1. (a) (i) (p)CO_2/blood pressure/H^+/pH/stretch; **I** O_2 1

(ii) Medulla; 1

(iii) Sympathetic system cardiac accelerator nerve / links CNS to SA node/pacemaker stimulated/increase rate of impulses;
noradrenaline released/stimulating SA node; **A** RA or change 2

(iv) Receptors detect CO_2 too high/blood pressure too low;
(CNS) increases heart rate to decrease/increase pCO_2/blood pressure;
cancels stimulus/receptor ceases to be stimulated; 2

(b) (i) Reduced/more O_2 unloaded; 1

(ii) Exercise lowers pO_2 / eq; to zero;
decreases saturation of Hb; to zero/unloads all O_2;
increase of temperature causes faster increase; max 4

(c) (i) points (close to or on a line) in correct direction;
between 1.5 and 6 litres; 2
A any vertical separation of points
A all points on the line
A points starting on bottom of Y axis
R obvious curves
R line with no curves
R line with no point
Ignore the line – look at the points

(ii) Surface area of respiratory lining proportional to vital capacity/more alveoli; 1

(d) Increase of adrenaline; **R**. urine adrenaline
increase available glucose;
and energetic drive/eq;
increase of blood to muscles/away from skin; 3

(e) (i) Required for synthesis of creatine phosphate/ C + ATP $\rightarrow$ CP + ADP;
in muscles;
provides ATP quickly/ in explosive sports; max. 2

(ii) Creatine found in meat/low (**A** none) concentration in vegetables; 1

[20]

2. (a) correct position of AVN; (at the top of Purkyne tissue) 1

(b) (i) pressure in ventricles increasing (so ventricle contracting);
QRS occurs before pressure increase/ventricle contraction/
contracts after S / 0.14s; 2

(ii) corresponds to time when heart is relaxed/filling with blood/
diastole / not contracting; 1

(c) (i) 0.2s ; 1

(ii) line below left ventricle;
in phase with left ventricle; 2

[7]

3. (a) (i) more (nerve) impulses;
along sympathetic neurones /pathway;
to SAN;

(ii) more nerve impulses;(award once only)
along parasympathetic neurones /pathway;
to SAN;(award once only) max 4

(b) (i) 70 x 72 = 5040 plus method shown for calculating percentage;
$756cm^3$; 2

(ii) (increase in size of heart) increasing amount of blood pumped out /
Increasing stroke volume; 1

[7]

4. (i) (cardiac) muscle is myogenic;
sinoatrial node/SAN;
wave of depolarisation/impulses/electrical activity (across atria);
initiates contraction of atria
atrioventricular node/AVN;
bundle of His/purkyne tissue spreads impulse across ventricles;
ventricles contract after atria/time delay enables ventricles to fill; 5 max

(ii) pressure receptors;
in aorta/carotid artery/sinus;
send impulses (*award once only*);
to medulla;
send impulses (*award once only*);
along parasympathetic / vagus pathway;
slows heart rate; 5 max

[10]

5. (a) (i) Sympathetic;
Parasympathetic/ vagus; 2

(ii) Medulla / cardiovascular centre 1

(b) (i) One to accelerate, one to decelerate heartbeat/ excite v inhibit 1

(ii) (Sympathetic) releases (nor)adrenalin/ norepinephrine to accelerate;
(Parasympathetic) releases acetylcholine to decelerate; max 2

[6]

6. (a) (i) Several rod cells to each neurone/bipolar cell;
additive effect of light striking several rod cells;

(ii) Each cone is connected to a specific neurone;
light striking cone cells generating separate action potentials; max 3

(b) Objects viewed directly are focused on fovea;
mainly cones not rods in fovea/most rods lie outside fovea
dim objects will not stimulate cones; max 2

[5]

7. (a) (Pressure) deforms / opens (sodium) channels; *reject any other ion*
Sodium ions enter;
Causing depolarisation;
Increased pressure opens more channels / greater sodium entry; 2 max

(b) (i) Arrow (labelled K) pointing out of node; 1

(ii) Same amplitude of action potentials as in medium pressure graph
but of a greater frequency; 1

(c) (i) Answer between 0.7 and 0.9(ms); 1

(ii) Correct answer based on candidate's response to (c) (i)
(i.e. 80 divided by answer to previous question)
Accept correct working shown with no final answer 1

(d) (i) Action potential / impulse unable to "jump" from node to node /
no saltatory conduction / action pd / impulse must pass through
a greater amount of membrane;
Slows / prevents impulse; 2 max

(ii) Greater entry of sodium ions / greater exit of K^+ in
de-myelinated neurone;
Ref. to active transport / ref. to ion pumps; 2

(e) (i) Kinesis; *ignore prefix* 1

(ii) Response is non-directional / related to intensity of the stimulus; 1

[12]

8. (a) Hot receptors in skin;
nervous impulse;
to hypothalamus;
blood temperature monitored;
heat loss centre involved;
vasodilation / dilation of arterioles;
more blood to surface / heat lost by radiation;
piloerector muscles relax;
hairs flatten on skin surface;
less insulation;
sweating initiated / increased;
panting / licking;
evaporation removes latent heat;
drop in metabolic rate / use less brown fat;
accept long term changes such as less fat deposition;
thinner fur;
migration;
accept one behavioural process; max. 8

(b) Rapid / slow;
direct / broadcast;
short lived/ long term;
mainly electrical ; chemical;
delivery via nerves / blood vessels;
cause depolarisation of target cell membrane /
receptors in membrane of target cell; max. 4

[12]

9. (a) Rapid response to a stimulus;
involuntary/invariable/innate;(any 2) 3

(b) Three neurones, one in ventral root, one in grey matter of spinal cord, one in dorsal root;
Names of all three neurones correct;
Sensory in dorsal root, motor in ventral root; 3

[6]

10. (a) (touch / pressure) receptors in mouth stimulated;
impulses in nerves / neurones to;
coordinator / brain; (*not just c.n.s.; via spinal cord disqualifies*)
salivary glands as effector / effector secretes saliva. 4

(b) chemical, (not electrical);
slower (to take effect / transmission);
longer-lasting;
delivered by blood, (not nerves);
broader targeting. 3

[7]

11. (a) In the light (accept converse for dark)
1. Faster/further (slower/ shorter distance)/ larger area;
2. Less turns (more turns); 2
(*Reject straighter lines*)

(b) (i) Kinesis; 1

(ii) Allows woodlouse to stay in/ to find favourable environment;
Avoids predators; prevent desiccation/keeps gas exchange surface moist;
near food source; 2

[5]

12. (a) (i) arc shows 3 neurones;
(*3 distinct neurones, one of which is in the grey matter, with correct route through dorsal and ventral roots and indication of synapses. Ignore position of cell bodies.*) 1

(ii) neurones labelled sensory, relay/intermediate, motor; 1

(iii) muscle labelled as effector; 1

(b) impulses to brain;
(*reject signal, message, information*)
sensory areas (in brain);
(in) cerebral hemispheres;
interpretation/processing by association area; 3 max

[6]