 osmoticeffect / 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 allow exchange /AW;sieve tube and companion cell;

***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 / less resistance / ease of transport  
organelles at edge / little cytoplasm / AW; / AW / more space for transport; **R** empty  
(*if specific organelles given, need*  
*at least 2*)

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 red 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 HCO3– = 2 marks* 3 max

(ii) H+ / hydrogen ions, combine with / AW, haemoglobin; **R** ‘mops up’ unqualified  
forms haemoglobinic 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  
genetically 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 max9

**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; max3

[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; max1

[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 dm3 s–1 to 1.5 dm3 s–1; **A** ecf from (i)

vital capacity remains constant;at 3.0 dm3; 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;more 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; orafor 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 / CO2 / 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 pO2 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]