1.

		excretion	*secretion*	
1	*one difference*	(metabolic) waste ***or*** toxin / harmful ***or*** substance is to be removed from body ***or*** does not use vesicles	useful product ***or*** used in cell communication (e.g. to target tissues) ***or*** released from glands (ducts or ductless) ***or*** uses vesicles ***or*** remain in body	;
2	*one example of a product*	urea / carbon dioxide / water / bile *pigment* / named example	hormone / enzyme / antibodies / mucus / bile *salts* / neurotransmitter / named example	;
3	*one similarity*	requires ATP ***or*** (involved in) homeostasis ***or*** (compounds) produced by cell(s) / produced by metabolism / need to cross membrane / need to move through membrane / need to leave cell / (may be) transported in blood		;

One mark per row.

CREDIT *converse statements on either side or unmatched statements for each*

1 ***IGNORE*** *name or type of product without qualification*
DO NOT CREDIT *any ref to egestion in 'excretion'*

2 ***IGNORE*** *sweat / urine / bile / saliva / salt / (named) digestive juice*

3 ***CREDIT*** *method of leaving cell e.g. exocytosis*
IGNORE *going into cells (as some excretory products do)*

[3]

2. ***S & C***

Mark the first answer*. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then =* ***0 marks***

CREDIT one statement and a suitable explanation related to that (first) given statement *(e.g. S3 + E3 but not S4 + E1)*

DO NOT AWARD 2 marks for 2 statements or 2 explanations

S1 glucose is not the only substrate / there are other substrates;

'fats can (also) be respired' = E1
'fats can be respired as well as glucose' = S1 + E1

E1 named alternative substrate;

or

S2 ATP is produced / energy is released;

DO NOT CREDIT energy *produced / made / created*

E2 (by) substrate level / oxidative, phosphorylation;

or

S3 ATP / energy, required;

E3 (for) phosphorylation / glycolysis;

or

S4 is not a single step reaction / other steps involved / other products / other intermediates;

E4 named stage(s) / named intermediate compound(s);

Krebs cycle / ETC, happens = E4
'other stages such as link reaction are involved' = S4 + E4
e.g. pyruvate / acetyl CoA / acetate

IGNORE *NAD(H) / FAD(H) / ATP*

or

S5 enzymes are involved;

E5 dehydrogenation / decarboxylation / oxidative phosphorylation / named (respiratory) enzyme;

or

S6 coenzymes / NAD, involved;

DO NOT CREDIT *NADP*

E6 oxidative phosphorylation / link reaction / Krebs cycle / glycolysis;

or

S7 glucose does not, combine / react, (directly) with oxygen;

E7 (oxygen) used in oxidative phosphorylation / is final electron acceptor / is final hydrogen acceptor;

[2]

3. (i)

Max 1 if referring to insulin receptors

1 unable to produce (enough) insulin / do not secrete insulin / produces ineffective insulin;

DO NOT CREDIT *excrete' as incorrect*

2 insulin-producing cells / beta cells / islets of Langerhans, not functioning (correctly) / damaged / destroyed / attacked;

ALLOW *lack of beta cells / ref to b cells*

DO NOT CREDIT *alpha cells / B cells (if lymphocytes implied)*

3 by (body's own) immune system / by (body's own) antibodies / auto-immune disease;

CREDIT *description*

4 (idea of) family history / genetic / hereditary;

5 (condition can be) triggered by, virus / environmental factor;

e.g.

- *shock*
- *drugs side effect*
- *(pancreatic) cancer*
- *infection / disease*

2 max

(ii) ***Mark the first 3 responses only***

1 increasing age / older / ageing / more prevalent over 40;

DO NOT CREDIT *age without 'older' implication*

2 (idea of) family history / genetic / hereditary;

3 (more common in) males;

4 (more common in)
some ethnic groups / African / Afro-Caribbean / Asian / Hispanic / Oceanic;

5 obese / overweight / fat around abdomen;

CREDIT *'apple shaped'*

6 high / frequent, intake of, sugar / highly processed food / high GI food;

IGNORE *'poor diet' / 'bad diet' / 'unhealthy diet'*
IGNORE *fat / carbohydrate, in diet*

7 lack of physical activity / sedentary lifestyle;

8 high blood pressure;

CREDIT *history of, heart attack / stroke*

9 excessive alcohol intake;

idea of too much is needed

3 max

[5]

4. (i) ***Mark the first answer****. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then =* ***0 marks***

glycolysis / glycolytic pathway;

CREDIT *phonetic spelling but must have 'glycol...'*

1

(ii) ***Mark the first answer****. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then =* ***0 marks***

cytoplasm;

CREDIT *cytosol*

DO NOT CREDIT *cytoplasm, in / of, mitochondrion*

1

(iii) ***Mark the first answer for each letter**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 mark***

D ATP;

E NAD;

***ALLOW** oxidised NAD*
***DO NOT CREDIT** NADP / reduced NAD*

F pyruvate;

***ACCEPT** pyruvic acid*

3

[5]

5. ***Award marks from labelled / annotated diagrams – but ensure that mp 2 only awarded if H clearly shown to be accepted by pyruvate***

1 (pyruvate / **F**) converted to lactate;

***ACCEPT** lactic acid*
***DO NOT CREDIT** if pyruvate → ethanol in the animal is indicated/implied*
***DO NOT CREDIT** wrong reaction type (e.g. oxidation)*

2 **F** / pyruvate, accepts hydrogen (atoms);

***ACCEPT** pyruvic acid*
***DO NOT CREDIT** hydrogen **ions** (unless also e^-) / molecule*

3 hydrogen from, **reduced** NAD / **reduced E**;

***ACCEPT** NADH / $NADH_2$ / NADH + H^+*

4 (catalysed by) lactate dehydrogenase;

*for pyruvate → lactate **ACCEPT** LDH*

5 no, oxygen / O_2, to act as (final),
hydrogen / electron, acceptor;

6 (so) link reaction / Krebs cycle / ETC, cannot take place;

Needs a clear statement of ***not*** *taking place*
CREDIT *no, electron transport chain / electron carrier chain / chemiosmosis / oxidative phosphorylation*

7 NAD / **E**, regenerated / recycled / able to be re-used;

IGNORE *reduced NAD, oxidised / reoxidised (as this does not give the idea of reusing it)*

8 allows glycolysis to continue / pyruvate continues to be made;

Needs a clear statement

9 limited / small amount of / some, ATP can be produced;

CREDIT *1 ATP (per pyruvate) / 2 ATP (rather than 28-38 per glucose) / only substrate level phosphorylation*
IGNORE *'enough ATP for ...'*

[5]

6. *physical (probably from diagrams)*

1 large nostrils (open) to take in air;

ACCEPT *oxygen*

2 (when submerged) nostrils close / nose closes, to, keep air in / stop air from escaping;

ACCEPT *oxygen*
IGNORE *ref to keeping water out*

3 lungs / airways, have high (vital) capacity;

ACCEPT *deep / barrel / large, chest* ***IGNORE*** *big lungs*
CREDIT *large lung <u>volume</u> /*
takes in large <u>volume</u> of oxygen /
larger numbers of alveoli /
larger (exchange) surface area /
increased number of capillaries

links to respiration

4 *idea that* seal, has low(er) metabolic rate / has low(er) respiratory rate / has low(er) energy requirements / uses (relatively) little ATP;

e.g.
- *(streamlined, less resistance so) uses less energy*
- *(insulated so retain heat so) uses less energy*
- *(buoyant so) less energy required*
- *(small flippers so less surface area of extremity so loses less heat so) uses less energy*

5 able to respire anaerobically for a long time / more glycolysis;
'anaerobic' needs time ref

6 large supplies of NAD (to accept H);

7 (this) prevents, build-up of lactate / lowering of pH;
***ACCEPT** lactic acid*

8 *idea that* (seal) tolerates lactate / removes lactate quickly;
***ACCEPT** lactic acid*

9 *idea that* (seal) tolerates high CO_2 concentration;

10 *idea that* (seal) tolerates low pH / has **more** pH buffers;

synoptic / inference

11 *idea that* blood diverted from certain regions / certain regions have reduced metabolic activity;
***DO NOT CREDIT** zero respiration rate*

12 *idea that* has plenty of, haemoglobin / red blood cells / myoglobin (as oxygen source);

13 *idea that* haemoglobin has a higher affinity for oxygen / dissociates less readily / dissociation curve shifted to **left**;

[3]

7. (a) **1** myelin / myelinated / lipid / fatty (sheath);
***DO NOT CREDIT** fatty acids*

2 (Schwann) cell, wrapped around / surrounds / AW, axon;

3 except at nodes of Ranvier / (sheath) not continuous / presence of gaps (in the sheath);
must be in the context of structure rather than function (as many refer to it in context of saltatory conduction)

2 max

(b) (i) **1** (myelination produces) greater speeds;
***IGNORE** ref to axon diameter for this mp*

2 unmyelinated needs larger diameter to produce same speed;

3 comparative figs, **all** with units, to support either the general trend or the exception to the trend with the mollusc;
*1 speed for myelinated (25 / 30 / 35, **m s^{-1}**) **and** 1 speed for unmyelinated (3 / 30, **m s^{-1}**) (allow m/s)*
or
*calculated difference in speed between myelinated and unmyelinated (**with units unless** a multiple e.g. approx. × 12)*

2 max

(ii) **1** larger axon diameter produces greater speeds; **ora**

needs to be a general statement

2 comparative figs, **all** with units, to support;

*2 diameters & speeds (**both with units**) for **myelinated***

or

*calculated difference in diameter for 2 stated speeds (**both with units unless** diameter is a multiple e.g. around × 1.4 / around 140%)*

type of neurone	diameter (μm)	speed (m s^{-1})	animal taxon
myelinated	4	25	mammal
myelinated	10	30	amphibian
myelinated	14	35	amphibian

or

*2 diameters & speeds (**both with units**) for **unmyelinated***

or

*calculated difference in diameter for 2 stated speeds (**both with units unless** diameter is a multiple e.g. about × 10)*

type of neurone	diameter (μm)	speed (m s^{-1})	animal taxon
unmyelinated	15	3	mammal
unmyelinated	1 000	30	mollusc

2 max

(c) (i) **1** increased <u>kinetic energy</u> / <u>KE</u> so,

- ions <u>diffuse</u>, across (axon) membrane / into neurone / into cell / between nodes / along neurone, more quickly

or

- faster movement of (neurotransmitter) vesicles / exocytosis (of neurotransmitter)

or

- neurotransmitter diffuses more quickly across, synapse / synaptic cleft

or

- neurotransmitter (ACh) broken down by enzyme (acetylcholinesterase) more quickly;

2 faster <u>diffusion</u> of ions leads to,

- faster depolarisation

or

- shorter duration of action potential

or

- shorter refractory period

or

- faster repolarisation;

description of ion movement must be correct (e.g. Na^+ in for depolarisation / Ca^{2+} into presynaptic knob)

1 max

(ii) ***DO NOT CREDIT*** *general denaturation of proteins / enzymes*

1 ion, channels / pumps,
disrupted / denatured / no longer function;

2 fluidity of, membrane / phospholipid / bilayer, disrupted;
IGNORE *leaky membrane unless qualified*

3 (named) synaptic enzymes denatured;

1 max

[8]

8.

IGNORE *ref to influx of* Na^+ *and events when action potential arrives at the synaptic knob - start when the* Ca^{2+} *channels open*

1 calcium **channel**s open;

2 Ca^{2+} / Ca^{++} / calcium ions, enter / diffuse into,

DO NOT CREDIT *'calcium' alone*
DO NOT CREDIT Ca^+
DO NOT CREDIT *'enter membrane' - must cross it*

3 acetylcholine / ACh / **neurotransmitter**, in **vesicle(s)**;

4 (synaptic) vesicles move towards **presynaptic** membrane;

CREDIT *pre-synaptic*

5 vesicles fuse with membrane;

DO NOT CREDIT *attach / bind / join*

'vesicles move and fuse with presynaptic membrane' = mps 4 & 5
'vesicles move and fuse with membrane' = mp 5 only

6 release acetylcholine, by **exocytosis**, into synaptic **cleft**;

3 max

QWC – technical terms used appropriately and spelt correctly;

Use of ***three*** *terms from:*

channel(s),	***vesicle(s),***
neurotransmitter,	***presynaptic / pre-synaptic,***
exocytosis,	***cleft,***

1

[4]

9. (i) ***Mark the first answer****. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then =* ***0 marks***

ultrafiltration;

This term required but ***ACCEPT*** *phonetic spelling*

1

(ii) 17.9;;

Correct answer = 2 marks
If answer incorrect, not rounded or incorrectly rounded then allow 1
mark for working
125 ÷ 700
or
an unrounded answer e.g. 17.857412

2

[3]

10. (i) ***Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks***

(cuboidal) epithelium / epithelial;

***DO NOT CREDIT** 'epithelium **cells**' / 'ciliated epithelium' / 'squamous epithelium' / endothelium*
***ALLOW** columnar epithelium*

1

(ii) ***Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks***

micro<u></u>villi / micro<u></u>villus;

***ACCEPT** 'brush border'*
***DO NOT CREDIT** cilia*

1

(iii) ***This is a QWC question***

1 selective **<u>re</u>absorption**;

2 of glucose <u>and</u> amino acids;

DO NOT CREDIT *if glucose & amino acids* ***& proteins***

3 **co-transport** / ***facilitated*** **diffusion** / uptake described;

ACCEPT *direct uptake, of glucose / amino acids, by active transport*

4 water follows by **osmosis** so concentration of, ions / nitrogenous waste / urea / remaining substances, increases;

5 AVP;

e.g.

- *microvilli provide large surface area for uptake*
- *many mitochondria provide energy for uptake*
- *many brush border enzymes (ATPase) for active uptake*
- *active secretion of nitrogenous waste into lumen*

3 max

QWC - technical terms used appropriately and spelt correctly;

Use of ***three*** *terms from:*
reabsorption *(or derived term),*
co-transport *(or derived term),*
facilitated diffusion, osmosis

1

[6]

11. (i) **L** artery / shunt / vein (at arterial end of shunt)
AND
M vein;

IGNORE *names of artery / vein (e.g. renal)*

DO NOT CREDIT *aorta and vena cava*

1

(ii) so that clots don't form,
while in the (dialysis) machine / during dialysis;

ALLOW *congeal instead of clot*

IGNORE *prevents clotting in the body*

IGNORE *clumping*

1

(iii) *idea of* allowing blood to clot normally after treatment;

CREDIT *preventing low blood pressure (as low viscosity)*

1

(iv) ***Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks***

(simple) diffusion;

***IGNORE** dialysis*
***DO NOT CREDIT** facilitated diffusion*

1

(v) *idea that* it,

maintains diffusion gradient /

***IGNORE** unqualified ref to countercurrent*

maintains concentration gradient /

maximises diffusion gradient /

maximises concentration gradient /

e.g.
- *solutions in contact over greater distance*
- *provides maximum contact for exchange*
- *allows exchange over longer distance*

allows maximum removal of waste /

allows maximum rate of diffusion / AW;

***IGNORE** ref to surface area*

1

[5]

12. (i) control;

***CREDIT** a description e.g.*
- *comparison*
- *to compare results with*
- *to show that (wavelengths of) light is producing the effect*
- *to show the result produced without light*
- *create baseline*
- *create set point*
- *validity*

***IGNORE** fair test'*

***DO NOT CREDIT** 'control variable' / 'controlled variable'*

1

(ii) **Read as paragraph. Mark the first 2 responses only.**

DO NOT CREDIT *ref to* ***time*** */ same* ***number*** *of leaf discs /* ***same plant*** *(as these given in the question)*

IGNORE *'fair test' without further explanation*

1 discs, the same size / cut with same cutter, ***so*** same surface area;

ALLOW *for same amount of pigment / chloroplast*

2 discs taken from same part of the leaf / leaves used from the same part of the plant ***so*** same amount of, pigment / chloroplast;

3 tubes same distance from light source ***so*** light intensity is the same;

4 light bulb the same (wattage) each time ***so*** light intensity is the same;

5 same thickness of filter ***so*** light intensity is the same;

6 carry out in darkened room / only 1 light source in room / completely cover tube with filter, ***so*** only light of desired wavelength enters;

7 CO_2 in excess / AW, ***so*** CO_2 not limiting / enough CO_2 for photosynthesis / enough CO_2 for Calvin cycle / enough CO_2 for light independent stage;

8 same, <u>volume</u> / <u>concentration</u> / batch, of indicator ***so*** that colour changes are comparable;

9 heat, sink / shield, between light source and tube ***to*** reduce temperature changes;

10 carry out at, same / constant, temperature ***as*** temperature affects enzyme, activity / structure;

Enzyme ref must be qualified

11 carry out, repeats / replicates, ***to***, calculate <u>mean</u> / identify anomalies;

IGNORE *ref to improving reliability*
IGNORE *how anomalies dealt with*
DO NOT CREDIT *preventing anomalies*

12 AVP (to include precaution and explanation);;

CREDIT *any reasonable precaution with a suitable explanation (even if explanation already given)*

e.g. • *rinse test tubes with distilled water* ***so*** *starting pH is the same*

2 max

(iii) ***Mark the first answer.*** *If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then =* ***0 marks***

chlorophyll **a**;

ALLOW *chlorophyll A / chlorophyll α*
IGNORE *p680 / p700 / PSI / PSII*
DO NOT CREDIT *chlorophyll a and b*
DO NOT CREDIT *chlorophyll alone*

1

(iv) **1** chlorophyll / pigments / leaf, reflect / does not absorb / absorbs little, green light / light of this wavelength;

Needs to refer to green rather than other colours

2 (green light) cannot be used in photosynthesis / no photosynthesis / little photosynthesis / no light dependent reaction (or described) / little light dependent reaction (or described)
correct ref to action spectrum in green region;

Needs to refer to green rather than other colours

3 little / no, photolysis / splitting of water;

CREDIT *(some) photolysis with accessory pigments*

4 little / no, CO_2, taken up / fixed (in light independent reaction);

5 some CO_2 produced during respiration;

6 (slight) increase in CO_2, increases acidity / decreases pH;

CREDIT *increase in* H^+ *decreasing pH for accessory pigments*

7 AVP;

e.g. • *accessory pigments absorb (some) green light*

3 max

[7]

13. ***Question is asking for an <u>increased</u> rate of photosynthesis and maximum production***

IGNORE LIGHT

1 photosynthesis / named stage, is controlled by / needs / involves / uses, (named photosynthetic) enzymes;

Needs to be a clear generalised statement – cannot be implied from a description of the effects
IGNORE *'enzymes are affected by temperature'*

2 temperature can be, increased by heater / reduced by ventilation (or fan) maintained by air conditioning (or other method);

Needs to indicate ***how*** *factor is controlled*

3 increase CO_2 concentration (in environment) by burning, fuel / gas / paraffin;

Needs to indicate ***how*** *factor is controlled*
CREDIT *increase in CO_2 by other reasonable methods*

4 *idea that* increased / more / high<u>er</u>, CO_2 (conc),
so CO_2 no longer a limiting factor / increases CO_2 fixation / (or described) increases Calvin cycle (or described);

ALLOW *ref to maximum rate for increase in rate*

5 *idea that* easier to control,
water supply / irrigation (to prevent wilting) / humidity / minerals / fertiliser;

Look for the idea that factors can be more easily regulated in the greenhouse rather than outside
CREDIT *use of hydroponics*

6 *idea that* easier to control use of, pesticides / pest control / biological control;

Look for the idea that factors can be more easily regulated in the greenhouse rather than outside

7 AVP;

e.g.
- *gas / paraffin, heater supplies heat* ***and*** *CO_2*
- *prevents described damage of plants by, wind chill / frost / wind / hail / etc*
- *description / effect, of photorespiration*

[4]

14. (a) islets of Langerhans; 1

(b) glucagon; 1

(c)
1 fall detected by, pancreas / islets of Langerhans / alpha cells / beta cells;
2 fall inhibits insulin, secretion / production;
3 stimulates, secretion / production, of glucagon (by alpha cells);
4 into blood;
5 binds to <u>receptor</u> on, liver cell / hepatocyte;
7 stimulates conversion of glycogen to glucose / glycogenolysis;
8 <u>gluconeogenesis</u> / detail of gluconeogenesis;
9 glucose into blood stream; 6

[8]

15. (a) (i) chlorophyll; *treat refs to a and b as neutral* 1

(ii) electron carrier / cytochrome / protein / electron acceptor / ferredoxin / plastoquinone; 1

(b) hydrogen ions are moved into the thylakoid space by action of electron carriers;
higher concentration of / more, hydrogen ions / protons reduces the pH;
R *hydrogen, H*
A *hydrogen ions produced in lumen*
hydrogen ions, move / diffuse, down concentration gradient;
across / through, (thylakoid) membrane / from lumen to stroma;
through ATP synthetase / synthase / protein channel / stalked particles;
generates ATP;

AVP; e.g. ref. to by <u>chemiosmosis</u>
ref. to an electrochemical gradient / proton motive force max 4

[6]

16. no photophosphorylation;
no ATP produced;
no reduced NADP produced;
no Calvin cycle / no light-independent stage;
no GP to TP / no TP to RuBP;
no fixation of carbon dioxide;

AVP; e.g. no production of, organic molecules / named molecules
A *autotrophic nutrition stops*
R *food*
ref to no respiratory substrate max 3

[3]

17. removal of, unwanted / toxic / waste, products;
of metabolism; 2

[2]

18. (i) *award both marks for correct answer*
evidence of 14.7 - 2.2 = 12.5 or 14.7 / 2.2 gains one calculation mark

12.5/2.2 × 100;
= 568.2 / 568 / 570;; 2

(ii) protein converted to amino acids;
excess amino acids undergo deamination / removal of amino group;
ammonia formed;
ammonia converted to urea;

AVP; e.g. ref. to ornithine cycle max 3

[5]

19. the longer the loop of Henle the lower the water potential (of urine); ora
ions pass out from ascending limb into, medulla / tissue fluid;
creating lower water potential in the medulla / AW;
water reabsorbed from collecting duct in medulla;
by osmosis; (*linked to previous marking point*)

AVP; e.g. ref to countercurrent multiplier max 3

[3]

20. (i) A glycolysis;
B fermentaion / anaerobic respiration / reduction of pyruvate;
C aerobic respiration / Krebs cycle and oxidative phosphorylation /
ETC / electron transport chain; 3

(ii) C;
allow ecf from (i) 1

(iii) A;
allow ecf from (i) 1

[5]

21. (i) (when cyanide absent) complete homogenate can fully respire the glucose/pyruvate to produce carbon dioxide;

(when cyanide is present), pyruvate does not enter the mitochondria;
some carbon dioxide produced when pyruvate is converted to ethanal;
breakdown of the glucose / pyruvate is incomplete;

ref. to anaerobic respiration; max 3

(ii) pyruvate is end product of glycolysis;
pyruvate can enter mitochondria;
carbon dioxide produced in the Krebs cycle and link reaction;
by, decarboxylation / decarboxylase(s);

glucose cannot enter the mitochondria;

AVP; further detail e.g. no carriers for glucose in mitochondrial membranes
glycolytic enzymes not found in mitochondria portion (of homogenate)
glycolytic enzymes found in, cytoplasm / cytosol max 3

(iii) pyruvate is converted to ethanal in cytoplasm;
ethanal is converted to ethanol;
does not involve, cytochromoes / ETC / oxidative phosphorylation;
enzymes in cytoplasm not inhibited by cyanide; max 3

[9]

22. (a) A axon terminal / synaptic knob / synaptic bulb;
B cell body / centron; 2

(b) *at X*:
sodium channels open and sodium ions move into neurone;
potential difference rises from –70mV to 30mV;

at Y:
potassium channels open and potassium ions move out of neurone;
potential difference falls from 30mV to –76mV;

AVP;; e.g. ref. to voltage gated channels
ref to movement by diffusion / passively
ref to electrochemical gradient 4

(c) *effect*:
myelinated fibres conduct more quickly than unmyelinated / AW;
ref. to one set of comparative figures from table;

explanation - max 4
myelin sheath acts as (electrical) insulator;
lack of sodium and potassium gates in myelinated region;
depolarisation occurs at nodes of Ranvier only;
(so) longer local circuits;
(action potential) jumps from one node to another / saltatory conduction; 5

[11]

23. (i) a biological molecule that can be broken down in respiration to release energy; 1

(ii) *award both marks for correct answer*
55/77;
0.7 / 0.71; 2

(iii) 1.0; 1

[4]

24. ref. to potassium hydroxide / soda lime;
ref. to equilibration / use syringe to set manometer fluid (level);

leave for suitable length of time (minimum 20 minutes) and measure distance moved by fluid;
repeats and calculate mean;
calculate volume of oxygen taken up per minute;

AVP; e.g. ref to set-up of control tube (e.g. same mass of beads as of fungus) or (same volume of inert substance as substance A)
detail of how to calculate volume of oxygen (by multiplying distance moved by fluid in capillary by $2\pi r$) max 4

[4]

25. (i) light absorbing/AW;
ref to excited electrons/AW;
used in light dependent stage;
ref. to location; e.g. chloroplasts, thylakoids, photosystems, grana, lamellae
AVP; e.g. (long) hydrocarbon chains,
different pigments absorb different wavelengths. max 3

(ii) high absorption of, wavelengths 450 – 480 nm/
blue region of spectrum;
high absorption of, wavelengths 660 – 710 nm/
red region of spectrum;
low absorption of, wavelengths 500 – 620 nm/
green region of spectrum;

for each marking point accept single figure in range.
If candidate gives range it
must fall within the range on the mark scheme.

only penalise lack of units once. max 2

[5]

26. (primary) act as reaction centres/where electrons are excited;
(accessory) other part of photosystem/antenna unit/surround reaction centre;
(accessory) absorb different wavelengths of light (not absorbed by primary);
(accessory pigments) transfer energy to primary pigments;
names of primary (chl a, P680, P700) and accessory pigment
(chl b, carotenoid); max 2

[2]

27. **1** non-cyclic photophosphorylation;
2 ref to photosystems 1 and 2 being involved; **A** *PS1 and 2/P700 and P680*
3 excited electrons emitted/AW;
4 ref to electron acceptor molecules;
5 (electrons pass along) chain of, electron carriers/ETC/cytochromes;
6 occurs in, thylakoid membranes/grana/lamellae;
7 sets up a, proton/H^+/hydrogen ion/pH gradient; **A** *proton pump idea*
8 ref to ATP synth(et)ase; **A** *ATPase, stalked particle*
9 ref to, proton motive force/flow of protons;
10 chemiosmosis;
11 formation of ATP;
12 movement of electrons from PS2 to PS1;
13 ref to photolysis;
14 movement of electrons from water to PS2;
15 cyclic photophosphorylation;
16 PS1 only;
17 AVP; e.g. named electron acceptors, named electron carriers, ref. to water splitting enzyme, ref to position of photosystems.(PS1 intergranal membrane and PS2 grana) max 8

QWC – clear well organised using specialist terms; 1

[9]

28. (a) (i) removal of, carbon dioxide/carboxyl group;
removal of hydrogen; **R** *H_2/hydrogen molecules/hydrogen ions* **A** *H/2H* 2

(ii) P and Q; 1

(b) 1; 1

(c) (i) 3;
1; 2

(ii)
1 inner mitochondrial membrane/cristae;
2 ref to (NADH) dehydrogenase;
3 hydrogen split into protons and electrons;
4 ref to, electron carriers/ETC/cytochromes;
5 energy released from electrons;
6 ref to protons pumped across membrane;
7 protons accumulate in intermembranal space;
8 proton gradient/pH gradient/H^+ gradient;
9 protons pass through ATPase; **A** *ATPsynthase/ ATP synthetase/stalked particle*
10 ref. to oxygen (final) hydrogen/electron acceptor;
11 formation of water; max 4

(d) fats/fatty acids, not respired;
ref to (β-)oxidation (of fatty acids) requires NAD;
NAD used in breakdown of alcohol;
NAD is, limiting/in short supply/AW;
fats formed from fatty acids plus glycerol;
AVP; e.g. further detail of alcohol/fat metabolism max 3

[13]

29. (i) **A** 3
B 2
C 1; 1

(ii) **A**
1 (voltage gated) sodium channels open;
2 sodium (ions) enter (axon);
3 positive feedback/more sodium channels open;
4 depolarisation/description of depolarisation;
5 sodium channels close;
6 ref to + 40 mV;

B 7 (voltage gated) potassium channels open;
8 potassium (ions) move out (of axon);
9 positive feedback/more potassium channels open;

*only award marking points 3 **or** 9, not both*

10 repolarisation/description of repolarisation;
11 beyond -65 mV/hyperpolarisation/AW;

C 12 Na/K pump (helps to), restore/maintain, resting potential;
13 membrane more permeable to potassium ions (at resting potential);
14 (many) potassium channels open (at resting potential); max 5

[6]

30. 1 sodium <u>ions</u> (inside axon), move/diffuse
2 towards, resting/negative region;
3 causes, depolarisation of this region/change of PD to reach threshold value;
4 (more) sodium channels open;
5 sodium (ions) move in;

marking points 3-5 only available if linked to sodium ions moving within axon

6 ref to local circuits;
7 one way transmission;
8 ref refractory period/region of axon behind AP recovering;
9 ref to insulating role of, myelin sheath/Schwann cells;
10 depolarisation cannot occur through myelin/ impermeable to (Na^+ and K^+) ions/ora;
11 ref to nodes of Ranvier;
12 longer local circuits;
13 saltatory conduction/AW;
14 AVP; e.g. fewer (Na^+ and K^+) ion channels in myelinated region/ora.
15 AVP; ref. to absolute and relative refractory period, ref. to actual distance between nodes (1 – 3mm); max 7

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

[8]

31. (i) releases/source of/provides/to give, energy;
for germination;
for growth/protein synthesis/spindle formation/organelle replication/ DNA replication/active transport/cell division/other named function; 2 max

(ii) higher energy density/release twice as much energy per, g/unit mass;
compared to, glucose/protein;
39 kJ g^{-1};
higher proportion of, hydrogen atoms/carbon-hydrogen bonds;
advantage for dispersal/named advantage;
AVP; e.g. ref to coenzyme A formation 2 max

[4]

32. *heat loss*
1 body/blood, temperature rises;
2 may affect/denature, enzymes/proteins;
3 panting cools body;
4 ref. evaporative cooling;

fate of lactate
5 (high) lactate concentration needs to be reduced;
6 due to anaerobic respiration;
7 panting provides extra oxygen/ref. oxygen debt;
8 lactate oxidized to pyruvate;

respiratory gases
9 myoglobin would be reoxygenated;
10 haemoglobin would be reoxygenated;
11 ATP/CP, resynthesised in muscle tissue;
12 removal of extra carbon dioxide; 4 max

[4]

33. 1 frequent need to urinate/diuresis;
2 large volume of urine/very dilute urine;
3 persistent feeling of thirst/excessive drinking;
4 electrolyte/mineral, imbalance;
5 AVP; e.g. dehydration, 3 max

[3]

34. (a) for, flying/hovering/beating wings;
muscle activity/AW;
ref. ATP/respiration;
AVP; e.g. explanation of energy demand of flight

small size qualified; e.g. increases heat loss/
ref. large surface area to volume ratio

homeothermic qualified;

migration qualified;

feather growth qualified; e.g. ref. mitosis/protein synthesis max 4

(b) *description*

D1 high(est) incidence of torpor/AW;
D2 low(est) oxygen consumption/AW;
D3 high(est) body mass/AW;
D4 data quote; *3 max*

explanation

E1 less food used;
E2 (for) less respiration/lower BMR/lower body temperature;
E3 more food stored;
E4 as fat;
E5 (food store/fat) for, migration/flight; max 4

(c) flying, easier/uses less energy (with incomplete feathers if mass low);
can, escape predators/find food, (by flying);
food used for feather growth;
therefore, fat stores used/less food stored;
incomplete/missing feathers may reduce body mass; max 2

(d) *yes*

(autumn) high(est) mass birds have low(est) oxygen consumption;
(spring) low(est) mass birds have high(est) oxygen consumption;
data quote mass plus O_2 consumption;
only generate heat in proportion to (small) mass;
but lose it in proportion to (large) surface area;
homeothermic/small birds find it hard to keep warm; max 3

[13]

35. 1 blood = transport fluid/AW;
2 blood has high (hydrostatic) pressure;
3 tissue fluid created/plasma moves out of capillaries/AW;

4	named substance;	glucose/amino acids/fatty acids/glycerol, oxygen, carbon dioxide, urea
5	from area;	gut, alveoli, liver cell, liver cell
6	moves to;	blood/liver cell, blood/liver cell, tissue fluid/alveoli, tissue fluid/kidney
7	method;	diffusion/facilitated diffusion/active transport/ endocytosis, diffusion, diffusion, diffusion
8	detail of transport in blood;	plasma/dissolved, red blood cells/ haemoglobin, HCO_3^- ions/dissolved/carbamino-haemoglobin, plasma/dissolved

9 ref. respiration;
10 ref. maintaining diffusion gradients;

11 osmoregulation by kidney/AW;
12 pH regulation by kidney/AW;
13 ref. osmosis;

14 AVP; e.g. deamination, ornithine cycle, ref. CO_2 acidic
15 AVP; e.g. ref. glycogen, ref. insulin/glucagon max 7

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

[8]

36. (a) cut/damage, breaks tonoplast/opens vacuole/mixes enzyme and precursor/
AW;
enzyme-substrate collisions/AW;
(enzyme-substrate complex) releases, smell/volatile chemicals; 3

(b) less precursor chemical;
due to, herbivore/fungal/bacterial damage;
due to sulphur recycling;
due to onion being older;
used pyruvate for, link reaction/Krebs cycle/respiration;
AVP; max 2

(c) (i) identify mildest/AW;
and breed together;
detail cross-pollination;
idea, repeat/many generations AW;
<u>directional selection</u>;
AVP; e.g. reference to frequency of <u>alleles</u> max 3

(ii) grow in low level of, sulphur/sulphate; 1

(d) method of quantifying onion strength/producing extracts of different concentration;
method of measuring, rotting/antibiotic effect of onion extract;
replicates/mean;
ref. control variable or example;
ref. fungi/bacteria;
AVP; e.g. reference to timescale
AVP; e.g. second controlled variable max 3

[12]

37. (i) light intensity; 1

(ii) some other factor becomes limiting;
carbon dioxide or temperature (linked to point 1); 2

[3]

38. 1 denaturing of enzyme;
2 change in shape of active site;
3 named photosynthetic enzyme;
4 less photolysis;
5 less ATP produced;
6 named step in Calvin cycle which is affected; **A** step described

7 increase in rate of respiration;
8 respiration occurring at faster rate than photosynthesis;
9 temperature compensation point;

10 increased rate of transpiration;
11 stomatal closure;
12 less carbon dioxide uptake;

13 AVP; e.g. ref to photorespiration 4 max

[4]

39. less reflection of light;
less transmission of light;
more light absorbed;
more, wavelengths absorbed; **A** colours of light
more, ATP / red NADP, formed;
increases temperature of leaf;
enzymes work more efficiently;
light intensity / temperature, being limiting; 3 max

[3]

40. *accept labelled sketch diagram for marking points below*

nitrogenous base / purine;
adenine;
pentose / 5 carbon, sugar;
ribose;
three, phosphate groups / Pi; **R** phosphate molecule
phosphorylated nucleotide;

A adenosine as an alternative to adenine **plus** ribose 4 max

[4]

41.
1 NAD / FAD, involved in respiration;
2 associated with, dehydrogenase enzymes / dehydrogenation;
3 2 molecules of NAD (reduced) in glycolysis;
4 link reaction producing 1 molecule of NAD (reduced);
5 Krebs cycle produces 3 NAD (reduced) (per turn of cycle);
6 detail of any one step in respiration where NAD (reduced) is produced;
7 Krebs cycle produces 1 FAD (reduced) (per turn of cycle);
8 carriers / transfers, hydrogen to, inner mitochondrial membrane / cristae / cytochromes / ETC;
9 mitochondrial shuttle (bringing NAD reduced from glycolysis into matrix);

10 NADP involved in photosynthesis;
11 produced in non-cyclic (photo)phosphorylation;
12 hydrogen comes from, water / photolysis;
13 (used in) Calvin cycle / light independent stage;
14 GP to TP step;
15 AVP; e.g. NADP involved in transporting hydrogen from grana to stroma
16 AVP; e.g. hydrogen split into electrons and protons at ETC

credit annotated diagrams 7 max

QWC – clear, well organised using specialist terms;
award QWC mark if three of the following are used

photophosphorylation	cristae	
glycolysis	photolysis	
Calvin cycle	link reaction	
Krebs cycle	dehydrogenase / dehydrogenation	1

[8]

42. (a) (i) wide / large, afferent arteriole;
narrow / small, efferent arteriole;

afferent arteriole, wider / larger, than efferent arteriole – 2 marks

ref to 'bottleneck' effect / AW; **R** *build up pressure on own*
to achieve filtration;
must be greater than 6.7 kPa for filtration; 2 max

(ii) *award two marks if correct answer (1.3) is given*
incorrect answer (or no answer) but correct working = 1 mark

8 – (4 + 2.7) **A** *8 – 6.7*
1.3;; 2

(b) (i) (too) large / RMM greater than 69000 *or* 70000;
to pass through <u>basement membrane</u>; 2

(ii) <u>glomerular</u> blood pressure is greater;
proteins <u>forced</u> through;
damage to capillaries / AW;
damage to basement membrane; 2 max

(c) 1 <u>endothelium</u> of capillaries;
2 large / many, fenestrations / gaps / holes;
3 modified epithelial cells of capsule / podocytes;
4 slit pores / foot-like processes; **A** finger like
5 basement membrane;
6 made up of, collagen / glycoproteins / molecular mesh;

accept annotated diagrams 4 max

(d) 1 volume will increase;
2 concentration decrease;
3 (wall of), collecting duct / DCT, (relatively) impermeable to water;
4 fewer water channels; **A** aquaporins
5 in membrane of epithelial cells;
6 less water reabsorbed (from the urine);
7 by osmosis (linked to marking point 6);
8 drinking increases liquid intake and therefore liquid loss; 4 max

[16]

43. CG acts as <u>antigen</u>;
move, attached to, free antibodies;
attach to, immobilised antibody;
coloured particles, form line;
ref to complementary shapes;
ref to antigen, antibody complex;
AVP; e.g. further detail of antibody structure
monoclonal
CG-antibody complex 4 max

[4]

44. **Q** – glucagon; **A** adrenaline
R – insulin; 2

[2]

45. conversion of one amino acid to another / AW;
(free) amino acids in body may not match body's requirements / AW;
can only occur with non-essential amino acids; 2 max

[2]

46.
1 increase in, HCO_3^- / H^+;
2 carotid / aortic / medulla, receptors;
3 increase of frequency of impulses;
4 along, accelerator / sympathetic / phrenic, nerve;
5 to diaphragm and intercostal muscles;
6 faster breathing;
7 deeper breathing / increased tidal volume;
8 to sino-atrial node;
9 causes heart to beat faster;
10 increased stroke volume / stronger contraction;
11 more / faster, removal of carbon dioxide;
12 (blood carbon dioxide falls to) norm / set point;
13 negative feedback / homeostasis;
14 AVP; e.g. buffering effect of haemoglobin, ref chemoreceptors 7 max

QWC – clear well organised using specialist terms; 1

award the QWC mark if three of the following are used in the correct context

carotid
aortic
sympathetic
diaphragm
intercostal
tidal volume
sino-atrial node
stroke volume
negative feedback
homeostasis

[8]

47. (i) S dorsal root ganglion;
T relay / intermediate / bipolar / internuncial, neurone; 2

(ii) 1 rapid / fast acting;
2 short lived;
3 automatic / involuntary / no conscious thought / brain not involved;
4 not learned / innate / genetic / inborn / instinctive;
5 response the same each time / stereotypical;
6 AVP; e.g. safety / survival 3 max

(iii) 1 distortion / AW;
2 Na^+, gates / channels, open; **A** sodium / Na
3 Na^+ / sodium ions, enter; **R** sodium / Na
4 depolarisation / –65mV to +40mV;
5 receptor / generator, potential;
6 ref to threshold;
7 action potential; *allow only if linked to idea of threshold reached* 3 max

(iv) neurotransmitter only, in presynaptic knob / released from presynaptic membrane;
receptors only on postsynaptic membrane;
ref to refractory period / hyperpolarisation; 2 max

[10]

48. **A** - stroma ; **A** ribosome
B - (outer/ inner) membrane / (chloroplast) envelope ; **R** cell membrane
C - thylakoid / lamella ; **A** lamellae
D - granum / granal stack ; **A** grana **A** thylakoid stack

[4]

49. **1** light absorbed by, pigment / bacteriorhodopsin / protein ;
2 ref to electron carriers / change in shape of bacteriorhodopsin ;
3 energy released from electrons ; **R** produced / created / made
4 protons into cell wall ;
5 create, proton gradient / electrochemical gradient / pH gradient / proton motive force ;
6 protons, diffuse / move down gradient ;
7 through, ATP synth(et)ase complex / stalked particles ; **A** ATPase
8 (ATP formed from) ADP + P(i) ;
9 AVP ; e.g. ref to chemiosmosis,
ref to energy transducing membrane,
ref to redox reactions. 4 max

[4]

50. removal of, unwanted / toxic / waste, products ;
of metabolism ;

[2]

51. proteins / polypeptides ; **R** amino acids **A** enzymes
nucleic acids / DNA / RNA / polynucleotides ;

[2]

52. (i) *award two marks if correct answer (568.18 / 568.2 / 568 / 570) is given evidence of 14.7 – 2.2 = 12.5 or 14.7/2.2 gains one calculation mark*

12.5/2.2 × 100 = 568.18 / 568.2 / 568 / 570 ; ; 2

(ii) (more) proteins to amino acids ;
ref to deamination / removal of amino group ;
(more) ammonia formed ;
ref to ornithine cycle ;
(more) ammonia converted to urea ; 2 max

[4]

53. ammonia is, alkaline / highly toxic / *ora* ;
ammonia is more soluble / *ora* ;
large volumes of water to excrete it ;
would cause dehydration ; 2 max

[2]

54.
1 both filtered / AW ;
2 both small molecules / AW ; **A** RMM close to 69 000
3 (all filtered) glucose reabsorbed ;
4 active uptake, carrier / cotransporter, proteins ;
5 (some) glucose used in, respiration / active processes, in kidney ;
6 some urea reabsorbed ;
7 by diffusion ;
8 ref to reabsorption in PCT ; *apply once to either glucose or urea* 5 max

[5]

55. ADH / anti diuretic hormone ;
reduces blood sugar levels / correct mechanism to achieve this ;
increases blood sugar levels / correct mechanism to achieve this ;
ABA / abscisic acid ;
auxin / IAA ;

[5]

56.
1 ref to change in receptor ;
2 creates, receptor potential / generator potential ;
3 if greater than threshold value ;
4 depolarisation / AW, (of axon / sensory / afferent, neurone) ;
5 ref to action potential (*anywhere in answer*) ;
6 ref to, myelin sheath / myelinated neurones ;
7 saltatory conduction / AW ;
8 ref to nodes of Ranvier ;
9 synapse with, motor / effector / efferent, neurone ;
10 ref to, calcium ions / calcium channels ;
11 vesicles of neurotransmitter fuse with presynaptic membrane ;
12 named neurotransmitter ;
13 secretion / exocytosis (from presynaptic membrane) ; **R** release
14 diffusion across synaptic cleft ;
15 receptors on postsynaptic membrane ;
16 depolarisation / AW, (of postsynaptic membrane / motor neurone) ;
17 ref to, neuromuscular junction / motor end plate ;
18 AVP ; e.g. ion movement,
refractory period
voltage-gated channels 8 max

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

[9]

57. **A** ;
C ;
C ;
B ;

[4]

58. ref to oxidative phosphorylation and ATP production ;
needs supply of hydrogen ;
to form reduced, NAD / FAD ;
lipids have more, hydrogen / hydrogen – carbon bonds ;
more acetyl coenzyme A generated / more 'turns' of Krebs cycle ; 2 max

[2]

59. dinitrophenol in body ;
ETC still functioning ;
less ATP formed in respiration ;
food not enough to meet metabolic demands of body / AW ;
had to respire, body tissues / food stores ;
AVP ; e.g. heat production increasing metabolic rate 3 max

[3]

60. **A** – sinusoid ;
B – (branch of) bile duct ;
C – (branch of hepatic) portal vein / HPV ;
D – (branch of) hepatic artery ;

[4]

61. bile pigments build up in blood ;
(pigments) do not enter gut / AW ;
AVP ; e.g. bile, canaliculi / duct, blocked / gall stones 2 max

[2]

62. (a) avoid attracting a mate of a different species ; *ora*
ensure reproductive isolation ; 1 max

(b) (i) diffusion ; 1

(ii) so that they do not receive oxygen constantly ;
there are mitochondria between them and the cell surface ; 1 max

(c) mitochondria / aerobic respiration / oxidative phosphorylation, inhibited only briefly ;
oxygen concentration decreases again ;
preventing, action of luciferase / production of light ;
each flash short ; *ora* e.g. so not continuously lit
AVP ; 2 max

(d) active transport ; **A** e.g. Na^+/K^+ pump
protein synthesis ;
synthesis of named substance ;
movement of organelles ;
phosphorylation of glucose ;
AVP ; ; ; e.g. transcription, translation, anabolic reaction

R respiration, DNA replication, chromosome movement, mitosis 3 max

(e) cells / membranes, damaged / disrupted ;
nitrous oxide released ;
mitochondria stop using oxygen ;
oxygen, allows light production / reaches light-producing organelles ;
in unlimited quantities / continuously, so light is brighter ;

respiration / oxidative phosphorylation, ceases ;
no more, ATP / $NADH_2$;
luciferin, synthesis / regeneration, stops ;
AVP ; 3 max

(f) live bacteria, respire / produce ATP ; *ora* 1

(g) <u>mRNA</u> (coding for luciferase) ; **A** DNA 1

[13]

63. (i) palisade (mesophyll) ;
spongy (mesophyll) ;

mesophyll / chlorenchyma – 1 mark 2

(ii) 1.7, 3.1, 4.0, 4.7, 4.9, 5.0 ; 1

(iii) selection of two temperatures 10 ºC apart ;

respiration
ref to release of carbon dioxide (in dark is measure of respiration) ;
state two figures very close to value of 2, therefore supports ;
(all steps in) respiration enzyme catalysed ;

photosynthesis
data quotes must be from true rate of photosynthesis
only value between 5 ºC and 15 ºC is close ;
photosynthesis does not support as (other) values not near 2 ;
A data quote to illustrate this / ecf
not just enzyme-controlled process / AW ; 4 max

(iv) light intensity limiting factor ;
low rate photosynthesis ;
rate respiration increases at higher temperatures ;
rate respiration, close to / exceeds, rate of photosynthesis ; **A** ora
net primary productivity is lower / sugars broken down more quickly than formed ; 3 max

[10]

64. **1** Calvin cycle ;

max 4 from marking points 2 to 10

2 ribulose bisphosphate carboxylase / rubisco ; *linked to marking point 3*
3 RuBP + carbon dioxide ;
4 (2 molecules of) GP ; **A** PGA
5 GP to TP ; **A** PGAL, GALP
6 uses ATP (from light reaction) ; *linked to marking point 5*
7 and red NADP / AW, (from light reaction) ; *linked to marking point 5*
8 some TP forms hexose sugars ;
9 (some) TP regenerates RuBP ; 5 max
10 AVP ; e.g. (unstable) 6C compound, detail of RuBP regeneration

accept an annotated diagram of the cycle

[5]

65. (i) directly proportional / AW ; 1

(ii) 2.6 ; 1

(iii) **1** high levels of glucose in glomerular filtrate ;
2 unable to reabsorb <u>all</u> glucose (in, PCT / kidney tubule) ;
A no more glucose can be reabsorbed
3 ref to glucose carriers / AW ;
4 at threshold value carriers, all saturated / limiting factor ;
5 AVP ; e.g. ref to renal threshold 3 max

[5]

66. **1** detected by cells in pancreas ;
2 β cells of islets of Langerhans ;
3 insulin produced ;
4 secreted into, blood / circulation / HPV ;
5 cells / named example, take up <u>more</u> glucose ;
6 <u>more</u> glucose carriers in membrane ;
7 conversion to glycogen / glycogenesis ;
8 increased rate of glucose use in respiration ;
9 ref to negative feedback ;
10 glucose concentration kept below threshold value in glomerular filtrate ;
11 all reabsorbed in PCT ;
12 AVP ; inhibits glucagon secretion, suppresses gluconeogenesis 5 max

[5]

67. (i) long loop of Henlé or/ deep / wide, medulla ;
very low water potential in medulla / AW ; **A** higher concentration of salts
collecting duct more permeable to water ;
large number of, water permeable channels / aquaporins, in collecting duct ;
more sensitive to ADH / more ADH produced ;
AVP ; e.g. other correct ref to kidney histology
all loops of Henlé are long
CD more permeable to urea
more capillary loops in medulla 3 max

(ii) seeds contain, storage molecules / AW ; **A** named example of storage molecule
aerobic ;
respiration ;
water is produced ; *linked to respiration*
R reference to condensation reactions

accurate equation for aerobic respiration can gain 3 marks
metabolic water = 2 marks 3 max

[6]

68. (i) **A** islet of Langerhans / α and β cells ;
B (branch of pancreatic) duct ; 2

(ii) *endocrine* ductless gland ;
hormones / named hormone ; e.g. insulin / glucagon
into blood ;

exocrine enzymes / pancreatic juice / HCO_3^- ;
amylase / trypsin / chymotrypsin / lipase / carboxypeptidase ;
into duct ;

if answers are interchanged then mark to 2 max 4 max

[6]

69. **1** ref to, medulla (oblongata) / cardiovascular centre (in brain) ;
2 sympathetic nervous system / accelerator nerve (to heart) ;
3 short preganglionic, neurone / fibre ;
4 (transmitter substance) noradrenaline ;
5 to sino atrial node (SAN) (in correct context) ;
6 heart rate increases ;
7 increased force of contraction ;
8 ref to adrenaline ;
9 parasympathetic nervous system / vagus nerve ;
10 (transmitter substance) acetylcholine ;
11 long preganglionic, neurone / fibre ;
12 heart rate decreases ;
13 AVP ; e.g. myogenic heart muscle / cardiac inhibitory centre

if answers to sympathetic and parasympathetic are interchanged mark to 4 max 7 max

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

[8]

70. (a) *T. sillamontana*

thicker / fleshier / succulent ;
hairy ;
more compact / AW ;
ref to different leaf shape ;
AVP ; e.g. petiole rolled round stem 2 max

(b) (i) *T. sillamontana* 14, *T. fluminensis* 19 ; 1

(ii) same magnification / AW ;
several leaves ;
leaves from similar parts of plants ;
same (environmental / light / water / soil / fertiliser) conditions ;
AVP ; e.g. same age 2 max

(c) **1** *T. sillamontana* drier / *T. fluminensis* wetter / AW ;

T. sillamontana

2 xerophytic / xeromorphic ;
3 fewer stomata / ora ;
4 hairs ;
5 trap water vapour / water potential gradient lower ; **R** trap, water / moisture
6 (so) transpiration / evaporation, slower ;
7 white hairs qualified ;
8 fleshy, stem / leaves, store water ;
9 AVP ; ref surface area to volume ratio, ref to rolling qualified

T. fluminensis

10 leaves further apart ;
11 so do not, trap air / shade each other ;
12 leaves, darker / have more chlorophyll ;
13 so improved photosynthesis ;
14 smooth / shiny, leaves allow water to drip off ; 5 max

(d) *T. fluminensis* has, max / optimum, rate at, 7 a.u. / 42 (- 50) % ;
T. sillamontana rate increases with increasing light intensity ;
T. sillamontana data quote (x + y) ;
comparative statement re data ;
comparative statement re conditions ;

AVP ; e.g. *T. fluminensis* may be damaged by high light intensity 3 max

[13]

71. **1** decomposition / decay / rotting (of grass) ;
2 (microbial) respiration ;
3 (releases) heat ;
4 temperature figures ;
5 uses up oxygen / aerobic ;
6 oxygen figures ;
7 produces carbon dioxide ;
8 carbon dioxide figures ;
9 grass cuttings provide insulation ;
10 AVP ; 5 max

[5]

72. (a) (i) noradrenaline / adrenaline / thyroxine / growth hormone / glucocorticosteroid; **R** steroid 1

(ii) insoluble;
unreactive / stable / inert;
cannot diffuse out of cell / AW;
no effect on water potential;
compact / branched;
lots of glucose in small space / AW; **R** lots of energy in small space
easy to, convert to glucose / hydrolyse;
lots of 'ends' for enzyme action; max 3

(b) **1** increases activity of glycogen synthetase;
2 slow initial effect / AW;
3 ref to figures to show an increase;
4 (overall effect) increases, production of glycogen / glycogenesis; **R** storage of
5 glycogen
6 lowers activity of glycogen phosphorylase;
7 rapid effect;
8 ref to figures to show a decrease;
9 prevents / reduces, breakdown of glycogen / glycogenolysis;
10 (glucose binds to) allosteric site / AW;
(glucose acts as) inhibitor / activator; **R** competitive inhibitor max 5

(c) *either*
deamination of amino acids / removal of NH_2 from amino acids;
pyruvate / carbon skeleton / AW;
triose phosphate / TP;
condensation / increasing number of carbon atoms;
or
breakdown of, lipid / triglyceride;
glycerol;
triose phosphate / TP;
condensation / increasing number of carbon atoms; max 3

[12]

73. (a) **1** rate of respiration can equal rate of photosynthesis / CO_2 used = CO_2 produced / O_2 used = O_2 produced;
2 ref to compensation point;
3 mitochondria use oxygen;
4 chloroplasts produce oxygen;
5 mitochondria are always active / respiration continues independently of light;
6 chloroplasts are inactive in dark / photosynthesis does not take place without light;
7 oxygen released by, chloroplasts / photosynthesis, can be utilised by mitochondria / respiration;
8 at high light intensities, chloroplasts produce more oxygen than the mitochondria consume;
9 AVP; e.g. valid refs to CO_2 exchange max 4

(b) phosphate ions are used to produce ATP;
in oxidative phosphorylation / Krebs cycle / chemiosmosis / electron transport / ATP synth(et)ase;
ATP leaves mitochondria; max 2

(c) carrier protein / transport protein / transmembrane protein involved;
A ref to a specific channel
concentration of triose phosphate is higher in the chloroplast (than in the cytoplasm);
because it is a product of, photosynthesis / light independent reaction / Calvin cycle;
triose phosphate moves, down concentration gradient / from high to low concentration;
ATP not involved / no energy used; max 2

(d) *ignore references to chloroplasts or mitochondria being cells, having cytoplasm and reference to free ribosomes*

free / naked, DNA; **A** DNA not surrounded by, membrane / envelope
have an inner folded membrane / AW;
ribosomes, smaller than those in cytosol / similar in size to prokaryotic ribosomes; **A** ref to 70S and 80S
circular DNA; **A** loop
AVP; e.g. absence of introns

R absence of a nucleus from the chloroplast or mitochondrion
R ref to membranous organelles as chloroplasts and mitochondria are these organelles max 2

[10]

74. **S;**
R;
S;
A – correct names instead of letters
[3]

75. FAD / NAD; **A** reduced FAD / reduced NAD / AW
[1]

76. chlorophyll a; **A** chlorophyll for one mark as an alternative to chl. a and b
chlorophyll b;
xanthophylls;
carotenoids / carotene;
[2]

77.
1 occurs in stroma;
2 a series of enzyme-controlled reactions;
3 carbon dioxide fixed by RuBP;
4 carboxylation;
5 enzyme is Rubisco;
6 (unstable) 6C intermediate;
7 forms (2 molecules) of GP;
8 forms TP;
9 using ATP (linked to point 8);
10 reduction step;
11 using reduced NADP;
12 ref to either ATP or NADP red coming from light dependent reaction;
13 (most of) TP regenerates RuBP;
14 rearrangement of carbons to form pentose sugars;
15 ATP required, for phosphorylation / ribulose phosphate to ribulose bisphosphate;
16 AVP; e.g. TP can be used to form, lipids / amino acids / hexose sugars / suitable named example max 7

QWC – legible text with accurate spelling, punctuation and grammar; 1
[8]

78. ductless gland;
secretes hormones; **R** excrete
(directly) into blood;
[2]

79. insulin produced by, microorganisms / bacteria;
cheaper source of insulin / more reliable supply / ref to large scale production;
more rapid response / shorter duration of response;
less chance of, immune / allergic, response; **R** reference to rejection
better for people who have developed a tolerance for animal insulin / less needed; **R** immune
acceptable to people who have ethical, moral or religious objections; **A** vegetarians
no risk of, infection / contamination;

[3]

80. thick axons transmit impulses quicker than thin ones / AW;
myelinated fibres quicker than unmyelinated / AW;
invertebrates have slower speed of impulse / *ora*;
ref to one set of comparative figures from table;

[2]

81. following an action potential;
need to, redistribute sodium and potassium ions / restore resting potential;
sodium voltage gated channels are closed;
(during which) another impulse cannot be, generated / conducted;
ensures impulses separated;
determines maximum frequency of impulse transmission;
impulse passes in one direction only along axon;
AVP; e.g. ref to absolute and relative refractory periods

[4]

82. (a) ref parasympathetic NS / AW;
sympathetic NS less active / AW;
more impulses in vagus nerve / less impulses in accelerator nerve;
more acetylcholine / less noradrenaline;
effect on SAN; max 3

(b) *any two of*
fibrinogen; **R** fibrin
prothrombin; **R** thrombin
albumin; **A** albumen
(named) globulin; **R** immunoglobulin or antibodies
AVP; e.g. transferrin max 2

(c) *similarities*

1 production of urea;
2 urea transported in blood;
3 urea filtered from blood;
4 synthesis of proteins from amino acids;

differences (assume refs are to brown bears unless otherwise stated)

5 amino acids synthesised from ammonia;
6 <u>all</u> urea reabsorbed;
7 from kidney <u>and</u> bladder;
8 urea converted to ammonia by <u>bacteria</u>;
9 AVP; e.g. (humans) less tolerant to high ammonia (in blood) max 5

(d) component of cell membranes / AW;
ref to, mechanical stability / impermeability / fluidity; *ignore* rigidity
production of, steroid hormone / named hormone;
production of vitamin D;
production of bile salts; max 3

(e) increases high density lipoproteins (HDLs);
reduces low density lipoproteins (LDL);
prevents, deposition of cholesterol / plaques / atherosclerosis; max 2

[15]

83. (a) ref limiting factor;
not carbon dioxide;
named factor e.g. light / temperature / limited number of chloroplasts; **R** water
photosynthesis at maximum rate;
explanation of effect of named factor e.g. ref to enzyme action; max 2

(b) ref respiration;
production of carbon dioxide; **R** release
(at low concentrations, CO_2 was) diffusing / moving down a concentration gradient;
respiration faster than photosynthesis / AW;
AVP; e.g. below compensation point max 2

(c) control of variables / light is a variable; **R** 'fair test' unqualified 1

(d) *accept ora here*
maintenance of water supply;
xylem / vascular bundles, intact;
water required for, photosynthesis / turgor; **A** water prevents wilting

stomata might close if the leaf detached;
leaves site of photosynthesis;
AVP; e.g. ABA, water stress, sugar transport max 2

(e) **1** one similarity between barley and sugar cane;
2 one difference between barley and sugar cane;
3 temperature ref between or within species;
4 CO_2 concentration ref between or within species; **A** ppm for concentration
5 data quote comparison with units;
6 ref to habitat; e.g. tropics, named country, biomes (biological zones), climate
7 ref to biochemistry; e.g. C4 / C3, different enzymes
8 ref to enzymes;
9 AVP; e.g. ref compensation point max 5

[12]