NERVOUS COORDINATION

ANSWERS & MARK SCHEMES

QUESTIONSHEET 1

(a) (i) motor; **1**

(ii) A - dendrite; B = Nissl granules; C = node of Ranvier; D = axon; E = myelin sheath;
F = Schwann cell; G = motor end plate/neuromuscular junction; **7**

(b) A. receives action potentials from preceding/relay/intermediate/connector neurones;
E. insulates axon causing saltatory conduction;
F. secretes the myelin; **3**

(c) when action potentials arrive at the synapse they cause calcium ions to leak/enter into the synaptic knobs;
(this) causes release of acetylcholine from the synaptic knobs;
this attaches to receptors on the sarcolemma;
making it permeable to sodium ions;
so that they rush into the fibre causing depolarisation; **max 4**

TOTAL 15

QUESTIONSHEET 2

(a) A = cerebral hemisphere; B = cerebellum; C = pons; D = medulla oblongata; **4**

(b) A. conscious thought/speech/storing memory/intelligence/any other valid example;
B. coordinating balance/posture and movements;
C. forms a 'bridge' between the medulla and the midbrain enabling relaying of impulses;
D. entry and exit of cranial nerves/ contains cardiac control centre/breathing control centre/any other valid example; **4**

(c) increases area and volume of cerebral cortex;
thus more nerve cells can be contained;
thus increasing abilities/control powers/intelligence; **max 2**

TOTAL 10

QUESTIONSHEET 3

(a) (i) A = grey matter; B = white matter; C.= dorsal root ganglion; **3**

(ii) A consists of non-myelinated relay neurones running across the spinal cord;
B consists of myelinated relay neurones running up and down the spinal cord; **2**

(b) (i) X = motor neurone; Y = sensory neurone; Z = relay neurone;
direction = y to z to x; **4**

(ii) a tap on the patella tendon/sudden pressure on the patellar tendon/hammer blow or equivalent; **1**

(c) Any three of: blinking/pupil reflex/accommodation/ coughing/sneezing/salivation/tear secretion/any other valid example;;; **3**

TOTAL 13

QUESTIONSHEET 4

motor; sensory; sodium; sodium pump; negative; stimulus; sodium; threshold; action potential; myelin; nodes; faster; acetylcholine; calcium;

TOTAL 14

QUESTIONSHEET 5

(i) medulla (oblongata); (ii) hypothalamus; (iii) cerebellum; (iv) thalamus/optic areas of cerebral cortex;
(v) corpus callosum; (vi) hypothalamus; (vii) hypothalamus;

TOTAL 7

QUESTIONSHEET 6

(a) enclosed within the bony cranium and vertebrae;
surrounded by tough meninges/dura mater;
bathed in cerebrospinal fluid which contains all white blood cells and any antibodies; **3**

(b) speeds up the rate of impulse passage in myelinated neurones;
sensory neurones are myelinated thus enabling rapid input of information from receptors to central nervous system;
voluntary motor neurones are myelinated thus allowing rapid response of skeletal muscles; **3**

(c) sympathetic outflow from CNS is via thoracic and lumbar spinal nerves whereas outflow of parasympathetic is via cranial nerves and sacral spinal nerves;
sympathetic involves nor-adrenaline as neurotransmitter whereas parasympathetic involves only acetylcholine;
sympathetic tends to increase activities whereas parasympathetic tends to decrease them; **max 2**

TOTAL 8

QUESTIONSHEET 7

(a) axon membrane is impermeable to sodium ions but permeable to potassium ions;
sodium pumped out of axon to surrounding tissue fluid;
thus there is a lack of positive ions within the axon which tends to draw potassium ions in;
this inflow of potassium is also supplemented by a weak potassium pump;
however, inflow of potassium ions cannot quite catch up with outflow of sodium ions;
and so inside stays negative with respect to outside;
ATP required to allow pumps to work; **max 5**

(b) (i)

Receptor	Position in body	Stimulus	
cone	retina		;
	under the skin	pressure	;
	hypothalamus	change in blood osmotic pressure	;
rod	retina		;
beta-cell	islets of Langerhans/pancreas		;
	under skin/hypothalamus	temperature change	; **6**

(ii) changes one form of energy to another/example; **1**

TOTAL 12

QUESTIONSHEET 8

(a) (i) the smallest stimulus that is capable of setting up an action potential; **1**

(ii) put arrow on or near to 0.7 millisecond; **1**

(iii) at the resting potential; **1**

(b) (i) stimulus makes axon membrane become permeable to sodium ions;
these flood into the axon along the diffusion gradient;
thus polarity of membrane reverses to give action potential; **max 2**

(ii) too many positive ions are inside the axon at this stage;
membrane is now super permeable to potassium which floods out of axon along (electrical) gradient;
thus potential across membrane reverses back to resting value, (although correct ionic balance is not yet restored);
max 2

(c) propogated by local currents;
electron flow occurs at margins of depolarised (+) and resting/repolarised (-) regions;
these currents make next bit of axon membrane permeable to sodium ions and so region of depolarisation spreads; **3**

TOTAL 10

QUESTIONSHEET 9

(a) (i) provide ATP;
to provide energy for active absorption of acetate/choline into the knobs;
for combining acetate and choline/to make acetylcholine/synthesis of acetylcholine; **max 2**

(ii) calcium ions enter synaptic knobs;
and attract vesicles to the pre-synaptic membrane;
these fuse with the membrane and release acetylcholine;
this attaches to receptors on post synaptic membrane;
making it become permeable to sodium ions;
these rush into the muscle fibre along the concentration gradient;
this alters the potential across the sarcolemma/membrane resulting in an action potential; **max 5**

(iii) acetylcholine esterase enzyme is released as soon as the muscle is depolarised;
this removes the acetylcholine from the receptors;
by hydrolysing/splitting it into acetate and choline;
thus membrane of muscle reverts to being impermeable to sodium ions;
resting potential is restored; **max 3**

(b) (i) the transmitter substance is <u>nor</u>-adrenaline;
the enzyme which removes it from the receptors is mono-amine oxidase; **2**

(ii) in the sympathetic nervous system; **1**

TOTAL 13

QUESTIONSHEET 10

(a) cerebrum is in the forebrain, cerebellum in the hind brain;
cerebellum concerned with balance/coordination of movements;
cerebrum concerned with conscious thought/speech/intelligence/memory/any other valid example; **3**

(b) motor neurone is a single cell running from CNS to effector organ/muscle/gland;
motor nerve is made of many motor neurones running side by side to either one effector or to several;
contains bundles of neurones grouped together in connective tissue/collagen sheaths; **3**

(c) myelinated neurones conduct impulses quickly/30 - 50 m sec^{-1}, non-myelinated neurones conduct impulses slowly/5 - l0 m sec^{-1};
voluntary motor and sensory neurones /white matter relay neurones are myelinated, autonomic motor/grey matter relay neurones are non-myelinated ; **2**

(d) rods are sensitive to dim light, cones to bright light;
rods for black and white vision, cones for colour vision;
rods use scotopsin, cones use photopsin (in their visual pigments);
rods have poor visual acuity, cones have good visual acuity; **max 3**

TOTAL 11

QUESTIONSHEET 11

(a) the period which must elapse after a (first) stimulus before a second stimulus can produce a second action potential;
axon must have repolarised almost completely before another potential can be set up; **2**

(b) the depolarising effect of discharging synaptic knobs is cumulative (= summation);
in spatial summation several synaptic knobs discharge simultaneously (onto the post-synaptic membrane);
whereas in temporal summation they discharge in rapid succession; **max 2**

(c) if a stimulus is above its threshold value;
it sets up a complete full sized action potential;
larger stimuli do not increase the size of the action potential; **max 2**

(d) a synapse which uses acetylcholine or nor-adrenaline as transmitter substances;
to set up an impulse in the post synaptic structure/neurone/muscle; **2**

(e) a synapse which uses dopamine/serotonin/glycine as neurotransmitter;
which prevent post-synaptic neurones from being excited by excitatory synapses/act as switch offs; **2**

TOTAL 10

QUESTIONSHEET 12

A membrane is impermeable to sodium ions;
sodium ions pumped out by active transport/higher concentration maintained outside;
potassium ions enter along electrical gradient;
influx of potassium cannot catch up with outflux of sodium so membrane is charged; **max 3**

B stimulus causes membrane to become permeable to sodium ions/sodium channels open;
sodium ions flow in;
membrane potential becomes positive; **3**

C sodium channels close;
potassium channels open/potassium ions leave the cell;
membrane potential becomes negative; **3**

D potassium ions continue to leave/potassium channels slow to close;
inside of cell becomes more negative than resting stage; **2**

TOTAL 11