

Applied Science

Advanced Subsidiary GCE

Unit **G622**: Monitoring the Activity of the Human Body

Mark Scheme for June 2011

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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Question		Expected Answers	Marks	Additional Guidance
1	(a)	<p>recreational drugs: cannabis (cannabinoids) / amphetamines / cocaine / methadone / morphine / heroin (diamorphine)/ alcohol/ caffeine/ ecstasy/ AVP;</p> <p>performance-enhancing drugs: (anabolic/ androgenic) steroids / e.g. stanozolol / e.g. nandrolone / beta-blockers / erythropoietin (EPO)/ testosterone/ amphetamines AVP;</p>	2	<p>accept common names reject coffee accept speed = amphetamine</p>
	(b)	<p><i>any two from</i></p> <p>(gas/ liquid/ HPL/ TL) chromatography; electrophoresis; (mass/ infrared) spectroscopy / spectrometry; immunoassay; ELISA test;</p>	2	<p>accept ELIZA</p>
	(c)	<p><i>any three from</i></p> <p>take a blood sample; divide sample into two; use one for testing and keep one for reference (later use); compare against a standard / choose a qualitative or quantitative procedure e.g. chromatography;</p>	3	<p>take two samples = 2 marks</p> <p>ignore second sample = standard for comparison</p> <p>accept AVP e.g. aseptic conditions</p>

Question		Expected Answers	Marks	Additional Guidance
	(d) (i)	<p><i>any two from</i></p> <p>red blood cell count is higher/more red blood cells (than normal/other sports competitors);</p> <p>red blood cells carry oxygen;</p> <p>more oxygen (available for muscles);</p> <p>aerobic respiration continues for longer in muscles;</p> <p>more energy/ATP (released for sport/activity);</p> <p>delays production of lactic acid/formation of oxygen debt;</p>	2	
1	(d) (ii)	<p><i>any three from</i></p> <p>red blood cells counted;</p> <p>using an automatic counter / haemocytometer / coulter counter;</p> <p>count compared to a standard/ norm;</p> <p>packed cell volume is determined;</p> <p>repeat test using the same sample;</p>	3	<p>ignore references to microscopes/ unqualified more red blood cells</p> <p>ignore using a piece of equipment</p>
		Total	12	

Question		Expected Answers	Marks	Additional Guidance
2	(a)	<p>type 1 any two from</p> <p>diminished / no production of insulin; malfunctioning pancreas / Islet of Langerhans / beta cells; insulin dependent / treated with insulin injections; may be born with the condition / young age / juvenile/ genetic basis; result of autoimmunity; weight loss; blurring of vision; (unexpected) cramp; constipation; genital itching/thrush; slow healing of wounds; glucose in urine;</p> <p>type 2 any two from</p> <p>resistance to the effects of insulin/ body cells do not respond effectively to insulin;</p> <p>treated / controlled with dietary adjustment; usually acquire the condition in later life / late onset; can be associated with obesity / overweight; treated with insulin injections; blurring of vision; sudden weight change; genital itching /thrush; foot ulceration; glucose in urine;</p>	<p>2</p> <p>2</p>	<p>accept no/less insulin produced by pancreas = 2 marks</p> <p>ignore non insulin-dependent ignore rejection of insulin</p> <p>ignore being fat</p>
	(b)	<p>any two from</p> <p>type 2 diabetes (involved); linked with sedentary lifestyles;</p> <p>excess sugar / carbohydrate / fats in diet which causes problems in insulin production / recognition by body cells;</p>	2	<p>accept qualified examples of sedentary lifestyles e.g. lack of exercise</p> <p>must state the link between diet and problem</p>

Question			Expected Answers	Marks	Additional Guidance
2	(c)	(i)	<p>biosensor operation any two from</p> <p>uses glucose oxidase / an enzyme (to detect glucose levels in body); (biosensors work by) keeping track of the number of electrons that pass through the enzyme; (some biosensors use) sensitive fluorescence measurements, monitoring changes in the intrinsic FAD fluorescence of glucose oxidase; latest versions are like a 'band aid' / opens tiny pores in the skin and tests interstitial fluid;</p> <p>results used by diabetic any one from</p> <p>to know when to inject insulin (at times of high glucose levels) / avoid hyperglycemia; to know when to take in extra glucose / avoid hypoglycaemia;</p>	<p>2</p> <p>1</p>	<p>accept involves a biological recognition layer</p> <p>reject references to tablets</p>
		(ii)	<p>any two from</p> <p>take insulin (injection) / increase insulin (dose/level) taken; reduce /do not eat / drink glucose-rich foods / drink alcohol (until the plasma level subsides); keep a diary/log of food eaten / record insulin injections given;</p>	2	<p>mark first two points only (even if on line 1)</p> <p>reject references to tablets</p> <p>accept sugary foods = glucose-rich foods</p> <p>ignore references to exercise</p> <p>must qualify the use of the diary/log</p> <p>ignore references to unqualified meals</p>
	(d)	(i)	<p>diabetic reading = 9.6 and normal reading = 5.2;</p> <p>difference (between the 2 readings) / 4.4 ÷ 5.2 x 100;</p> <p>84.62 / 85 (percentage increase);</p>	3	<p>correct answer = 3 marks</p> <p>if readings are correct OR incorrect, the calculation must show one number (diabetic minus normal reading) ÷ normal reading x 100</p> <p>no subtraction = no ecf</p> <p>accept any significant figures eg. 84.6</p> <p>reject 84.61</p>
		(ii)	<p>gradually enters the cells / metabolised / converted into energy / ATP / used in respiration;</p> <p>lost / excreted in urine;</p>	2	<p>ignore used for exercise/ muscle contraction</p> <p>ignore stored (unless qualified, with glycogen)</p> <p>ignore broken down</p>

Question		Expected Answers		Marks	Additional Guidance
2	(e)	<p>risk</p> <p><i>any two from</i></p> <p>excess blood loss;</p> <p>contamination;</p> <p>excess bruising;</p>	<p>related procedure to minimise risk</p> <p><i>any two from</i></p> <p>adequate training / named procedure;</p> <p>sterilisation of skin / needle / new needle / wear gloves / use of sharp bin;</p> <p>adequate training / named procedure;</p>	4	<p>ignore references to sample e.g. put in a sealed bottle</p> <p>each procedure must relate directly to the correct, named risk in each row of the table if risk is incorrect – no mark allocated for procedure</p> <p>accept AIDS/HIV/infection = contamination ignore clean</p> <p>ignore being stabbed / injured / needle stick</p>
		Total		20	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	<p><i>any two from</i></p> <p>one cell thick / thin walls; large surface area; surrounded by blood capillaries; permeable; moist;</p>	2	<p>reject thin cell walls ignore unqualified reference to large number of alveoli reject porous</p>
		(ii)	<p><i>any three from</i></p> <p>oxygen enters (capillaries/blood/body); carbon dioxide leaves (the capillaries/blood/body); diffusion; correct reference to haemoglobin / oxyhaemoglobin;</p>	3	<p>ignore references to air</p> <p>diffusion must be in correct context accept correct description of diffusion eg. from a high concentration to a low concentration</p>
	(b)		<p>blood vessel;</p>	1	<p>accept artery/vein/arteriole/venule reject capillary</p>
	(c)		<p>fewer alveoli / larger air spaces;</p> <p>reduced surface area; blood capillaries damaged;</p>	3	<p>ignore alveoli are damaged accept air sacs = alveoli</p>

Question	Expected Answers	Marks	Additional Guidance
3 (d)	<p>[0 marks] Candidate does not include more than one valid point.</p> <p>[1 mark] Candidate shows a basic understanding of how a peak flow meter can be used to measure peak expiratory flow, including at least two valid points but with little or no explanation. With little evidence of a logical order.</p> <p>[2 – 3 marks] Candidate shows an understanding, explaining how a peak flow meter can be used to measure peak expiratory flow, including at least three valid points. The explanation follows some logical order.</p> <p>[4 marks] Candidate shows a high level of understanding and gives a full explanation of how a peak flow meter can be used to measure peak expiratory flow, including at least five valid points (including one or both at the higher level). The explanation follows a clear logical order.</p>	4	<p>reject marking points if answer refers to spirometer</p> <p>valid points:</p> <ul style="list-style-type: none"> • zero the meter; • person is at rest/relaxed; ignore sitting/standing • hold meter horizontally; • sterilise the mouth piece/; use new/clean mouthpiece; accept clean equipment • put lips/mouth (firmly) around the mouth piece; <ul style="list-style-type: none"> • take a minimum of at least three readings; • use highest of three readings (reject take an average); <p>higher level valid points:</p> <ul style="list-style-type: none"> • patient takes in as a deep as breath as possible; • patient blows out as hard as possible (into the mouthpiece); accept as fast/quick/sharp as possible <p>ignore a long breath</p>
(e)	<p><i>any three from</i></p> <p>ribs lowered / ribs move in and down/ return to original position; sternum is lowered / returned to original position; intercostal muscles relax; diaphragm is raised / /relaxed OR return to dome/original position; nervous stimulation e.g. sympathetic nerve; reduced volume of rib cage / lungs; increased pressure in lungs;</p>	3	<p>mark first three points in response, if one is incorrect = 2 max.</p> <p>ignore any references to inhalation use of incorrect cause eg. because air leaves the lungs the ribs are lowered = 1 mark lost accept normal = original position</p> <p>ignore reference to less space in rib cage/lungs</p>

Question			Expected Answers	Marks	Additional Guidance	
3	(f)	(i)	Any one from; good <u>soft tissue</u> resolution/clarity/detailed/3D image (is needed for the lungs);		1	ignore unqualified 3D image – must refer to <u>soft tissue</u>
		(ii)	<p>hazard for the patient [2]</p> <p><i>accept two from</i></p> <p>(strongly) magnetic/ (wearing) metal objects/ joint replacement;</p> <p>noise;</p> <p>confined space/ claustrophobia/ claustrophobic;</p>	<p>precautions [2]</p> <p><i>accept two from</i></p> <p>remove metal objects/ jewellery/ complete a pre- questionnaire/ ask patient about metal objects/ use alternative scanner;</p> <p>wear headphones/ ear protection/ calm down/ advanced notice;</p> <p>calm patient/ give sedative/ use alternative scanner; complete a pre-questionnaire/ ask patient about medical history;</p>	2 and 2	<p>precaution must relate directly to the hazard</p> <p>accept piercings</p> <p>avoid using this scanner = use alternative scanner reject having just part of the body scanned with MRI</p>
			Total		21	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	oxygen → carbon dioxide + water; energy / ATP;	1 1	accept <i>correct</i> formulae / symbols, where used accept any order for carbon dioxide + water + ATP ignore references to number of ATP molecules
		(ii)	lactate / lactic acid and energy / ATP;	1	accept either order ignore references to number of ATP molecules
	(b)		ATP / adenosine triphosphate;	1	accept phonetic spelling
	(c)		type of respiration aerobic (respiration); reasons <i>any two from</i> make (lots of) ATP ; glucose is fully/completely oxidised; releasing all energy available; correct reference to Krebs cycle / electron transfer chain / ETC in aerobic only; anaerobic respiration leads to lactic acid; lactate / lactic acid is a potential energy source;	1 2	accept reverse arguments for anaerobic respiration if numbers used, must be correct number for ATP (molecules) produced (32 to 38)
		(d)	<i>any two from</i> low levels of oxygen (in muscle cells); takes place at start of exercise fast vigorous exercise (before oxygen can be supplied); quick/rapid/short term/immediate source of energy/ATP; energy/ATP used for muscle (cell) contraction;	2	accept starved of oxygen / operates without oxygen accept eg. sprinting, weight-lifting ignore muscles working/activity
	(e)		(cell) cytoplasm / cytosol;	1	

Question			Expected Answers		Marks	Additional Guidance	
4	(f)	(i)	<p>effect [2]</p> <p>lowers pulse rate before exercise</p> <p>lowers pulse rate during exercise</p> <p>reduces recovery time (3 minutes)/ lowers pulse rate 3 minutes after exercise</p>	<p>supporting data [2] (beats min⁻¹)</p> <p>76 → 65 / 11 difference</p> <p>120 → 110 /10 difference</p> <p>85 → 67 /18 difference</p>	<p>explanation [2]</p> <p><i>any from:</i></p> <p>thicker/hypertrophy heart wall/muscle; stronger contraction/ larger stroke volume; fitter; improved ventilation rate; AVP;</p>	<p>2 + 2 + 2</p>	<p>data response must be linked to a correct effect explanation response must also be linked to a correct effect if effect is incorrect, no marks can be scored accept unqualified 'lowers pulse rate' once accept heart rate = pulse rate</p>
		(ii)	<p>increased pulse rate causes an increased blood flow / greater volume of blood delivered;</p> <p>more oxygen and glucose available for aerobic respiration, releasing more energy;</p>		<p>2</p>	<p>accept reverse argument</p>	
	(g)	(i)	<p><i>any one from</i></p> <p>increased running speed = increased levels of (blood) lactate / lactic acid;</p> <p>positive correlation;</p>		<p>1</p>	<p>accept correct references to data from table eg. changes from 2.4 to 4.0 or reverse argument</p>	

Question			Expected Answers	Marks	Additional Guidance
4	(g)	(ii)	<p>effect lower levels of (blood) lactic acid (for all running speeds);</p> <p>explanation <i>any one from</i></p> <p>heart / circulation gives improved supply of oxygen; aerobic respiration continues for longer (during running);</p>	<p>1</p> <p>1</p>	<p>if effect is incorrect – explanation cannot be given a mark</p> <p>accept more aerobic respiration / less anaerobic respiration</p>
		(iii)	<p><i>any two from</i></p> <p>cramp; <u>muscle</u> fatigue; lower performance; hinder recovery; (lactate / lactic acid) is toxic / poisonous; (lactate / lactic acid) can cause acidosis (in the blood); oxygen is needed to break down the lactate / lactic acid; oxygen debt;</p>	2	<p>ignore stitch – not equivalent to cramp</p>
		(iv)	<p><i>any one from</i></p> <p>take more readings / increased replication/ extend the study; spot / identify / remove anomalies;</p>	1	<p>ignore calculate a mean/average</p>
			Total	24	

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	to prevent reflection (of ultrasound) / improve contact / lubricate (probe) / exclude air;	1	ignore to allow the ultrasound to go through/penetrate
		(ii)	ultrasound does not pass through bone / the ribs;	1	accept bone absorbs/reflects ultrasound ignore cannot see through bone
		(iii)	<p>[0 marks] Candidate does not include more than one valid point.</p> <p>[1 mark] Candidate shows a basic understanding of the principles of ultrasound scanning, including at least two valid points but with little or no explanation of the principles.</p> <p>[2 – 3 marks] Candidate shows an understanding of the principles of ultrasound scanning, including at least three valid points. The response is logical and, at least, shows some explanation of the principles.</p> <p>[4 – 5 marks] Candidate shows a high level of understanding of the principles of ultrasound scanning, including at least five valid points. The response is highly logical and shows a clear explanation of the principles.</p>	5	<p>valid points:</p> <ul style="list-style-type: none"> • uses sound waves; • ‘real time’; • sound waves reflected/bounced back; • images (on screen) / photos; • frequencies used 1 to 20 MHz; • provides series of echoes; • echoes converted into images; • returning waves picked up by transducer/microphone/sensor; • short pulses / about 1µs sent into body; • waves reflected at boundary between two different materials e.g. bone and soft tissue/ different organs; • time for reflected wave to come back indicates depth of interface;

Question	Expected Answers	Marks	Additional Guidance
(b)	<p><i>any two from</i></p> <p>(oxygenated / deoxygenated) blood mixed;</p> <p>less oxygen carried/transported/delivered by blood/ to the body; oxygenated blood returns to lungs;</p> <p>lower blood pressure around the body; high blood pressure reaching the lungs;</p>	2	<p>accept blood can move between ventricles = mixed blood</p> <p>accept lowers gaseous exchange</p>
(c)	<p><i>any two from</i></p> <p>quick / cheap / readily available;</p> <p>non-invasive;</p> <p>real time / to see heart beating / blood flowing;</p> <p>no known side effects / safe/ not harmful;</p> <p>record changes in (heart) structure over time;</p> <p>images of <u>soft</u> tissues;</p> <p>can hear heart beat / blood flow;</p>	2	<p>ignore easy / easier to do</p> <p>accept cheaper/quicker</p> <p>ignore pain free</p> <p>references to radiation must be qualified</p>
(d)	<p><i>any two from</i></p> <p>to monitor fetal developments / locate the placenta;</p> <p>find cysts/tumours/cancer OR find problems/abnormalities, in soft tissue/named example;</p> <p>guide surgeons during keyhole surgery;</p> <p>angioplasty;</p> <p>inserting wires for pacemakers;</p>	2	<p>accept to look at the unborn baby / confirm pregnancy</p> <p>ignore unqualified lumps</p> <p>accept any correct qualified, diagnostic use</p> <p>ignore use of ultrasound waves for treatment (rather than observation)</p>
	Total	13	

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