CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



MARK SCHEME

15 CONTROL AND COORDINATION

SCORE	PERCENTAGE
/	%

STEMUP

These questions belong to CIE, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Cambridge International (CIE). They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with CIE and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. CIE has not endorsed, approved or been involved in the production of it. CIE and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

CIE publishes its past papers, mark schemes and examiner reports. Always check the current syllabus at cambridgeinternational.org before you revise.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

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.

STEMUP.CO.UK

(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 pincocytosis – 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.

STEMUP.CO.UK

Question			Marks
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 ;;	3 max
	(b)	(in / from) CNS / brain / spinal cord ;	
		ref. to synapse with intermediate / relay neurone ;	
		ref. to neuromuscular junction / (neuro)transmitter released ;	
		ref. response ;	3 max
	(c)	ref. synapses ;	
		vesicles containing transmitter only found on preSM ;	
		receptors for transmitter only found on postSM ;	
		ref. to refractory period / hyperpolarisation ;	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.

STEMUP.CO.UK

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 **only** in, pre-synaptic knob / neurone ; receptors found **only** 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. ß cells of, Islets of Langerhans / pancreas, detect increase ;
3. ref. K^+ channels close / role of Ca^{2+} ;
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.

STEMUP.CO.UK

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* FEV_1 *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 FEV_1 than males ;
3. use of figures ; e.g. males FEV_1 49 whereas female FEV_1 42
or female FEV_1 1.16 times lower than male FEV_1 [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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

6 (a) (i) 17.9;;

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

(ii) *fluid can pass through glomerular capillaries because* (max 3)
1. fenestrations in capillary <u>endothelium;</u> **A** hole / pores / gaps

2. <u>basement membrane</u> 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) <u>microvilli;</u> [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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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) NH_2 / 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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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** ; *accept **C** lower ψ than **B*** *accept ψ gets more negative as fluid moves down descending limb*	
		2	comparative figs ;	
		3	water moves out by, diffusion / osmosis ;	
		4	into, medulla tissue / tissue fluid ;	
		5	**D** / **E**, higher ψ than **C** ; *accept ψ gets less negative as fluid moves up ascending limb*	
		6	comparative figs ;	
		7	Na^+ / Cl^-, move out ;	
		8	into, medulla tissue / tissue fluid ;	
		9	by active transport ;	
		10	**A** and **E** same ψ / AW ; *penalise once for no units* *allow **either** 4 **or** 8*	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 ; *accept correct values for mm, cm or m*	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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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 <u>basement</u> 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. <u>most</u> urea stays in urine ; **R** all urea stays

5. other substances are reabsorbed ; [2 max]

[Total: 9]

Q20.

6	(a)	(i)	*ignore refs to function* <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]

STEMUP.CO.UK

	(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 animal insulin ;	[3 max]
				[Total: 7]

Q21.

STEMUP.CO.UK

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. $\frac{110 - 30}{30}$ (× 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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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]

© University of Cambridge International Examinations 2011

(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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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]

STEMUP.CO.UK

(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]

STEMUP.CO.UK

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

STEMUP.CO.UK

(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]

STEMUP.CO.UK

(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]

STEMUP.CO.UK

(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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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]

STEMUP.CO.UK

(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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

10	(a)	1	strong stimulus in receptor / AW ;	
		2	action potential / impulses, along sensory neurone ;	
		3	dorsal root 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 ;	[7 max]
	(b)	14	Schwann cells ;	
		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	depolarisation (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	saltatory conduction ;	
		23	increases speed / reduces time, of impulse transmission ;	
		24	up to 100 ms^{-1} ;	
		25	speed in non-myelinated neurones about 0.5 ms^{-1} ;	[8 max]
				[Total: 15]

17.

STEMUP.CO.UK

10	(a)	1	action potential / depolarisation, reaches presynaptic membrane ;	
		2	(Ca^{2+}) channels open in presynaptic membrane / presynaptic membrane 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 diffuses across (cleft) ;	
		8	ACh binds to receptor (proteins) / AW ;	
		9	on postsynaptic membrane ;	
		10	proteins change shape / channels open ;	
		11	sodium ions (rush) into postsynaptic neurone ; **R** membrane	
		12	postsynaptic membrane depolarised ;	
		13	action potential / nerve impulse ;	
		14	action of acetylcholinesterase ;	[9 max]
	(b)	15	ensure one-way transmission;	
		16	receptor (proteins) only in postsynaptic, membrane / neurone ; *ora*	
		17	vesicles only in presynaptic neurone ; *ora*	
		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 ;	[6 max]
				[Total: 15]

Q18.

STEMUP.CO.UK

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

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

[max 2]
[6 max]

[Total: 15]

19.

STEMUP.CO.UK

10 (a) 1 PII absorbs light ;
2 enzyme (in PII) involved ;
3 to break down water / AW ;
4 $2H_2O \longrightarrow 4H^+ + 4e^- + O_2$;
5 <u>oxygen</u> 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.

STEMUP.CO.UK

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]

STEMUP.CO.UK