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**CO-ORDINATED SCIENCES**

**0654/41**

Paper 4 Theory (Extended)

**May/June 2017**

MARK SCHEME

Maximum Mark: 120

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**Published**

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Question	Answer	Marks
1(a)(i)	Y umbilical cord ; Z amniotic fluid ;	2
1(a)(ii)	protects (the fetus) from mechanical shock ; protects (the fetus) from drying out ; protects (the fetus) from temperature fluctuations ;	max 1
1(a)(iii)	carries oxygen / glucose / nutrients, to the fetus ; carries, urea / toxins / carbon dioxide / waste products, away from fetus ;	2
1(b)(i)	accept an 'X' placed anywhere immediately above or on the top of the cervix ;	1
1(b)(ii)	bleeding / haemorrhaging ; damage to placenta ; blocks passage of baby / AW ;	max 1

Question	Answer	Marks
2(a)(i)	temperature change = $31\text{ }^{\circ}\text{C}$ ; $E/m\Delta\theta$ / $156\ 000 / 1.2 \times 31$ ; = $4190 / 4194$ (J / Kg $^{\circ}\text{C}$ ) ;	3
2(a)(ii)	efficiency = useful energy out / energy in $\times 100$ / $2600 / 3000 \times 100$ ; = $87(\%)$ ;	2
2(b)	latent heat (of vaporisation) required ; as energy to break bonds / to overcome attractive forces ; between molecules / intermolecular bonds ; to increase <u>potential</u> energy of the molecules ;	2

Question	Answer	Marks
3(a)(i)	produced in car engines / by lightning ; contributes to acid rain / acidifies lakes / reference to damage to, plants / aquatic organisms / reference to damage to (animal) respiratory systems / damage to buildings / AVP ;	2
3(a)(ii)	Haber ;	1
3(a)(iii)	$\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{CO}(\text{g}) + 3 \text{H}_2(\text{g})$ symbols and state symbols ; balanced ;	2
3(b)(i)	6 shared electrons ; remaining lone pair ;	2
3(b)(ii)	multiple bonding / 6 / 3 pairs, bonding electrons / triple bond ; bond between the atoms is very strong / difficult to break / (relatively) large amount of energy required (to break bond) ;	2
3(c)(i)	$M_r$ of hydrazine = $(14 \times 2) + (1 \times 4)$ ;	1
3(c)(ii)	moles of hydrazine = $192 \div 32 = 6$ ; so moles of ammonia = $4 \times 2 / 4 \times 6 \div 3 = 8$ ; volume of ammonia = $8 \times 24 = 192 \text{ (dm}^3\text{)}$ ;	3

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)(i)	(pH) 9 ;	<b>1</b>
4(a)(ii)	enzyme, is denatured / changes shape ;	<b>1</b>
4(a)(iii)	temperature / substrate concentration ;	<b>1</b>
4(b)	breakdown of large molecules into small molecules ; from insoluble to soluble ; using, mechanical / chemical, processes / means ;	<b>3</b>
4(c)	(enzyme) <b>A</b> ; (enzyme <b>A</b> ) works at low pH / in acidic conditions / optimum pH is 1.9 ;	<b>2</b>

Question	Answer	Marks
5(a)	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ symbols ; balancing ;	<b>2</b>
5(b)	stunted weak stem ;	<b>1</b>
5(c)(i)	transpiration ; water loss / diffusion of water vapour / evaporation from, leaf / stomata ; (water and ions) drawn up xylem ; down water potential gradient ; ref to cohesion of water molecules ;	<b>max 3</b>
5(c)(ii)	less transpiration / diffusion of water vapour / water loss / evaporation ;  smaller water potential gradient ; slower movement of, water / ions ;	<b>max 2</b>
5(d)	eutrophication ; algal bloom causes lack of light ; lack of light causes death of plants ; death of plants causes increase in bacteria ; increase in bacteria / bacteria respiration, reduces oxygen concentration reduced oxygen kills fish ;	<b>max 3</b>

Question	Answer	Marks
6(a)(i)	<u>fractional distillation</u> ;	<b>1</b>
6(a)(ii)	(average) size / surface area of molecules increases ; so intermolecular forces / forces between molecules increase ; so greater (thermal) energy / higher temperature required to separate molecules ;	<b>3</b>
6(a)(iii)	pure / single substances have discrete boiling point / owtte ; liquid mixture has a range of boiling point ;	<b>2</b>
6(b)(i)	<pre>       H   H   H   H                     H — C — C — C — C — H                           H   H   H   H           </pre> 4 carbon atoms and 10 hydrogen atoms ; all else correct ;	<b>2</b>
6(b)(ii)	flammable / produce CO <sub>2</sub> / H <sub>2</sub> O / CO when burnt ;	<b>1</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(a)(i)	4 (m / s) ;	<b>1</b>
7(a)(ii)	area under graph / working ; 20 + 20 + 50 = 90 (m) ;	<b>2</b>
7(a)(iii)	working ; e.g. correct substitution into formula such as 4 / 10 ;	<b>1</b>
7(a)(iv)	force = mass $\times$ acceleration / $950 \times 0.4$ ; 380 (N) ;	<b>2</b>
7(b)(i)	move faster ;	<b>1</b>
7(b)(ii)	more frequent collisions / collide at greater speed, with tyre wall ; more force exerted on tyre walls ;	<b>2</b>
7(c)(i)	current in low voltage circuit creates magnetic field (around solenoid) ; soft iron attracted (to magnet / solenoid) ; contacts in high voltage circuit close ;	<b>3</b>
7(c)(ii)	so that humans, are not exposed to the high voltage circuit / operate low voltage switching circuit / owtte ;	<b>1</b>

Question	Answer	Marks
8(a)(i)	(D)      E      (A)      C      B	1
8(a)(ii)	brain is closer / spinal cord is further away ;	1
8(b)(i)	radial muscles contract ; pupil widens ; let more light into the, eye / retina ;	max 2
8(b)(ii)	no conscious thought / automatic / immediate / rapid ;	1
8(c)	bigger eyes / wider pupils ;	1

Question	Answer	Marks
9(a)(i)	12 protons ; 14 neutrons ;	2
9(a)(ii)	2,8,2 ;	1
9(b)(i)	hydrogen ;	1
9(b)(ii)	(concentration of) acid decreases ; (concentration of) magnesium chloride increases ; (mass of) magnesium decreases ;	max 2
9(b)(iii)	K.E. higher at <b>B</b> than at <b>A</b> AND K.E. at <b>B</b> and <b>C</b> the same ;	1
9(c)(i)	reaction releases thermal energy / temperature of mixture increases / exothermic / temperature affects rate ; water (seeks to) keep temperature constant ;	2
9(c)(ii)	reaction rate increases ; increased collision frequency ;	2



<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)	suitable temperature / warmth AND water / moisture ;	<b>1</b>
10(b)	glucose ;	<b>1</b>
10(c)	red liquid would move, further / more quickly (to the left) ; increased respiration ; increased oxygen used ;	<b>3</b>
10(d)	no movement of red liquid ; enzymes denatured ; no respiration / no oxygen used ;	<b>3</b>

Question	Answer	Marks
11(a)	use Geiger counter etc. ;  test for absorption by shield of lead / thick aluminium ; $\gamma$ -rays are more penetrating than $\alpha$ or $\beta$ / $\alpha$ and $\beta$ will not penetrate lead ; OR measure deflection by magnetic / electric field ; $\gamma$ -rays not deflected / $\alpha$ and $\beta$ deflected ;	3
11(b)	${}_{92}^{235}\text{U}$ ; ${}_{2}^{4}\text{He}$ OR ${}_{2}^{4}\alpha$ ;	2
11(c)	correct working ; 28 ( $\Omega$ ) ;	2
11(d)(i)	approx sin wave ; constant amplitude ;	2
11(d)(ii)	stronger magnet / spin coil faster / greater number of turns / increased coil area ;	1
11(e)(i)	$\lambda = v / f / 340 / 490$ ; = 0.69 (m) ;	2
11(e)(ii)	compression correctly labelled ;	1
11(e)(iii)	decreases / closer together ;	1

Question	Answer	Marks
12(a)(i)	sodium atoms lose one electron / change from 2,8,1 to 2,8 ; chlorine atoms gain one electron / change from 2,8,7 to 2,8,8 ;	2
12(a)(ii)	alternating sodium and chloride ions in two directions ;	1
12(b)(i)	(aqueous NaCl)      hydrogen      chlorine ; (molten NaCl)      sodium      chlorine ;	2
12(b)(ii)	mobile ions carry charge / produce current / allow electricity to flow ; ions are not mobile / fixed in a solid ;	2

Question	Answer	Marks
13(a)(i)	light travels faster than sound ;	1
13(a)(ii)	region where a charge experiences a force ;	1
13(a)(iii)	current = charge / time / 1.21 / 0.00011 ; = 11000 (A) ;	2
13(b)(i)	middle ray passes through without deviation AND bottom ray passes out parallel to principal axis AND all 3 rays pass through a point ;	1
13(b)(ii)	inverted arrow drawn from principal axis to intersection of three rays ;	1