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. (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]

3. (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]

4.

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 **<u>presynaptic</u>** 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]

5. (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]

6. (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]

7. (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]

8. 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]

9. (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]

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

[2]

11. 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]

12. (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]

13. 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]

14.
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]

15. **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]

16. (i) **A** islet of Langerhans / α <u>and</u> 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]

17. **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]

18. ductless gland;

secretes hormones; **R** excrete
(directly) into blood;

[2]

19. 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]

20. 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]

21. 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]