

Q1.

- 3 (a) A vesicles containing transmitter/acetylcholine/synaptic vesicle;
B presynaptic membrane;
C synaptic cleft/gap;
D post synaptic membrane;
E receptor/protein/ Na^+ gate; 5
- (b) arrow pointing down; 1
- (c) ref. low Ca^{2+} in synaptic knob/high Ca^{2+} outside knob;
action potential/depolarization causes opening of Ca^{2+} channels;
 Ca^{2+} into synaptic knob;
causes vesicles to move towards presynaptic membrane;
causes vesicles to fuse with presynaptic membrane;
vesicle contents/transmitter/exocytosis into synaptic cleft/gap; 3 max
- Total: 9**

Q2.

- (a) **A** microvilli / brush border ;
B invagination / infolding of membrane / basal channels ;
- 2**
- (b) basal channels / microvilli / brush border – increase surface area ;
many mitochondria – provide ATP for active transport ;
carrier proteins / cation pumps in csm – active uptake / facilitated diffusion / co-transport ;
tight junctions – prevent migration of membrane proteins / separate tubule fluid ;
ref. to pinocytosis – protein uptake ;
- 3 max**
- (c) Na^+ actively transported (out of cell) into blood ;
creates concentration gradient ;
 Na^+ enters cell by diffusion ;
through cotransporter / symporter proteins ;
glucose cotransported / facilitated diffusion (from lumen to cells) ;
glucose diffuses into blood capillaries ;
- 3 max**
- (d) proximal convoluted tubule cells have a low / more negative water / solute potential ;
due to high concentration of salts / ions / glucose / Na^+ ;
water enters by osmosis ;
down water potential gradient (idea) ;
- 2 max**
- Total: 10**

Q3.

Question	Marks
<p>3 (a) idea of energy conversion (linked to receptor) ; Na⁺ in / AW ; depolarization ; receptor / generator potential ; ref. to threshold ; (therefore) action potential / wave of depolarisation ;;</p>	3 max
<p>(b) (in / from) CNS / brain / spinal cord ; ref. to synapse with intermediate / relay neurone ; ref. to neuromuscular junction / (neuro)transmitter released ; ref. response ;</p>	3 max
<p>(c) ref. synapses ; vesicles containing transmitter only found on preSM ; receptors for transmitter only found on postSM ; ref. to refractory period / hyperpolarisation ;</p>	2 max
	Total: 8

Q4.

Question	Expected Answers	Marks
3 (a)	A – basement membrane ; B – minor process / foot ;	[2]
(b)	arrow going from capillary (through pore in capillary wall) and through gaps in podocyte processes ; arrow continues into renal capsule ;	[2]
(c) (i)	glomerular filtrate ;	[1]
(ii)	less protein ; no large protein ; ref. less than MM 68 000 to 69 000 ; no blood cells ; AVP ;	[2 max]
(d)	sufficient hydrostatic (blood) pressure ; comparison between afferent and efferent vessels ; to force fluid through ; basement membrane ; selective barrier / AW ;	[3 max]
		[Total: 10]

Q5.

4	(a)	acetylcholine / Ach ;	[1]
	(b)	wave of depolarisation / action potential, in pre-synaptic axon / membrane ; Ca ²⁺ channels open ; Ca ²⁺ enter pre-synaptic neurone / synaptic knob ; causes synaptic vesicles to move towards presynaptic membrane ; ref. exocytosis of Ach / neurotransmitter ;	[4 max]
	(c)	vesicles found <u>only</u> in, pre-synaptic knob / neurone ; receptors found <u>only</u> in post-synaptic membrane ;	[2]
			[Total: 7]

Q6.

- 4 (a) 1. norm concentration of blood glucose is 80 - 120 mg 100cm⁻³ ; (A within range)
2. β cells of, Islets of Langerhans / pancreas, detect increase ;
3. ref. K⁺ channels close / role of Ca²⁺ ;
4. secrete insulin ;
5. ref. glycogenesis ;
6. increased uptake of glucose (by cells) ;
7. increased use of glucose in respiration / glucose converted to fat ;
8. ref. negative feedback / described ;
- [4 max]

Q7.

- 2 (a) A – (pancreatic) duct ; A capillary
B – islet of Langerhans / α and β cells ;
- [2]
- (b) α cells / β cells / islets / B, secrete, hormones / glucagon / insulin ;
into the blood / not into a duct ;
- [2]
- (c) 1 increases permeability of membrane to glucose / increases glucose uptake ;
2 increases respiration of glucose ;
3 (increases), conversion of glucose to glycogen / glycogenesis ;
4 (increases) protein / fat, synthesis ;
- [2 max]
- (d) 1 it is identical to human insulin / ora ;
2 works better than non-human insulin / more rapid response ;
3 no / fewer, rejection problems / side effects / allergic reactions ;
4 ref. to ethical / moral / religious, issues ;
5 cheaper to produce in large volume / unlimited availability ; R cheap to produce
6 less risk of, transmitting disease / infection ;
7 good for people who have developed intolerance / allergic reactions / immune responses
to animal insulin ;
- [2 max]

[Total: 8]

Q8.

4 (a)

1.	β cells detect glucose levels	or	no detection of blood glucose conc.	;
2.	β cells secrete insulin	or	no insulin released	;
3.	when blood glucose concentration rises	or	when blood glucose concentration rises	;
4.	(insulin causes) muscle cells / adipose tissue / liver cells	or	muscle cells / adipose tissue / liver cells	;
5.	to increase uptake of glucose from blood / increased membrane permeability to glucose	or	do not take up excess glucose	;
6.	(insulin causes liver cells) to convert glucose to glycogen	or	glucose not converted to glycogen (by liver cells)	;
7.	(insulin causes liver cells) to increase respiration of glucose	or	rate of respiration of glucose does not increase	;
8.	(if no β cells) no control of blood glucose levels / AW	or	no control of blood glucose levels / AW	;

[4 max]

- (b) (i) 1. (yes) more people with infection have CFRD than those without infection ;
 2. use of 'with CFRD' comparative figs ;
either using number of people – 44 / 52 / 96 (no infection)
against 106 / 121 / 227 (with infection)
or using FEV₁ values – 71.1 / 53.6 / 124.7 (no infection)
against 49.0 / 42.0 / 91.0 (with infection)
or 28.5% males against 35.8% females (no infection)
or 38.9% males against 50.05% females (with infection)
 3. AVP ; e.g. we do not know how the sample was chosen (so this may not be a valid conclusion) [2 max]

(ii) $\frac{2.2}{71.4} \times 100 ; = 3.08 / 3.1 ;$
 or
 $\frac{2.2}{73.6} \times 100 ; = 2.99 / 3.0 ;$ [2]

- (iii) 1. more lung damage in females (with CFRD) than in males ;
 2. females (with CFRD) have lower FEV₁ than males ;
 3. use of figures ; e.g. males FEV₁ 49 whereas female FEV₁ 42
 or female FEV₁ 1.16 times lower than male FEV₁ [3]

- (c) 1. CFTR protein acts as chloride channel (in cell membranes) ;
with CF
 2. faulty (CFTR) gene ;
 3. faulty / non-functional, (CFTR) protein produced ;
 4. chloride ions not able to move out (of cell) ;
 5. by active transport ;
 6. so less water passes out (of cell) ;
 7. down water potential gradient ; **A** by osmosis
 8. mucus secreted contains less water ; [4 max]

[Total: 15]

Q9.

- 6 (a) (i) A – calcium ions ; A Ca^{2+} R calcium/Ca/ Ca^{+}
 B – sodium ions ; A Na^{+} R sodium/Na [2]
- (ii) exocytosis; [1]
- (iii) depolarisation (of post-synaptic membrane)/action potential ; [1]
- (iv) 1. splits ACh;
 2. into acetate and choline;
 3. stops continuous depolarisation of postsynaptic membrane/AW;
 4. choline recycled (into presynaptic neurone); [max 3]
- (b) binds to/blocks, dopamine receptors (on postsynaptic membrane);
 prevents depolarization (of postsynaptic membrane);
 reduces **effect** of dopamine;
 R reduces amount of dopamine [max 2]
- (c) *ref 13 base deletion*
frame shift/alters reading frame (after mutation);
 (so) all amino acids different **after** mutation;
 3-D shape/tertiary structure, of protein changed;
 (whereas) 21 base-pair deletion, loses 7 amino acids/no frame shift;
 (whereas) substitution, may change only one amino acid/may be silent; [max 3]
- (d) increased chances of, survival/breeding/mating;
 provides a selective advantage;
allele passed on (to next generation);
 allele increases in frequency over time;
natural selection; [max 3]

[Total: 15]

Q10.

6 (a) (i) 17.9;;

allow $\frac{125}{700}$ ($\times 100$) or 17.8 for one mark [2]

(ii) *fluid can pass through glomerular capillaries because* (max 3)

1. fenestrations in capillary endothelium; **A** hole / pores / gaps
2. basement membrane acts as a filter;
3. no substances $>68\ 000$ MM can get through;
4. no cells can get through;

fluid can pass through podocytes because

5. have, projections / AW;
6. gaps (between projections); **A** filtration slits [4 max]

(b) (i) microvilli; [1]

(ii) 1. produce ATP / provide energy;

2. for active transport of Na^+ ;

3. **out** (of cell); [max 2]

(iii) *mark first two answers*
any named ion / mineral ions;

vitamins;

amino acids;

glucose;

some urea; [max 2]

[Total: 11]

Q11.

Question 3

(a)

engulf / remove / breakdown red blood cells ;
haemoglobin broken down ;
into haem and globin ;
iron removed (from haem) ;
remainder passes to liver cells to form bile pigments ;
globin broken down into amino acids ;

4 max

(b)

forms lipoproteins ;
stores fats ;
synthesises cholesterol ;
forms bile salts from cholesterol ;
converts glucose to fats ;
converts fats to fatty acids and glycerol ;
converts fats/glycerol to glucose ;

3 max

(c)

diffuses into sinusoids ;
dissolved/in solution ;
in blood/ plasma ;
via hepatic vein ;
via renal artery ;

2 max

(d)

(i)

less glucose / amino acids / fatty acids and glycerol / nutrients/more urea ;

1

(ii)

less oxygen / more carbon dioxide ;

1

Total : 11

Q12.

Question 3

(a)

increases rapidly / sharply ;
to a maximum of 7.0 - 7.5 / a rise of approximately 3 ;
then falls below original value ;
recovering from 240 minutes / AW ;

3 max

(b)

(i)

increase in glucose stimulates beta cells ;
in islets of Langerhans / pancreas ;

2

(ii)

as glucose level drops ;
beta cells no longer stimulated / insulin secretion stops ;
Insulin is broken down ;

2 max

(c)

secreted by alpha cells ;
when blood glucose levels low ;
cause glycogen to be converted to glucose ;
raise blood glucose ;
correct ref: negative feedback / idea that glucagons action is opposite to insulin ;

3 max

Total : 10

Q13.

Question 5

- (a) globin / protein to amino acids ;
haem to iron ;
iron stored / reused ;
residue / remainder to bile pigments / biliverdin / bilirubin ;
pass into bile ;
excreted ; 4 max
- (b) NH₂ / amino group removed ;
to ammonia ;
and keto acid / oxo produced ;
ref: ammonia to urea ; 3 max
- (c) *alternative mark schemes*
- 1 ethanol / alcohol ;
oxidized ; R broken down
to ethanal / acetaldehyde in ;
ref: respiration / fat synthesis;
- OR
- 2 ammonia ;
combines with CO₂ ;
to produce urea ;
via ornithine cycle ;
- OR
- 3 lactate ;
oxidised ;
by dehydrogenase ;
to pyruvate ;
- OR
- 4 hydrogen peroxide ;
to water and oxygen ;
by catalase ; R hormones 3 max

Q14.

-
- 2 (a) 1 reference to Na^+/K^+ pump;
- 2 active process/ATP used;
- 3 Na^+ (pumped) out and K^+ (pumped) in;
- 4 high Na^+ outside and high K^+ inside axon;
- 5 membrane slightly more leaky to K^+ /more K^+ leaks out than Na^+ leaks in/
reference to some K^+ channels open;
- 6 inside more negative than outside; **3 max**
- (b) 1 reference stimulation;
- 2 opening of Na^+ channels;
- 3 Na^+ diffuses in (across axon membrane);
- 4 inside more positive than outside/outside more negative than inside;
- 5 potential across the membrane changes; **3 max**
- (c) 1 reference to closing Na^+ channels;
- 2 opening of K^+ channels;
- 3 K^+ diffuses out (across axon membrane);
- 4 (charge on the K^+) restores the membrane/resting potential;
- 5 reference to slight overshoot/hyperpolarisation;
- 6 reference K^+ channels close; **3 max**
- (d) 1 electrical vs chemical;
- 2 (impulses) along nerve cells vs (hormones) through blood;
- 3 rapid vs slow;
- 4 response immediate vs relatively slow;
- 5 responses short lived vs long lived; **3 max**

Q15.

Question	Expected Answers	Marks
3 (a)	control / maintain, water / solute, concentration / potential ; of, body fluids / internal environment / cells ;	2
(b)	1 B / C , lower ψ than A ; <i>accept C lower ψ than B</i> <i>accept ψ gets more negative as fluid moves down descending limb</i> 2 comparative figs ; 3 water moves out by, diffusion / osmosis ; 4 into, medulla tissue / tissue fluid ; 5 D / E , higher ψ than C ; <i>accept ψ gets less negative as fluid moves up ascending limb</i> 6 comparative figs ; 7 $\text{Na}^+ / \text{Cl}^-$, move out ; 8 into, medulla tissue / tissue fluid ; 9 by active transport ; 10 A and E same ψ / AW ; <i>penalise once for no units</i> <i>allow either 4 or 8</i>	5 max
(c)	receptor – hypothalamus ; effector – pituitary gland / cells or walls of collecting duct ; R anterior pituitary	2

[Total: 9]

Q16.

Question	Expected Answers	Marks
5 (a)	5.0 – 5.5 ; μm ; <i>accept correct values for mm, cm or m</i>	2
(b)	1 plant produces ABA ; 2 (due to) high temperature ; 3 (due to) reduced water supply / water loss / drought ; 4 guard cells lose K^+ ; 5 ref. water potential gradient ; 6 guard cells lose water ; 7 loss of turgor causes stomatal closure ; 8 AVP ; e.g. stress hormone / different thickness of cell wall / ABA binds to receptors on guard cells	4 max
(c)	(rate of transpiration due to) difference in relative humidity inside and outside, stomata / leaf ; in still air / low wind speed, external water vapour remains close to stomata / AW ; reduced, concentration gradient / water potential gradient ;	2 max

[Total: 8]

Q17.

- 4 (a) 1 maintains, constant / stable, internal environment ; **R normal**
 2 a change in, some parameter / example of parameter ; (*like blood glucose or temperature*)
 3 detected by a, sensor / receptor ;
 4 brings about response via an effector / ref.corrective mechanism ;
 5 ref. return to, norm / set point ;
 6 named, receptor / effector ; [4 max]
- (b) 1 enzyme immobilised (in biosensor) ;
 2 H⁺ ions released (from gluconic acid) ;
 3 give positive charge ;
 4 current flows ;
 5 size of current proportional to concentration of, H⁺ / glucose ;
 6 low reading (when blood tested) indicates, hypoglycaemia / low blood glucose concentration ; **A ora** [4 max]
- alternative points*
 2 platinum electrodes ;
 3 detects oxygen concentration ;

[Total: 8]

Q18.

- 8 (a) C – depolarisation / inside (membrane) more positive ;
 sodium ions / Na⁺, flow in ;
 D – repolarisation / inside (membrane) more negative ;
 potassium ions / K⁺, flow out ;
 E – hyperpolarisation / refractory period ;
 more negative than resting potential ; [6]
- (b) *for A (ora for B)*
 (generator / receptor) potential (difference) ;
 does not overcome threshold ; [2]

[Total: 8]

Q19.

- 7 (a) **G** to cells in centre ;
R to surrounding white area ; [2]
- (b) ADH ; [1]
- (c) (i) (too) large / MM > 68 000 ;
to pass through basement membrane ; **R** gaps / wall [2]
- (ii) reabsorbed ;
in proximal convoluted tubule ; [2]
- (iii) 1. more urea in urine than in filtrate / ora ; **A** comparative figs
2. water is reabsorbed ;
3. in, distal convoluted tubule / collecting duct ;
4. most urea stays in urine ; **R** all urea stays
5. other substances are reabsorbed ; [2 max]
- [Total:9]**

Q20.

6	(a)	(i)	<i>ignore refs to function</i> <u>islets of Langerhans</u> ; scattered throughout pancreas / AW ; alpha and beta cells ; blood supply (to carry hormones away) ;	[3 max]
		(ii)	<u>globular protein</u> ;	[1]

	(b)	1	it is identical to human insulin / fits membrane receptor on (target) cells ;	
		2	(more) rapid response ;	
		3	no / fewer, rejection problems / side effects / allergic reactions ;	
		4	ref. to ethical / moral / religious, issues ;	
		5	cheaper to produce in large volume / unlimited availability ; R cheap to produce	
		6	less risk of, transmitting disease / infection ;	
		7	good for people who have developed tolerance to <u>animal</u> insulin ;	[3 max]
				[Total: 7]

Q21.

- 7 (a) 1 apical bud is source of auxin ;
2 auxin inhibits growth of side shoot ;
3 remove bud and auxin conc falls ;
4 this allows cell, division / elongation, to take place (in side shoots) ; [3 max]

(b) 267 ;;

accept suitable working for one mark e.g. $\frac{110-30}{30} (\times 100)$

or

accept 266.7 for one mark

[2]

(c) *days 2 to 8*

D1 no increase in length with paste plus auxin (compared to control) ;

E2 auxin moves from paste into plants ;

E3 inhibits growth ;

days 8 to 13

D4 increase in length occurs (with paste and auxin) ;

E5 less auxin left ;

D6 supportive figs ; e.g. two blue points on two days plus units or one red and one blue point on same day plus units

must have at least one D (description) and one E (explanation) to score 3 marks

[3 max]

[Total: 8]

Q22.

- 7 (a) 1 removal / elimination, of waste products ;
2 of metabolism ;
3 (which are) toxic ;
4 (or) substances excess (to requirements) ; [2 max]
- (b) 1 homeostasis / AW ;
2 change in water potential ;
3 detected by (osmo)receptors ;
4 in hypothalamus ;
5 response via effector ;
6 ADH released ;
7 effect on collecting duct ;
8 return to, norm / set point ; [4 max]
- (c) 1 blood diverted away from skin ;
2 less sweating ;
3 more water retained in body / high water potential in body ;
4 less water reabsorbed from collecting duct / AW ; [2 max]
- [Total: 8]**

Q23.

- 2 (a) 1. only three colours (for positive reactions) / only a small range ;
 2. no measurement of actual concentration / no numerical value measured ; [2]
- (b) (i) peroxidase ; [1]
- (ii) 1. (catalyses breakdown of hydrogen peroxide) to produce oxygen ;
 2. chromogen, oxidised by / reacts with, (oxygen) ;
 3. produces range of colours ;
 4. more, peroxide / oxygen produced, = greater change / darker colour ; [2 max]
- (iii) 1. to keep out, proteins / enzymes / polymer / named large molecule ;
R large molecules unqualified
 2. to prevent interference (to reactions) ;
 3. to prevent loss of, enzyme / chromogen ;
 4. so still allowing reaction to occur ; [2 max]
- (c) (i) 1. **B** has diabetes and **A** does not ;
 2. **A**'s, values / peak, lower because he secretes insulin
 or
B's, values / peak, higher because, no / little, insulin ;
in A
 3. (insulin affects), liver / muscle, cells ;
 4. increase in glucose uptake / increase in permeability of membranes (to glucose) ;
 5. increase in use of glucose in respiration ;
 6. (more) glucose converted to glycogen ;
in B
 7. because cells unresponsive to insulin ; [4 max]
accept quoted values for lower and higher in mark point 2
- (ii) (the concentration of blood glucose), above which some glucose appears in the urine /
 AW ; [1]
- (iii) 1. (at first), glucose reabsorbed by proximal convoluted tubule ;
 2. ref. co transported with Na⁺ / facilitated diffusion / protein carrier ;
 3. above 180mg (100cm⁻³ glucose in blood) no further reabsorption ;
 4. because carriers (in PCT) saturated / AW ; [3 max]

[Total: 15]

Q24.

7 (a)

event	initial effect of event on blood concentration of		
	glucose	insulin	glucagon
meal containing sucrose	increase	increase	decrease
meal containing only protein	no effect	no effect	no effect ;
fasting	decrease	decrease	increase ;
exercising	decrease	decrease	increase ;
meal containing starch	increase	increase	decrease ;

[4]

- (b)
1. affects liver cells ; R muscle cells / liver and muscle cells
 2. promotes glycogenolysis / AW ;
 3. promotes use of fatty acids in respiration ;
 4. promotes gluconeogenesis / AW ;
 5. results in rise in (blood) glucose concentration ;
 6. back to, norm / set point ;

[3 max]

[Total: 7]

Q25.

- 9 (a) 1. myelin sheath insulates axon ;
 2. *idea of* depolarisation / action potentials, only at nodes of Ranvier ;
 3. ref. saltatory conduction / AW ; [2 max]

- (b) (i) 1. (impulse from TENS) causes release of endorphins ;
 2. endorphins attach to morphine receptors ;
 3. slows / stops, ACh release ;
 4. no / less, binding of ACh on receptors ;
 5. in postsynaptic membrane ;
 6. fewer / no, action potentials/ impulses, to pain centre (in brain) ;
 7. AVP ; e.g. ref role of Ca^{2+} [4 max]

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- (ii) *any two from*
 1. no need to use drugs ;
 2. no addiction to drugs ;
 3. patient can control the treatment / AW ;
 4. fewer / no, side effects ;
 5. cheaper ; [2 max]

[Total: 8]

Q26.

1 (a)

correct order	letter of stage
1	E
2	H
3	A
4	J
5	C
6	F
7	B
8	G
9	D
10	I

H A J C all above F ;
H A J C in correct order ;

B G D I all below F ;
B G D I in correct order ;

[4]

(b) (i) vesicles found **only** in presynaptic neurone /
ACh released **only** from presynaptic neurone or membrane ;

receptor (proteins) found **only** on postsynaptic membrane ;

[2]

- (ii)
1. allows more interconnection of nerve pathways / AW ;
 2. for, memory / AW ; *ignore learning*
 3. allows wider range of responses ;
 4. AVP ; e.g. summation

[2 max]

[Total: 8]

Q27.

- 1 (a) A - mitochondrion ;
 B - post-synaptic membrane ;
 C - myelin sheath / Schwann cell ; [3]
- (b) 1 produces ATP ; (1)
 R produces energy
any two from
 2 (for) ACh production ;
 3 (for) vesicle formation ;
 4 (for) vesicle movement ;
 5 (for) exocytosis / described ;
 6 (for) functioning of ion pumps ;
 R calcium ions (2 max) [3 max]
- (c) 1 fits into (membrane) receptors ;
 2 not broken down (by enzymes) ;
 3 (so) action potentials generated for a long time (in post-synaptic neurone) ;
ignore ref to increased frequency of action potentials
 4 AVP ; e.g. causes release of other transmitters / stimulant and depressant / variable response [2 max]
- [Total: 8]

Q28.

- 6 (a) (i) greater speed (if myelinated) ;
 comparative figures with units ; [2]
- (ii) larger diameter greater speed / ora ;
 comparative figures with units ; [2]
- (b) 1. myelin insulates axon ;
 2. no myelin at nodes ;
 3. action potentials / depolarisation, only at nodes (of Ranvier) ;
 4. local circuits set up between nodes ;
 5. action potentials 'jump' from node to node / saltatory conduction ;
 6. myelination prevents leakage of ions ; **ora** [max 3]
- (c) (i) 1. (sheath) treated as, 'foreign' / non-self ;
 2. ref. role of, antibodies / phagocytes / lymphocytes ; [2]
- (ii) 1. less insulation of axon ;
 2. action potentials, slow down / stop ; [2]
- [Total: 11]

Q29.

- 9 dormancy ;
 embryo ;
 aleurone ;
 endosperm ;
 maltose ;
 ATP / energy ;
 transcription / expression ;
- [7]
- [Total: 7]**

Q30.

- 6 (a) (i) B ;
 (ii) E ;
 (iii) D ;
 (iv) A + F ; *both required*
- [4]
- (b) (i) Protoctista ;
- [1]
- (ii) 1. ref. to voltage-gated sodium ion channels / ref. ligand gated channels ;
 2. channels change shape (when, pd / voltage, changes) ;
 3. open when, membrane depolarises / action potential arrives / neurotransmitter binds to receptors ;
 4. sodium ions flood in ;
 5. diffuses / down concentration gradient ;
 6. channels close when membrane, repolarises / potential reaches +30mV ;
 7. ref. to sodium-potassium pump ;
- [max 3]
- (iii) 1. no, depolarisation / action potentials ;
 2. *idea of life-threatening paralysis / named consequence ;*
 e.g. cannot breathe / heart stops
- [2]
- [Total: 10]**

Q31.

9 active transport / diffusion ;

mass ;

phloem ;

dominance ;

decrease / reduce / lower ;

division / mitosis / elongation ;

elongation / division / mitosis ;

[7]

[Total: 7]

Q32.

6 (a) channels ; I voltage-gated

depolarised ; **A** positive inside

receptor / generator ;

threshold ;

frequency ; **A** number per second / rate **R** speed

[5]

(b) action potential stimulates neighbouring area of membrane ; **AW**

Na^+ , moves sideways / attracted to areas at resting potential ; **A** local circuit

causes, Na^+ ion channels to open / 2nd depolarisation ;

(transmission) in one direction due to, hyperpolarisation / refractory period ;

myelin sheath / Schwann cell ;

sheath insulates, axon / dendron / neurone ;

depolarisation / action potential, only at nodes of Ranvier / unmyelinated part ; **ora**

saltatory conduction / action potential 'jumps' from node to node ;

[max 5]

[Total:10]

Q33.

- 6 (a) (i) tendency of water molecules to move from one region to another/potential energy of water/ability of water to do work ; [1]
- (ii) (water potential) becomes, lower/ more negative ; [1]
- (iii) posterior pituitary ; [1]
- (iv) for **one** mark ;
any 2 from
 urine
 sweat
 water vapour (from exhaled air)
 faeces
 bleeding
 tears [max 1]
- (b) affects collecting duct, (cells/wall) ; **A** distal convoluted tubule cells
 binds to receptors on cell surface membranes ;
 activates series of enzyme controlled reactions ;
 (phosphorylase causes), vesicles/ aquaporins, to move to cell surface membrane (on lumen side) ;
 vesicles/aquaporins, fuse with cell surface membrane ;
 cells/wall, more permeable to water ;
 water moves out of lumen (of collecting duct) ;
 down water potential gradient ; [max 5]
- (c) produce, a lot of urine / dilute urine ;
 dehydration / thirsty ;
 cramps/ loss of salts ; [max 2]
- [Total:11]**

Q34.

6 (a)

statement	letter
is myelinated	B
may form a synapse with an intermediate neurone	B
cell body lies within the CNS	M
dendron is usually longer than axon	S
cell body lies within spinal nerve	S
has many dendrites	B

 ;;;

*all correct = 3 marks
3/4 correct = 2 marks
1/2 correct = 1 mark*

[3]

- (b) 1 Ca^{2+} channels open (in presynaptic membrane/presynaptic knob) ;
2 Ca^{2+} enter (pre)synaptic knob ;
3 vesicles contain, neurotransmitter/ACh ;
4 (vesicles) move towards/fuse with, presynaptic membrane ;
5 (ACh/neurotransmitter) released/exocytosis ;
6 (ACh/neurotransmitter) diffuses (across cleft) ;
7 binds to receptors on postsynaptic membrane ;
8 Na^{+} channels open ;
9 Na^{+} enters post-synaptic neurone ;

*penalise lack of mention of ions in mp2 and 9 **once** only*

[max 5]

- (c) hydrolyses/breaks down, ACh ;

stops continuous production of action potentials (in post-synaptic neurone) ;

[2]

[Total: 10]

Q35.

6 (a)

ion	role	type of cell
Fe ²⁺	oxygen transport/haemoglobin structure ;	red blood cell
Na ⁺	co-transport in the kidney	proximal convoluted tubule/epithelial ;
Ca ⁺	synaptic transmission/ described ;	neurone

[3]

(b) receptor/generator ; **A** threshold

[1]

(c) 1 high blood pressure in glomerulus ;

2 (due to) greater diameter of afferent vessel ; **ora**

3 molecules pass through holes in (capillary) endothelium ;

4 basement membrane selectively permeable/only small molecules pass through basement membrane/large molecules unable to pass through basement membrane ;

5 less than 69 000 RMM ;

6 molecules pass between gaps in podocytes ;

7 enter renal capsule ;

[max 4]

[Total: 8]

Section_B

1.

Question 6

(a)

- 1 depolarisation/action potential ;
- 2 of presynaptic membran,/synaptic knob ;
- 3 opening calcium ion channels ;
- 4 calcium ions in ;
- 5 vesicles containing transmitter / acetylcholine ;
- 6 fuse with membrane ;
- 7 contents emptied into synaptic cleft / exocytosis ;
- 8 transmitter / acetylcholine diffuses across synaptic cleft ;
- 9 transmitter / acetylcholine binds to receptor ; **R** protein channel
- 10 on post synaptic membrane ;
- 11 Na^+ channels open / Na^+ enters ;
- 12 depolarises post synaptic membrane ;
- 13 action potential set up / impulse transmitted ;
- 14 breakdown / hydrolysis of transmitter / acetylcholine by enzyme /
cholinesterase ;

9 max

(b)

- 15 when blood glucose levels low ;
- 16 glucagon released from alpha cells (in pancreas) ;
- 17 (acts on) liver (cells) ;
- 18 breakdown of glycogen to glucose ;
- 19 use of fatty acids in respiration ; **R** fats
- 20 production of glucose from other compounds / fats / amino acids /
gluconeogenesis ;
- 21 liver releases glucose into blood ;
- 22 glucose levels rise / return to normal ;
- 23 switching off glucagon secretion ;
- 24 antagonistic to insulin ;

6 max

Total : 15

2.

- 6 (a) *auxin = IAA*
- 1 auxin produced in apical bud / AW ;
 - 2 diffuses down stem ;
 - 3 active transport (cell to cell) ;
 - 4 role of plasmodesmata ;
 - 5 also in phloem ;
 - 6 (auxin) inhibits growth of lateral buds ;
 - 7 plant grows up instead of branching out ;
 - 8 removal of apical bud allows lateral buds to grow ;
 - 9 AVP ; e.g. auxin concentrated in lateral bud / auxin in low amounts in lateral bud
 - 10 AVP ; e.g. correct ref to effect of ABA / cytokinins
- 6 max**
- (b)
- 11 seed absorbs water ;
 - 12 by osmosis ;
 - 13 gibberellin produced by embryo plant ;
 - 14 passes to aleurone layer ;
 - 15 switches on / activation, transcription enzyme genes / AW ;
 - 16 storage proteins broken down to amino acids ;
 - 17 stimulates synthesis / release of amylase ;
 - 18 amylase diffuses / moves into endosperm ;
 - 19 breaks down / hydrolyses starch to maltose ;
 - 20 maltose to glucose ;
 - 21 glucose diffuses / moves into embryo plant ;
 - 22 provides source of energy for growth of embryo plant ;
- 9 max**
- Total: 15**

3.

Question	Expected Answers	Marks
6 (a)	1 maintenance of constant / stable, internal environment ; 2 despite changes in external environment ; 3 negative feedback ; 4 receptor and effector ; 5 beta cells ; 6 in islets of langerhans / pancreas ; 7 release insulin (into blood) ; 8 alpha cells stop releasing glucagon ; 9 affects liver / muscle cells ; 10 increased permeability to glucose / absorption from blood ; 11 increased use of glucose in respiration ; 12 increase in conversion of glucose to glycogen ; 13 stored in liver and muscles ; 14 fall in blood glucose concentration / return to normal ;	[8 max]
(b)	15 low blood water content / water potential ; 16 detected by osmoreceptors ; 17 in hypothalamus ; 18 ADH produced / released ; 19 from posterior pituitary gland ; 20 target kidney ; 21 cells of collecting duct ; 22 binds to receptors ; 23 vesicles with water permeable channels ; 24 fuse with cell membrane ; 25 cells more permeable to water / water passes into cells ; 26 urine lower volume ; 27 higher concentration ;	[7 max]
		[Total: 15]

4.

- 9 (a)
1. action potential / depolarisation, reaches presynaptic membrane ;
 2. calcium (ion) channels open / presynaptic membrane becomes more permeable to Ca^{2+} ;
 3. Ca^{2+} flood into presynaptic neurone ; R membrane
 4. this causes vesicles of (neuro)transmitter to move towards presynaptic membrane ;
 5. ref. acetylcholine / ACh ;
 6. vesicle fuses with presynaptic membrane / exocytosis ;
 7. ACh released into synaptic cleft ;
 8. ACh diffuses across (cleft) ;
 9. ACh binds to receptor (proteins) / AW ;
 10. on postsynaptic membrane ; R neurone
 11. proteins change shape / channels open ;
 12. sodium ions rush into postsynaptic neurone ; R membrane
 13. postsynaptic membrane depolarised ;
 14. action potential / nerve impulse ;
 15. AVP ; e.g. action of acetylcholinesterase
- [9 max]

- (b) 16. ensure one-way transmission ;
 17. receptor (proteins) only in postsynaptic, membrane / neurone ; *ora*
 18. vesicles only in presynaptic neurone ; *ora*
 19. ref. adaptation ;
 20. increased range of actions ;
 21. due to interconnection of many nerve pathways ;
 22. ref. inhibitory synapses ;
 23. involved in memory / learning ;
 24. due to new synapses being formed ;
 25. AVP; e.g. summation / discrimination

[6 max]

[Total:15]

5.

- 10 (a) *endocrine*
 1 hormones ;
 2 chemical messengers ; **A** chemicals that transfer information
 3 ductless glands / (released) into blood ;
 4 target, organs / cells ;
 5 ref. receptors on cell membranes ;
 6 example of named hormone and effect ;

nervous

- 7 impulses / action potentials ; **R** electrical, signals / current
 8 along, neurones / nerve fibres ; **R** nerves
 9 synapse (with target) / neuromuscular junction ;
 10 ref. receptor / effector / sensory / motor, neurones ;

differences – endocrine

- 11 slow effect / *ora* ;
 12 long lasting effect / *ora* ;
 13 widespread effect / *ora* ;
 14 AVP ; e.g. extra detail of synapse

[8 max]

- (b) 15 IAA / plant growth regulator ;
 16 synthesised in, growing tips / apical buds / meristems ;
 17 moves by diffusion ;
 18 from cell to cell ;
 19 also, mass flow / in phloem ;
 20 stimulates cell elongation ; **R** cell enlargement
 21 inhibits, side / lateral, buds / growth ; **A** inhibits branching
 22 plant grows, upwards / taller ; **A** stem elongates
 23 IAA / auxin, not solely responsible ;
 24 interaction between IAA and other plant growth regulators ;
 25 AVP ; e.g. role of ABA and lateral bud inhibition
 26 AVP ; e.g. cytokinins antagonistic to IAA / gibberellins enhance IAA

[7 max]

6.

- 10 (a) 1 selective reabsorption ;
2 (pct cells have) villi / microvilli / large surface area ;
3 (pct cells have) many mitochondria ;
4 Na^+ leave pct cells ;
5 by active transport ;
6 Na^+ concentration falls in (pct) cells / Na^+ concentration gradient ;
7 Na^+ (diffuse) from lumen into (pct) cells ;
8 through, transporter / carrier, proteins ; *ignore channel proteins*
9 cotransport ;
10 of, glucose / amino acids / vitamins / chloride ions ;
11 (from pct cells) into intercellular fluid ; *linked to 10*
12 (then) diffusion into blood ; *linked to 10*
13 (normally) all glucose reabsorbed ;
14 some water reabsorbed ;
15 some urea reabsorbed ;
16 AVP ; e.g. creatinine secreted into lumen

[8 max]

*accept sodium ions but reject sodium or Na
penalise once only*

- (b) 17 ADH affects collecting duct ;
 18 binds to receptor on membrane ;
 19 increase membrane permeability (to water) / more water channels ;
 20 ref. enzyme controlled reactions ;
 21 produces (active) phosphorylase ;
 22 (which causes) vesicles with, water channels / aquaporins ; *must be linked to 23*
 23 to, move to / fuse with, (plasma) membrane ;
 24 more water flows out of collecting duct ;
 25 down / along, water potential gradient ;
 26 (then) into blood ;
 27 urine (more) concentrated / small volume of urine ;
 28 ref. negative feedback ;
 29 AVP ; e.g. role of loop of Henle in creating water potential gradient
 movement of urea increases water potential gradient [7 max]
- [Total: 15]**

7.

- 10 (a) 1 renal/Bowman's, capsule ;
 2 ref. podocytes ;
 3 (proximal convoluted tubule/distal convoluted tubule/capsule) in cortex ;
 4 proximal convoluted tubule ;
 5 loop of Henle ;
 6 (loop) in medulla ;
 7 distal convoluted tubule ;
 8 afferent arteriole ;
 9 glomerulus ;
 10 efferent arteriole ;
 11 capillary network around/proximal convoluted tubule/loop/distal convoluted tubule ;
 12 collecting duct ;
- accept points on a labelled diagram* [7 max]

- (b) 13 endothelium of, blood capillaries/glomerulus ;
- 14 more/large, gaps between endothelial cells ;
- 15 podocytes ;
- 16 large gaps between podocytes/filtration slits ;
- 17 basement membrane, selective barrier/acts as a filter ;
- 18 prevents, large protein/RMM > 68 000, passing through ;
- 19 no cells pass through ;
- 20 named molecule which is filtered ; e.g. urea/water/glucose/uric acid/creatinine/
Na⁺/K⁺/Cl⁻ ;
- 21 high, blood/hydrostatic, pressure in glomerulus ;
- 22 afferent arteriole wider than efferent arteriole ;
- 23 lower pressure in, renal/Bowman's, capsule ;
- 24 fluid forced into capsule/ultrafiltration ;

[8 max]

[Total: 15]

8.

- 10 (a) 1 nucleus in cell body ;
- 2 (long) dendron ; **R** plural
- 3 (shorter) axon ;
- 4 many mitochondria (in cell body) ;
- 5 many RER/nissl's granules, (in cell body) ;
- 6 synaptic knobs ;
- 7 detail of synaptic knob ;
- 8 (terminal) dendrites ;
- 9 Schwann cells ;
- 10 detail of myelin sheath ;
- 11 nodes of Ranvier ;
- accept points on labelled diagram*

[7 max]

- (b) 12 Na⁺ channels ~~open~~ ; **A** sodium channels
- 13 Na⁺ enter cell ; **R** enter membrane
- 14 inside becomes, less negative/positive/+40mV ~~or membrane~~ depolarised ;
- 15 Na⁺ channels ~~close~~ ; **A** sodium channels
- 16 K⁺ channels ~~open~~ ; **A** potassium channels
- 17 K⁺ move out (of cell) ; **R** of membrane
- 18 inside becomes negative ~~or membrane~~ repolarised ; **A** negative figure
max 5
- 19 local circuits/description ;
- 20 (myelin sheath/Schwann cells) insulate axon/does not allow movement of ions ;
- 21 action potential/depolarisation, only at nodes (of Ranvier)/gaps ;
- 22 saltatory conduction/AW ;
- 23 one-way transmission ;
- 24 AVP ; e.g. hyperpolarisation/refractory period [8 max]

[Total: 15]

9.

- 9 (a) *endocrine*
1. hormones ;
 2. chemical messengers ; **A** chemicals that transfer information
 3. ductless glands / (released) into blood ;
 4. target, organs / cells ;
 5. ref. receptors on cell membranes ;
 6. example of named hormone and effect ;
- nervous*
7. impulses/ action potentials ; **R** electrical, signals / current
 8. along, axon / neurones / nerve fibres ; **R** nerves **R** across
 9. synapse (with target) / neuromuscular junction ;
 10. ref. receptor / sensory neurones ;
 11. ref. effector / motor neurones ;
- differences – endocrine*
12. slow effect / ora ;
 13. long lasting effect / ora ;
 14. widespread effect / ora ;
 15. AVP ; e.g. extra detail of synapse / hormone changes triggered within cells [8 max]
- (b) 16. IAA / plant growth regulator ; **R** plant hormone
17. synthesised in, growing tips / apical buds / meristems ; **R** root tip
 18. moves by diffusion ;
 19. moves by active transport ;
 20. from cell to cell ;
 21. also, mass flow / in phloem ;
 22. stimulates cell elongation ; **R** cell enlargement
 23. inhibits, side / lateral, buds / growth ; **A** inhibits branching
 24. plant grows, upwards / taller ; **A** stem elongates
 25. auxin not solely responsible or interaction between auxin and other plant growth regulators ;
 26. AVP ; e.g. role of ABA and lateral bud inhibition
 27. AVP ; e.g. cytokinins antagonistic to IAA / gibberellins enhance IAA [7 max]
- [Total: 15]**

10.

- 11 (a)** *accept ABA for abscisic acid*
1. stress hormone ;
 2. plant secretes ABA in, high temperatures / dry conditions ;
 3. ABA binds to receptors ;
 4. on plasma membranes of guard cells ;
 5. inhibits proton pump / H^+ not pumped out of cell ;
 6. high H^+ conc / positive charge, inside cell ;
 7. K^+ diffuses out of cell ;
 8. water potential of cell increases ; **A** increase in solute potential
 9. water moves out of cell by osmosis ;
 10. volume of guard cells decreases ;
 11. guard cells become flaccid ;
 12. response very fast ;
- [8 max]
- (b)**
13. (barley) seed is, dormant / metabolically inactive ;
 14. seed absorbs water ;
 15. embryo produces gibberellin ;
 16. gibberellin stimulates aleurone layer ;
 17. to produce amylase ;
 18. amylase hydrolyses starch ;
 19. in endosperm ;
 20. to maltose / glucose ;
 21. embryo uses sugars for respiration ;
 22. energy used for growth ;
 23. gibberellins affect, gene / transcription of mRNA, coding for amylase ;
- [7 max]
- [Total: 15]**

11.

- 10 (a)** *many of these mps can be given from a labelled diagram*
1. (outer) cortex ;
 2. medulla ;
 3. pelvis ;
 4. renal artery ;
 5. renal vein ;
 6. nephron / (kidney) tubule ;
 7. renal capsule / proximal convoluted tubule (pct) / distal convoluted tubule (dct), in cortex ;
 8. loop of Henle / collecting duct (cd), in medulla ;
 9. glomerulus ;
 10. afferent & efferent arterioles;
 11. capillary network, surrounds tubule / in medulla ;
- [6 max]

(b) mechanisms

12. active transport ; **A** actively pumped / uses ATP
13. Na^+ , out of pct cells / into blood ;
14. (sets up) Na^+ ion gradient ;
15. facilitated diffusion ;
16. using protein carrier ; **A** transport protein
17. cotransport (from lumen to pct cell);
18. of, glucose / amino acids / ions;
19. osmosis ;
20. down water potential gradient ;
21. diffusion (in correct context) ;
22. down a concentration gradient ;

max 7

adaptations

23. microvilli ; **A** brush border
24. many mitochondria ;
25. tight junctions ;
26. folded, basal membrane / described ;
27. many, transport proteins / cotransporters / pumps;
28. AVP ; e.g. many aquaporins

[9 max]

[Total: 15]

12.

- 10 (a)**
1. (homeostasis is) maintenance of, constant / stable, internal environment ;
 2. irrespective of changes in external environment ;
 3. negative feedback ;
 4. receptor /appropriate named cell, detects change in, parameter / blood glucose concentration ;
 5. (receptors are) β / α , cells ;
 6. in, Islets of Langerhans / pancreas ;
 7. insulin / glucagon, released ;
 8. action taken by effector / correct action described (liver / muscle, cell) ;
 9. restoration of, norm / set point / AW ;
 10. ref. fluctuation around the norm ;

[6 max]

(b) endocrine

11. hormones ;
12. chemical messengers ; **A** chemicals that transfer information
13. ductless glands / (released) into blood ;
14. target, organs / cells ;
15. ref. receptors on cell membranes ;
16. example of named hormone and effect ;

nervous

17. impulses / action potentials ; **R** electrical, signals / current
18. along, neurones ; **R** nerves
19. synapse (with target) / neuromuscular junction ;
20. ref. receptor / effector **or** sensory / motor, neurones ;

differences – endocrine

21. slow effect / **ora** ;
22. long lasting effect / **ora** ;
23. widespread effect / **ora** ;
24. AVP ; e.g. extra detail of synapse

[9 max]

[Total: 15]

13.

Question 7

(a) *Explain the source and importance of removing nitrogenous waste products from the body.* [6]

(b) *Describe how the kidney removes metabolic wastes from the body.* [9]

(a) deamination;
ref. to ornithine cycle ;
ref. to not all urea / produced each day / always some present ;
ref. to urea ;
ref. to creatinine and uric acid ;
and ammonium ions ;
produced in liver ;
continuously / from excess amino acids ;
toxic ;
if allowed to accumulate ;
ref. to potential damage to tissues ;
ref. to not all urea / that produced each day ; [6 max]

(b) ultrafiltration ;
of blood in glomerulus ;
forming filtrate in Bowman's capsule ;
of kidney tubule ;
soluble molecules ;
including urea ;
and ammonium ions pass into filtrate ;
concentrated by removal of water (in collecting ducts) ;
ref. to formation of ammonium ions in distal convoluted tubule ;
from ammonia and protons ;
ref. to removal of metabolic water (as a waste product) ;
and osmoregulation ;
by collecting ducts ;
ref. formation of urine ;
ref. to distal convoluted tubule excrete excess acid ; [9 max]

Total [15]

14.

- 6 (a) Describe how the structure of neurones speeds up the transmission of action potentials. [6]
- (b) Explain, using a named example, how sensory receptors in mammals convert energy into action potentials. [9]

[Total: 15]

- (a)
- 1 myelin sheath / schwann cell ;
 - 2 insulates, axon / dendron ;
 - 3 impermeable to Na^+ / K^+ ;
 - 4 depolarisation only at nodes of Ranvier ;
 - 5 ref. local circuits ;
 - 6 action potentials 'jump' from node to node ;
 - 7 saltatory conduction ;
 - 8 speed increased by 50 times / 0.5 ms^{-1} to 100 ms^{-1} ;
 - 9 axons with large diameter / giant axon ;
 - 10 reduce resistance ;
 - 11 elongated, axon / dendron / neurone ;
- 6 max**

- (b)
- 12 ref. specific example ; e.g. pacinian corpuscle / rod / cone / hair cell
 - 13 correct stimulus ; e.g. touch / pressure light / sound
 - 14 detail of receptor response ; e.g. deformation of pacinian corpuscle membrane
 - 15 stimulus causes Na^+ channels to open ;
 - 16 Na^+ enters cell ;
 - 17 K^+ channels open ;
 - 18 K^+ leaves cell ;
 - 19 depolarisation ;
 - 20 receptor / generator potential ;
 - 21 greater than threshold leads to, action potential / impulses ;
 - 22 less than threshold only localised depolarisation ;
 - 23 increased stimulus leads to increased frequency of action potentials ;
 - 24 AVP ;
- apply max 8 for points 15 - 24*
- 9 max**

Total 15

15.

- 10 (a) *most of these points can be taken from an annotated diagram*
- 1 nucleus in cell body ;
 - 2 (short), dendrites / dendrons ;
 - 3 axon ;
 - 4 (axon) much longer than, dendrite / dendrons ;
must be stated / not on diagram
 - 5 cell body contains, mitochondria / RER / golgi / groups of ribosomes ;
 - 6 many mitochondria at, synaptic knob / terminal branch ;
 - 7 synaptic vesicles ;
 - 8 neurotransmitter / named neurotransmitter ; *linked to 7*
 - 9 Schwann cells / myelin sheath ;
 - 10 nucleus in Schwann cell ; **R** nucleus in myelin sheath
 - 11 node of Ranvier ;
 - 12 AVP ; e.g. motor end plate / (dendrites) have receptors (for neurotransmitters) [7 max]
- (b)
- 13 Na⁺ channels open ; **A** sodium channels
 - 14 Na⁺ enter cell ; **R** enter membrane
 - 15 inside becomes, less negative / positive / +40mV / depolarised ;
 - 16 Na⁺ channels close ; **A** sodium channels
 - 17 K⁺ channels open ; **A** potassium channels
 - 18 K⁺ move out (of cell) ; **R** of membrane
 - 19 inside becomes, negative / repolarised ; **A** negative figure [5 max]
 - 20 local circuits / description ;
 - 21 (myelin sheath / Schwann cells) insulate axon / does not allow movement of ions ;
 - 22 action potential / depolarisation, only at nodes (of Ranvier) / gaps ;
 - 23 saltatory conduction / AW ;
 - 24 one-way transmission ;
 - 25 AVP ; e.g. hyperpolarisation / refractory period *related to 24* [3 max]

[Total: 15]

16.

10	(a)	1	strong stimulus in receptor / AW ;	[7 max]
		2	action potential / impulses, along sensory neurone ;	
		3	dorsal <u>root</u> of spinal nerve ;	
		4	into spinal cord ;	
		5	synapse with intermediate neurone ;	
		6	(then) motor neurone ;	
		7	action potential / impulses, to effector ;	
		8	action potential / impulses, to brain ;	
		9	response ; e.g. knee jerk 5 max can be on diagram	
		10	fast / immediate ;	
		11	stops / limits, damage / danger ;	
		12	automatic / no conscious thought ;	
		13	innate / stereotyped / instinctive ;	

	(b)	14	<u>Schwann</u> cells ;	[8 max]		
		15	wrap around axon ;			
		16	sheath mainly lipid ;			
		17	(sheath) insulates axon (membrane) ;			
		18	Na ⁺ / K ⁺ , cannot pass through sheath / can only pass through membrane at nodes ;			
		19	<u>depolarisation</u> (of axon membrane) cannot occur where there is sheath / only at nodes of Ranvier ;			
		20	local circuits between nodes ;			
		21	action potentials 'jump' between nodes ;			
		22	<u>saltatory conduction</u> ;			
		23	<u>increases</u> speed / reduces time, of impulse <u>transmission</u> ;			
		24	up to 100 ms ⁻¹ ;			
		25	speed in non-myelinated neurones about 0.5 ms ⁻¹ ;			
					[Total: 15]	

17.

10	(a)	1	action potential / depolarisation, reaches <u>presynaptic membrane</u> ;	[9 max]
		2	(Ca ²⁺) channels open in <u>presynaptic membrane</u> / <u>presynaptic membrane</u> becomes more permeable to (Ca ²⁺) ; R calcium / Ca / Ca ⁺	
		3	Ca ²⁺ (flood) into presynaptic, neurone / knob ; R membrane	
		4	(this causes) vesicles of, acetylcholine / ACh ;	
		5	(to) move towards presynaptic membrane / (to) fuse with presynaptic membrane;	
		6	ACh released into synaptic cleft / exocytosis of ACh ;	
		7	ACh <u>diffuses</u> across (cleft) ;	
		8	ACh binds to receptor (proteins) / AW ;	
		9	on <u>postsynaptic membrane</u> ;	
		10	proteins change shape / channels open ;	
		11	sodium ions (rush) into postsynaptic neurone ; R membrane	
		12	postsynaptic <u>membrane</u> depolarised ;	
		13	action potential / nerve impulse ;	
		14	action of <u>acetylcholinesterase</u> ;	
	(b)	15	ensure one-way transmission;	[6 max]
		16	receptor (proteins) <u>only</u> in postsynaptic, membrane / neurone ; <i>ora</i>	
		17	vesicles <u>only</u> in presynaptic neurone ; <i>ora</i>	
		18	adaptation / ACh amount reduces due to overuse of synapse ;	
		19	wide range of responses ;	
		20	due to interconnection of many nerve pathways ;	
		21	inhibitory synapses affect other synapses ;	
		22	involved in memory / learning ;	
		23	due to new synapses being formed ;	
		24	summation / discrimination ;	
				[Total: 15]

Q18.

- 11 (a)
1. axon phospholipid bilayer impermeable to K^+ / Na^+ ;
 2. sodium – potassium pump ;
 3. detail of sodium-potassium pump ; e.g. transmembrane / globular / ATP binding site
 4. active process / ATP used / energy needed ;
 5. 3 Na^+ (pumped) out / 2 K^+ (pumped) in ;
 6. K^+ diffuse out / Na^+ diffuse in ;
 7. through, protein channels transport proteins ;
 8. more K^+ channels open than Na^+ channels ;
 9. therefore, membrane more permeable to K^+ or more K^+ leave than Na^+ enter (axon) ;
 10. inside relatively more negative than outside ;
 11. $-65mV$; **A** $-70mV$
 12. *idea* of leaking K^+ responsible for resting potential / AW ;
 13. electrochemical gradient ;
 14. voltage-gated channels closed ;
- [9 max]

(b) *general*

15. respond to stimuli / AW ;
16. (some) receptors are the ends of sensory neurones ;
17. (some) receptors are cells ;
18. they are energy transducers ;
19. stimulus causes sodium ion channels to open ;
20. sodium ions enter cell ;
21. depolarisation ;
22. receptor / generator, potential ;
23. if (receptor potential) greater than threshold then action potential generated / all or nothing principle described ;
24. increased stimulus strength leads to increased frequency of action potentials ;

examples – allow any two below

<i>receptor</i>	form of energy detected
rods / cones	light ;
taste buds / olfactory cells	chemical ;
Pacinian \ Meissner's, corpuscle	pressure / touch ;
Ruffinis endings	heat ;
proprioceptors	mechanical displacement ;
hair cells in semicircular canals	movement ;
hairs cells in cochlea	sound ;

[max 2]

[6 max]

[Total: 15]

19.

- 10 (a) 1 PII absorbs light ;
 2 enzyme (in PII) involved ;
 3 to break down water / AW ;
 4 $2\text{H}_2\text{O} \longrightarrow 4\text{H}^+ + 4\text{e}^- + \text{O}_2$;
 5 oxygen is produced ;
 6 used by cells for (aerobic) respiration ;
 7 or released (out of plant) through stomata ;
 8 protons used to reduce NADP ;
 9 with electrons from PI ;
 10 reduced NADP used in, light independent stage / Calvin cycle ;
 11 to convert GP to TP ;
 12 electrons also used in ETC ;
 13 to release energy for photophosphorylation ;
 14 to produce ATP ;
 15 electrons (from PII) go to PI ;
 16 ref. re-stabilise PI ;
- [10 max]

- (b) 16 gibberellin is a, plant growth regulator / plant hormone / plant growth substance ;
 17 stimulates cell division ;
 18 stimulates cell elongation ;
 19 detail of cell elongation ; e.g. changes plasticity of cell wall
 20 plant grows tall ;
 21 apply gibberellin to dwarf plants and they grow taller / gibberellin promotes bolting of some rosette plants ;
 22 ref. inactive and active forms ;
 23 dwarf plants, lack active form / have inactive form, of gibberellin ;
 24 (dominant) allele causes synthesis of enzyme ;
 25 (enzyme) catalyses the production of the active form of gibberellin ;
 26 recessive allele only inactive form of gibberellin formed / dominant allele results in active form of gibberellins ;
 27 AVP ; e.g. ref. to different forms of gibberellins / there is interaction between / gibberellin and other plant growth regulators
- [5 max]

[Total: 15]

20.

- 9 (a)
1. glucagon binds to receptors in cell surface membrane (of liver cell) ;
 2. receptor changes conformation ;
 3. G-protein activated ;
 4. adenylate cyclase activated ;
 5. ATP converted to cyclic AMP / cyclic AMP made ;
 6. (cyclic AMP is) second messenger ;
 7. (cyclic AMP) activates kinase protein ;
 8. ref. enzyme cascade ;
 9. ref. phosphorylase enzyme(s) / glycogen phosphorylase ;
 10. glycogen broken to glucose ;
 11. glucose, diffuses / passes out, of (liver) cell (into the blood) ;
 12. through GLUT2 transporter proteins ;
 13. AVP ; e.g. ref. to stimulating gluconeogenesis
- [max 9]

(b) *method*

1. stick dipped into urine ;
2. glucose oxidase (on stick) reacts with glucose (in urine) ;
3. forms gluconolactone ;
4. and hydrogen peroxide ;
5. (hydrogen peroxide) reacts with chromogen (on stick) ;
6. catalysed by peroxidase enzyme ;
7. colour produced matched against chart ; (*max 4*)

advantages

8. electronic biosensor does not involve colour matching ; ora
A ref to subjectivity of results from dip sticks
9. gives a specific reading, not a range of values (if not an exact match to a colour) ; ora
10. biosensor gives a digital reading so no need to interpret a colour chart ;
11. biosensor can be re-used again ; ora (*max 3*)

[max 6]

[Total: 15]

