

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	1. fMRI ; and any two from: 2. (fMRI) operates in real time / eq ; 3. as experience will be short lived / eq ; 4. Active areas will {light up / be coloured / eq} (on the image) / eq ; 5. high resolution (as areas involved may be small) / eq ; 6. Safer / eq ;	2 ACCEPT live images, 4 images per second 4. ACCEPT idea of active areas require more oxygen/oxygenated blood 5 ACCEPT more pixels, image is more detailed 6. ACCEPT ref. to not using X rays, etc	(3)

Question Number	Answer	Mark
1(c)(ii)	D ;	(1)

Question Number	Answer	Additional guidance	Mark
2(a)	<ol style="list-style-type: none"> 1. alpha glucose in starch and beta glucose in cellulose; 2. only {starch / amylopectin} can be branched / cellulose only a linear molecule ; 3. starch contains two types of molecule, cellulose only one ; 4. alternate monomers rotated through 180° in cellulose only ; 5. only {amylopectin / starch} can have 1-6 glycosidic bonds / cellulose has 1-4 glycosidic bonds only ; 	<p>ACCEPT 3 - the two named molecules of starch – amylose and amylopectin</p> <p>ACCEPT 5 – starch can have 1-6 & 1-4 glycosidic bonds but cellulose only 1-4</p>	(2)

Question Number	Answer	Additional guidance	Mark
2(b)(i)	<ol style="list-style-type: none"> 1. thermoreceptors in hypothalamus / eq ; 2. detect the increase in (core) blood temperature / eq ; 3. reference to heat loss centre activated ; 4. reference to autonomic nervous system ; 5. reference to impulses down motor neurones ; 6. to {effectors / named effector} / eq ; 7. detail of method of heat loss / eq ; 	<p>ACCEPT 5 - effector neurone for motor neurone</p> <p>ACCEPT 7 – vasodilation of blood vessels, sweat released, heat loss from blood through radiation</p>	(4)

Question Number	Answer	Additional guidance	Mark
2(b)(ii)	<ol style="list-style-type: none"> 1. (shivering) is muscle contraction ; 2. which uses {respiration / ATP / eq} ; 3. which release heat (to warm body) / eq ; 	<p>ACCEPT 2 - oxidative phosphorylation, ATP being converted to ADP and Pi</p>	(2)

Question Number	Answer	Additional guidance	Mark
2(c)	<ol style="list-style-type: none"> 1. (cancer causing) gene identified / eq ; 2. gene {cut / isolated / eq} from DNA / eq ; 3. using a {restriction / eq} enzyme / eq ; 4. gene in {vector / named vector} ; 5. mechanism for getting {gene / vector} into host cells (of naked mole rats) / eq ; 	<p>ACCEPT 4 – named examples including retrovirus, virus, liposome</p> <p>ACCEPT 5 - reference to (micro)injection, microprojectiles, electroporation, gene gun, inhaler</p>	(3)

Question Number	Answer	Additional guidance	Mark
*2(d)	<p>QWC – Spelling of technical terms (<i>shown in italics</i>) must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none"> 1. idea that this air has higher CO₂ content ; 2. {CO₂ level in blood increases / pH of blood falls / eq} ; 3. change detected by chemoreceptors in {carotid body / carotid artery / aortic body / aorta / medulla} ; 4. reference to {ventilation centre / eq} (in medulla) ; 5. sends more impulses along neurones / eq ; 6. to intercostal muscles / diaphragm / eq ; 7. causing an increased {ventilation rate / rate of breathing / depth of breathing} / eq ; 	<p>ACCEPT 2 - high, higher (for CO₂)</p> <p>ACCEPT 4 – respiratory centre, inspiratory centre for ventilation centre</p> <p>ACCEPT 5 – impulses sent more often</p>	(5)

Question Number	Answer	Additional guidance	Mark
2(e)	<ol style="list-style-type: none"> naked mole rat's {incisors / eq} grow through {skin / lip} without {damage / eq} ; lead to new {coatings / permanent seal /eq} at {skin / bone / metal} interface ; so soft tissue is {not damaged / eq } (by the prosthetic) / eq ; 		(2)
Question Number	Answer	Additional guidance	Mark
2(f)	gonadotrophin-releasing (hormone) and anterior pituitary / gonadotrophins and {ovaries / testes} ;	ACCEPT - testosterone and testes ACCEPT - gonads for testes or ovaries	(1)

Question Number	Answer	Additional guidance	Mark
2(g)	<ol style="list-style-type: none"> idea of irregularity of flagellum ; Idea of irregularity associated with mid-region ; 	ACCEPT 1 – no or more than one flagellum ACCEPT 2 – not enough mitochondria	(2)

Question Number	Answer	Additional guidance	Mark
2(h)	<ol style="list-style-type: none"> idea of high levels of inbreeding ; low level of genetic diversity / eq ; idea that there is some variation because more than one male is involved in ; unfamiliar males used as mates (by queen) / eq ; fusion of colonies / eq ; arrival of a dispersal phenotype (from a different colony) ; mutations / eq ; 	ACCEPT 1 – accept idea in context of only one queen/female breeds ACCEPT 2 – restricted gene pool, low genetic variation	(3)

Question Number	Answer	Additional guidance	Mark
2(i)	<ol style="list-style-type: none"> 1. reduces inbreeding (depression) / eq ; 2. increases outbreeding / outbreeding qualified ; 3. (leading to) increase in genetic diversity ; 4. idea of colony size regulation ; 5. idea of increase in fecundity ; 6. idea of increased chance of survival ; 	<p>ACCEPT 1 - less genetic drift</p> <p>ACCEPT 2 – disperser/new comer more likely to breed</p> <p>ACCEPT 3 – increased genetic variation, increase in variety of alleles</p> <p>ACCEPT 6 – appropriate ref to natural selection, due to environmental changes</p>	(2)

Question Number	Answer	Additional guidance	Mark
2(j)	<p>Paired responses:</p> <ol style="list-style-type: none"> 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. high CO₂ in air (of tunnels) ; 3. haemoglobin has higher affinity for oxygen / brain can tolerate eq ; 4. low O₂ levels (in tunnels) / eq ; 5. increased number of oxytocin receptors in brain ; 6. overcrowding / eq ; 7. non-pigmented ; 8. lack of UV light ; 9. outbreeding mechanisms such as disperser; 10. low genetic diversity ; 11. hairless/ naked/ reduction of sweat gland / loose skin / no insulating layer / poikilothermic ; 12. due to nature of its temperature environment / eq ; 13. teeth arrangement / eq ; 14. for digging underground ; 15. keen sense of smell/reduce eyesight / ref to circadian rhythms ; 16. dark conditions ; 17. division of labour ; 18. for the survival of the eusocial colony ; 	<p>ACCEPT1 - lack or receptor for chemical pain</p> <p>ACCEPT 3 – ref to brain's hypoxia response, neurones or brain resistance to hypoxia</p> <p>ACCEPT13 - forward of lips or long</p>	(4)

Question Number	Answer	Mark						
3(a)	<table border="1"> <thead> <tr> <th>Region of the brain</th> <th>One role while she is on the beam</th> </tr> </thead> <tbody> <tr> <td>Cerebellum</td> <td>maintaining balance / coordination of movement / muscle control / eq ;</td> </tr> <tr> <td>Medulla oblongata</td> <td>regulation of {breathing / heart beat} / eq ;</td> </tr> </tbody> </table>	Region of the brain	One role while she is on the beam	Cerebellum	maintaining balance / coordination of movement / muscle control / eq ;	Medulla oblongata	regulation of {breathing / heart beat} / eq ;	(2)
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Question Number	Answer	Mark
3(b)	<ol style="list-style-type: none"> 1. idea more blood flows near the skin surface / eq ; 2. due to {vasodilation / dilation of arterioles / eq} ; 3. {vasoconstriction / eq} of shunt vessels / eq ; 4. more blood to capillaries / eq ; 5. idea of more heat lost ; 6. via radiation ; 	(4)

Question Number	Answer	Mark
3(c)(i)	<ol style="list-style-type: none"> 1. {in the knee / behind the knee cap} / {cross- shaped / two ligaments} ; 2. (connective tissue that) connects bone to bone / eq ; 	(2)

Question Number	Answer	Mark
3(c)(ii)	<ol style="list-style-type: none">1. idea of smaller incision reduces chance of infection / eq ;2. idea of smaller incision reduces recovery time ;3. idea of smaller incision reduces likelihood of osteoarthritis / knee joint replacement later / eq ;4. idea of smaller incision so less scar tissue / eq ;5. idea of smaller incision so less blood loss / eq ;6. idea of smaller incision so less pain / eq ;7. use of local anaesthetic means less (associated) risk / eq ;8. idea of cheaper related to fewer staff needed ;	(2)