Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CO-ORDINATED SCIENCES **0654/41**

Paper 4 Theory (Extended) **May/June 2017**

MARK SCHEME

Maximum Mark: 120

Published

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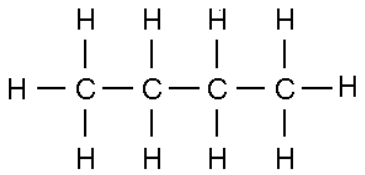
Question	Answer	Marks
1(a)(i)	**Y** umbilical cord ; **Z** amniotic fluid ;	**2**
1(a)(ii)	protects (the fetus) from mechanical shock ; protects (the fetus) from drying out ; protects (the fetus) from temperature fluctuations ;	**max 1**
1(a)(iii)	carries oxygen / glucose / nutrients, to the fetus ; 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 °C ; $E/m\Delta\theta$ / 156 000 / 1.2 × 31 ; = 4190 / 4194 (J / Kg °C) ;	**3**
2(a)(ii)	efficiency = useful energy out / energy in × 100 / 2600 / 3000 × 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)	$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3H_2(g)$ 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 = 4×2 / $4 \times 6 \div 3 = 8$; volume of ammonia = $8 \times 24 = 192$ (dm^3) ;	**3**

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

Question	Answer	Marks
5(a)	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ symbols ; balancing ;	**2**
5(b)	stunted weak stem ;	**1**
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 ;	**max 3**
5(c)(ii)	less transpiration / diffusion of water vapour / water loss / evaporation ; smaller water potential gradient ; slower movement of, water / ions ;	**max 2**
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 ;	**max 3**

Question	Answer	Marks
6(a)(i)	<u>fractional distillation</u> ;	**1**
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 ;	**3**
6(a)(iii)	pure / single substances have discrete boiling point / owtte ; liquid mixture has a range of boiling point ;	**2**
6(b)(i)	 4 carbon atoms and 10 hydrogen atoms ; all else correct ;	**2**
6(b)(ii)	flammable / produce CO_2 / H_2O / CO when burnt ;	**1**

Question	Answer	Marks
7(a)(i)	4 (m / s) ;	**1**
7(a)(ii)	area under graph / working ; 20 + 20 + 50 = 90 (m) ;	**2**
7(a)(iii)	working **;** e.g. correct substitution into formula such as 4 / 10 ;	**1**
7(a)(iv)	force = mass × acceleration / 950 × 0.4 ; 380 (N) ;	**2**
7(b)(i)	move faster ;	**1**
7(b)(ii)	more frequent collisions / collide at greater speed, with tyre wall ; more force exerted on tyre walls ;	**2**
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 ;	**3**
7(c)(ii)	so that humans, are not exposed to the high voltage circuit / operate low voltage switching circuit / owtte ;	**1**

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** than at **A** AND K.E. at **B** and **C** 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**

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

Question	Answer	Marks
11(a)	use Geiger counter etc. ; test for absorption by shield of lead / thick aluminium ; γ-rays are more penetrating than α or β / α and β will not penetrate lead ; OR measure deflection by magnetic / electric field ; γ-rays not deflected / α and β deflected ;	**3**
11(b)	$^{235}_{92}U$; $^{4}_{2}He$ OR $^{4}_{2}\alpha$;	**2**
11(c)	correct working ; 28 (Ω) ;	**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)	λ = 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**