1. (a) (apical / terminal) bud is source of auxin;
auxin inhibits growth of side shoot / ora;
remove bud and auxin concentration drops;
(this allows) cell division / elongation to take place;
ecf – marking points 2 and 3 if growth regulator or hormone used instead of auxin max 3

(b) *award two marks if correct answer (80%) is given*

award one mark for calculation if answer is not correct

(90 – 50 = 40) 40 / 50 × 100;
80%;; 2

(c) no growth until day, 8 / 10;
auxin moves out of paste / AW;
inhibits growth;
growth occurs after, 8 / 10, days;
because auxin, levels fall / 'used up'; 3

[8]

2. (a) (i) due to mutation; **A** *named mutation*
has changed, gene/allele/base sequence/DNA;
random;
irradiation/other named mutagen;
genetically engineered;
altered, mRNA/enzyme/protein;
selective breeding; max 2

(ii) light <u>intensity</u>;
carbon dioxide;
water/humidity;
temperature;
mineral content of soil/potting compost; **R** *nutrients*
pH;
lighting regime; max 2

(b) *wild type*
no significant/very little, difference;
those with water taller/ora;
18 day result an anomaly;
ref to figures from table; *need two figures at same age with correct units*

dwarf
those with gibberellin taller;
difference greater as they get older;
still shorter than wild type;
ref to figures from table; *need two figures at same age with correct units*

only penalise lack of units once

calculation of % difference between treatments for either wild type or dwarf; max 5

(c) dwarf unable to produce (active) GA/ora;
dwarf lacks enzyme for (active) GA formation/ora;
details of why dwarf lacks enzyme; **A** *has, recessive/mutant allele* max 2

[11]

3. light / daylength;
gravity;
water / humidity;
touch;
chemicals; **R** carbon dioxide
temperature; **A** heat 3 max

[3]

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

[5]

5. (i) depends on plant growth regulators ; **A** plant growth substances / plant hormones
named plant growth regulator ;
produced in a variety of tissues ;
may have effect at a distance ;
move, cell to cell / by diffusion / by active transport / via vascular tissue
via a named vascular tissue / via plasmodesmata ;
different effects in different tissues ;
different effects when acting together ; 2 max

(ii) coordinate, growth / development / activities, of different parts ;
respond to internal changes ;
respond to, external / environmental / e.g. environmental, change ;
AVP ; e.g. comparison with animals 2 max

[4]

6. (a) (i) *penalise lack of units once in answer*

increase in, elongation / length, with auxin concentration up to, 1.4 / 1.8, μmol dm^{-3};

peak / maximum, at 1.4 μmol dm^{-3};
decrease between 1.4 and 1.8 μmol dm^{-3};
data quote with any 2 points;
linear / directly proportional, before 1.2 or linear inversely proportional after 1.5;
R length decreases max 3

(ii) *mark first three factors*
temperature;
age of stems;
light, intensity / wavelength;
concentration of dissolved, ions / salts;
(concentration of) other named growth substance;
AVP;;;

e.g. pH, genotype (of plant), concentration of named metabolite (e.g. glucose / amino acids), O_2 concentration, CO_2 concentration

R 'amount of' max 3

(b) cell, enlargement / elongation; **R** stem
enzyme synthesis;
vacuolation;
increase in plasticity of cell walls;
(cell) wall softened by, H^+ / lowered pH;
high concentration of auxin causes inhibition of growth;
AVP; e.g. cell division, mitosis, replication, cytokinesis, increase in number of cells
R ref to uptake of nutrients max 2

(c) *assume answer is about plant growth substances unless stated otherwise*
treat refs to target, cells / tissue(s) and external stimuli as neutral

growth substances produced by, dividing cells / meristems;
ora hormones produced by, islets of Langerhans / alpha cells / beta cells / endocrine gland / pancreas
growth substances move, in phloem / in xylem / from cell to cell;
ora hormones / named hormone(s), move in blood
growth substances usually produce a permanent change in the plant;
ora hormones produce reversible change in blood sugar
(GS) not homeostatic / no negative feedback; *ora* for hormones
R positive feedback **A** description of negative feedback
(GS) not protein / not polypeptide; *ora* insulin / glucagon, are proteins
AVP; max 2

[10]

7. (a) from below / ventral / AW; **A idea of brain being seen from below**
R *upside down, looking upwards* 1

(b) (i) **reject choice of answers, accept any reasonable spelling**
A cerebrum / cerebral hemisphere / cerebral cortex / frontal lobe; ignore refs to right or left **R** *incorrect lobe*
B pituitary (gland); **R** *hypothalamus*
C cerebellum;
D medulla (oblongata) 4

(ii) control of breathing;
control of heart rate;
control of circulation;
control of swallowing / salivation / vomiting reflex; 2

(c) *If blood hormone concentration rises*

inhibits output of trophic hormones by pituitary gland;
which inhibits output of hormones by endocrine glands;
blood hormone concentration falls to normal levels;
ref. negative feedback;
ORA max 2

[9]

8. (i) **A** scapula
B humerus
C ulna
D radius; *2 or 3 correct = 1 mark, 4 correct = 2 marks* 2

(ii) *ligament*
holds bones together/prevents dislocation;
high tensile strength;
flexible;

cartilage
ends of bones;
low friction/smooth/slippery;
ref. shock absorber/stops bones rubbing together; 4 max

(iii) biceps/brachialis;
(contraction) pulls on radius;
flexor (muscle)/bends arm/pulls lower arm up; *2 max*

triceps;
(contraction) pulls on end of ulna;
extensor (muscle)/straightens arm/pulls lower arm down; *2 max* 3 max

[9]

9. (calcium ions/Ca^{2+}) released from sarcoplasmic reticulum;
bind to troponin;
troponin changes shape;
troponin/tropomyosin, moves;
myosin binding site exposed;
myosin head binds (to actin); 3 max

[3]

10. *(Alzheimer's)*
1 reduced uptake of isotope/less positrons emitted/less glucose in brain
2 cells;
3 reduced blood flow;
4 reduced brain activity;
5 reduced respiration in cells;
AVP; e.g. parts of brain *accept reverse argument for all points* 3 max

[3]

11. (i) ***R** if refer to body muscles*

less, oxygen / nutrients / sugars / fatty acids, supplied (to heart muscle);
slower removal of carbon dioxide;
less, respiration / ATP made;
muscle contraction is weaker / cannot pump as forcefully / contraction stops;
death of heart muscle;
makes (remaining) heart muscle work harder / hypertrophy; max 3

(ii) angina / chest pain when, exercising / exertion;
reduced ability to perform exercise;
breathlessness;
myocardial infarction / heart attack / cardiac arrest; max 2

[5]

12. (i) **A** cartilage;

B synovial fluid; 2

(ii) reduces friction / stops bones rubbing together; **R** no friction
shock absorber / cushions bone;
keeps (joint) lubricated / AW;
(fluid) provides nutrients to, chondrocytes / cartilage; **A** cells 3 max

[5]

13. 1 cone cells absorbs light;
2 iodopsin changes form / AW;
3 ref to three different types of cone;
4 hyperpolarisation / –40mV to –70mV;
5 stops releasing transmitter;
6 bipolar / ganglion, cells;
7 action potentials / impulses, along optic nerve; *max 4*

8 to, visual sensory area / sensory cortex;
9 then visual association area;
10 ref to occipital lobe;
11 then temporal lobe;
12 where word is identified from memory / AW;
13 AVP; e.g. glutamate,
optic chiasma,
inhibitory action of transmitter 6 max

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

[7]

14. *chimpanzees*
arboreal / AW;
co-ordination of movement more complex / chimps perform more complicated tasks / AW; ora
more neurones required / AW; ora
AVP; e.g. hand-eye co-ordination 2 max

[2]

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

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

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

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

[10]

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

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

[9]

17. ref. faster / rapid / AW ;

AVP ; e.g. survival 1 max

[1]

18. (i) corpus callosum ; 1

(ii) cerebellum ;
medulla (oblongata) ;
hypothalamus ;
cerebrum / cerebral cortex ; 4

[5]

19. acetylcholine – neurotransmitter / AW ;
acetylcholinesterase – breaks down ACh / enables repolarisation of post synaptic membrane ;

[2]

20. (i) stimulus causes, increase in tension / twitch ;
fluctuation in tension / AW ;
overall increase in tension ;
AVP ; e.g. ref to figs (must have time units) 2 max

(ii) state of constant, contraction / tension ; **R** paralysed alone
correct ref. to heart ;
difficulty in ingestion / jaw muscles fixed ;
rib / intercostal, muscles remain contracted ;
difficulty in, lung ventilation / breathing ;
AVP ; e.g. fever / headache 3 max

[5]

21. **1** ATP produced ;
2 Na^+ *or* K^+ pump / maintains concentration gradient / repolarisation ;

transmission of impulses
3 acetylcholine / neurotransmitter formation ;
4 vesicle formation ;
5 movement of vesicles ;
6 exocytosis / vesicles fuse with membrane ;
7 ref. active transport (of ACh / Ca^{2+}) ;
8 AVP ; e.g. ref to microtubules / endocytosis 4 max

muscular contraction
9 ATP attaches to myosin head / ATPase ;
10 hydrolysis of ATP / ATP → ADP + P ;
11 myosin head tilts / shortening of sarcomere ;
12 ATP / energy, required for detachment of myosin head ;
13 from actin ;
14 calcium pumps in sarcoplasmic reticulum ;
15 synthesis of protein (for repair, growth) ;
16 AVP ; 5 max 8 max

QWC – clear, well-organised using specialist terms ; 1

award the QWC mark if four of the following are used in correct context
acetylcholine, actin, myosin, sarcoplasmic reticulum, exocytosis, hydrolysis, repolarisation

[9]

22. surrounded by meninges ;
cerebrospinal fluid ;
absorbs shocks ;
brain protected by, cranium / skull ;
spinal cord protected by vertebrae ; 3 max

[3]

23. (a) *cerebellum*

coordination of, (voluntary) movement / skeletal muscles;
(control of) posture;
(control of) balance;
AVP; max 2

medulla oblongata

initiation / control of, breathing rate;
control of heart rate; **R** initiation of heart rate
control of blood pressure;
control of peristalsis (in alimentary canal);
AVP; max 2

(b) (i) build up of, tau / protein; 1

(ii) secretion of / high levels of, Aβ42 / beta amyloid 42 / abnormal Aβ; **R** Aβ40 1

(c) similar shape to, acetylcholine / ACh;
binds to / enters, active site;
prevents ACh entry;
competitive (inhibitor);
different shape to ACh;
enters / binds, but not at active site;
allosteric / indirect;
change in, tertiary structure / shape of active site;
non-competitive (inhibitor); max 3

(d) prevents ACh breakdown / increase ACh level;
ACh binds to, proteins / receptors;
on post-synaptic membrane;
depolarisation / action potential / impulse (produced;
activates memory circuit / AW; max 2

(e) control group;
given, placebo / tablet / injection / no drug;
idea of 'double-blind' trial, i.e. neither patient nor doctor aware of which treatment each patient receives;
random assignment of each patient to one group;
similar severity of symptoms before trial;
control of age;
control of gender;
control of diet;
control of drug, dosage / administration;
not taking any other, drug / medication;
ref to suitable sample size;
AVP; max 3

[14]

24. (a) dissolve / destroy, cell membranes (idea); 1

(b) block the receptor / prevent ACh from binding;
no longer able to stimulate post synaptic membrane;
muscle fibres, not stimulated (by nerve fibres) / do not contract; **A** tetany idea
AVP; e.g. ref to lack of synaptic transmission max 2

(c) toxin acts too fast, for immunity / antitoxin to develop (idea);
human unlikely to have been, bitten before / exposed to toxin or antigen;
one / a / few (immature), lymphocyte(s) / stem cell(s)
(able to bind the toxin);
these must be stimulated to divide / ref to clonal selection *or* clonal expansion;
mitosis takes too long;
has no memory cells;
AVP; max 2

(d) more, antibody-secreting cells / B lymphocytes, produced;
enough / more, antitoxin produced; (idea of good yield)
faster / goes on for longer;
secondary response;
more mitosis (of antibody producing cells);
second injection of toxin would result in clonal expansion;
ref memory cells;
AVP; e.g. large dose would kill the horse max 3

(e) antibody / antitoxin, only remains in, blood / body, for short time;
acquired immunity / passive immunity;
person not themselves producing any antitoxin;
no clonal selection;
no memory cells;
immune system will (soon) reject / destroy the (foreign) horse antibody;
AVP; e.g. further detail explaining why immune system not stimulated
different snakes have different toxins max 2

[10]

25. (cortex is group of), specialised / similar / same, cells / neurones;
performing, similar / same / named, function;
brain is made of, more than one / different tissue(s);
carrying out more than one function / AW;

[3]

26. planning a task;

[1]

27. ulna;

[1]