Question			Answer	Marks	Guidance
1			**1 E ;** **2 C ;** **3 B ;** **4** given **5 F ;** **6 A ;** **7 G ;** **8 D ;**	7	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
			Total	**7**	

Question			Answer	Mark	Guid
2	(a)	(	**T** mitochondrion / mitochondria **;** **U** Z line **;** **V** myofibril**;**	3	**FA** for each line **ACCEPT** nucleus **CREDIT** zwischenscheibe line **CREDIT** myofilaments **ACCEPT** actin **and** myosin
		(ii)	sarcomere **;**	1	**FA** **DO NOT CREDIT** 'sacromere' (section 12 spelling rules apply)
		(iii)	energy storage **;** hydrolyses / breaks down **,** to glucose **;** (glucose / glycogen, for) respiration / to make ATP **;** glycogen insoluble / glucose would exert osmotic effect **;**	max 2	**IGNORE** just 'provides energy' or source **ACCEPT** converted to glucose, provides glucose
		(iv)	1.2 / 1.3 **; ;**	2	**Correct answer = 2 marks** If answer is incorrect then **ALLOW 1 mark** for correct working - 52 mm **or** 52 000 µm **or** 5.2 cm ÷ 42 000 If answer is not correctly rounded to 1dp **ALLOW 1 mark** for unrounded answers, e.g.for 52 mm - 1.238095 **or** 1.23 **ACCEPT** measurements in range 51–53 mm and corresponding unrounded figures - 1.21428 or 1.21 or 1.261904 **or** 1.26

Question			Answer	Mark	Guidance
2	(b)		*A band* stays the same / no change **;** *H zone* decreases / shorter / smaller **;** *I band* decreases / shorter / smaller **;**	3	**ACCEPT** disappears
	(c)		**1** (***fewer***) Ca^{2+} / calcium ions, bind to troponin **;** **2** (***fewer***) troponin (proteins) change shape **;** **3** (***fewer***) tropomyosin (proteins) move aside **;** **4** (***fewer***) binding sites on actin available **;** **5** (***fewer*** actin-myosin) cross bridges / links, form / AW **;** **6** power stroke ***reduced*** / AW **;** **7** actin filaments pulled past myosin with ***less*** force **;** **8** ref. pH and denaturing of proteins **;** **QWC** – at least **two** given mark points also indicate idea in bold italics **;**	max 5 1 1	'Fewer' not needed to award mps 1 to 5 but is required twice for QWC. **ACCEPT** less / decreased for 'fewer'. **ACCEPT** mps 1-5 if event described said not to occur at all but don't award QWC green spot for this. **1 IGNORE** 'reduced ability of Ca^{2+} to bind' for QWC **2** "Troponin does not change shape as much" gets mp 2 but not QWC **4 ACCEPT** thin filament for actin **ACCEPT** actin-myosin binding sites or binding sites for myosin heads, available / exposed **6 IGNORE** reduction in force of contraction **DO NOT ACCEPT** fewer power strokes **7 IGNORE** reduction in force of contraction **8 ACCEPT** description e.g. "H^+ changes protein's 3D structure" and allow reference to enzyme or to ATPase
			Total	**17**	

Question			Answer	Marks	Guidance
3	(a)		**1** receptors **;** **2** intensity **;** **3** chemical **;** **4** potential / value **;** **5** impulse **;**	**5**	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **1 ACCEPT** receptor cells **DO NOT CREDIT** neurones / organs **2 IGNORE** brightness **DO NOT CREDIT** frequency **3 IGNORE** volatile / soluble **4 ACCEPT** 'level' / '(needed) for depolarisation' **IGNORE** numerical value quoted / 'receptor' **DO NOT CREDIT** action potential **5 ACCEPT** action potential **DO NOT CREDIT** message / signal / information / stimulus

Question			Answer	Marks	Guidance
3	(b)	(i)	*the motor neurone - structure* the cell body is at (one) end of the , neurone / cell **or** the cell body is in , brain / spinal cord / CNS **or** dendrites connected (directly) to cell body **or** long(er) axon **or** no dendron **or** axon , connects to / ends at , effector / motor end plate ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** ref to cell size / myelin(ation) **DO NOT CREDIT** at end of axon / nerve **IGNORE** reference to dendrite length **CREDIT ora for sensory** i.e. cell body is at centre of cell **or** cell body is in PNS **or** dendrites at the end(s) of , axon / dendron **or** short(er) axon **or** dendron present **or** connects to / starts at , receptor

Question			Answer	Marks	Guidance
3	(b)	(ii)	*the motor* neurone - *function* carries **,** impulse(s) / action potential(s) **,** from **,** brain / spinal cord / CNS / relay neurone **or** carries **,** impulse(s) / action potential(s) **,** to **,** effector / muscle / gland **;**	**1**	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** refs to 'connects …' **DO NOT CREDIT** message / signal / information / stimulus **DO NOT CREDIT** message / signal / information / stimulus **CREDIT ora for sensory** i.e. carries **,** impulse(s) / action potential(s) **,** to **,** brain / spinal cord / CNS / relay neurone **or** carries **,** impulse(s) / action potential(s) **,** from receptor
			Total	**7**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>husky in Fig. 2.2 has
ears, laid back / held low / not upright ;
pupils, dilated / bigger ;
different / tensed / lower, posture ;
hair (on neck) standing up / hackles raised ;
mouth open / showing teeth / teeth bared / snarling / tongue withdrawn ;
tail standing up / held high ;</td><td>3 max</td><td>CREDIT correct non-subjective visible differences wherever they appear (read as prose)
IGNORE causes

DO NOT CREDIT eyes dilated</td></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><td>organ</td><td>calm mammal</td><td>frightened mammal</td></tr>
<tr><td>heart ;</td><td>rate slow / small force ;</td><td>rate fast / great force ;</td></tr>
<tr><td>lungs ;</td><td>breathing, slow / shallow ;</td><td>breathing, fast / deep ;</td></tr>
<tr><td>(skeletal) muscle / arteries to muscle ;</td><td>less, active / blood flow ;</td><td>more, active / blood flow ;</td></tr>
<tr><td>liver ;</td><td>glucose → glycogen / glucose taken up ;</td><td>glycogen → glucose / glucose released ;</td></tr>
<tr><td>gut / named part of gut ;</td><td>peristalsis / secretions / digestion / blood flow to gut, occurring ;</td><td>no / less, peristalsis / secretions / digestion / blood flow to gut ;</td></tr>
</table>
</td><td>6 max</td><td>CREDIT first correct answer per box if not contradicted later. No requirement for calm and frightened comments to be opposites.

IGNORE steady, regular, normal with respect to calm mammal
CREDIT reasonable figures for heart and breathing rates
CREDIT AW such as stroke volume, cardiac output (of heart), tidal volume, ventilation rate (of lungs).
ACCEPT named muscle(s)
ACCEPT ecf across table for structures that are not organs, eg bronchioles

CREDIT brain, bladder in first column for 1 mark

CREDIT arterioles constricted for less blood flow (context gut in frightened mammal)

CREDIT named secretions, eg saliva, gastric juice.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(c)</td><td></td><td>
<table>
<tr><th></th><th>calm mammal
Fig. 2.1</th><th>frightened mammal
Fig. 2.2</th></tr>
<tr><td>division</td><td>parasympathetic ;</td><td>sympathetic ;</td></tr>
<tr><td>neuro-transmitter</td><td>acetylcholine / ACh ;</td><td>noradrenaline / NA
norepinephrine / NE ;</td></tr>
</table>
</td><td>4</td><td>First Answer in each box (0 marks if additional answer contradicts)

DO NOT CREDIT adrenaline for noradrenaline
CREDIT ecf for second line if name matches NS division stated</td></tr>
<tr><td></td><td>(d)</td><td></td><td>adrenal (glands) ;
(adrenal) medulla ;</td><td>2</td><td>First Answer (0 marks if additional answer contradicts)
DO NOT CREDIT medulla oblongata or medulla alone</td></tr>
<tr><td></td><td>(e)</td><td>(i)</td><td>1 adrenaline binds to receptor ;

2 complementary / specific, fit / shape ;

3 G protein activated ;
4 adenyl(ate) cyclase activated ;

5 ATP converted to cAMP ;

6 cAMP activates, proteins / enzymes ;
7 by, altering 3D structure / phosphorylation ;</td><td>4 max</td><td>IGNORE neurones
ACCEPT attaches to
DO NOT ACCEPT detected by, recognised by

IGNORE stimulated (mps 3, 4 6)
CREDIT AW eg made active, caused to work (3,4,6)

ACCEPT named enzymes eg kinases</td></tr>
<tr><td></td><td>(e)</td><td>(ii)</td><td>idea that one / named, molecule causes, production / activation of, many others ;

idea that this multiplying effect is repeated at, next / every / later step ;
idea of recycling / temporary binding, of cAMP ;</td><td>2</td><td>ACCEPT 1 adrenaline → many cAMP molecules
1 molecule causes many responses (in cell)
CREDIT idea of amplification / cascade effect
IGNORE chain reaction, domino effect</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>21</td><td></td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
5	(a)		*somatic* changes / uses **,** body cells **;** change cannot be passed to offspring **;** cures / alleviates **,** genetic disease in one individual **;** short-lived / repeat treatments needed **;** *germ line* changes / uses **,** gametes / zygote / embryo / reproductive tissue **;** banned **;**	**2 max**	**ORA** germ line changes could be passed to offspring **ACCEPT** sperm / eggs
5	(b)		*central* **CI** brain and spinal cord **;** **C2** intermediate neurones **;** **C3** has **,** coordinating role / many synapses **;** *peripheral* ***max 3*** **P1** nerves **,** from sense organs / to muscles / to glands **;** **P2** sensory **and** motor **,** neurones / nerve cells **;** **P3** role in **,** sensing stimuli / controlling effectors **or** conducting impulses, to / from **,** CNS / brain / spinal cord **;** **P4** includes **,** somatic / autonomic / sympathetic / parasympathetic **;**	**4 max**	**For full marks needs at least 1 C mark** **C2** **CREDIT** relay / internuncial / bipolar **C3** **IGNORE** processing **P1** **IGNORE** effectors **P2** **DO NOT CREDIT** if intermediate included **DO NOT CREDIT** nerves **P3** **IGNORE** messages / signals / information
5	(c)		*prophase 1* homologous chromosomes pair up / bivalents form **;** chiasmata / crossing-over / recombination **;**	**2**	**CREDIT** reverse arguments for prophase 2 **ACCEPT** description e.g. non-sister chromatids exchange **,** (matching sections of) DNA / alleles / genetic material
				8	