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**CO-ORDINATED SCIENCES**

**0654/41**

Paper 4 Theory (Extended)

**October/November 2017**

MARK SCHEME

Maximum Mark: 120

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**Published**

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This document consists of **12** printed pages.

Question	Answer	Marks
1(a)(i)	<b>A</b> – prostate gland ; <b>B</b> – urethra ;	<b>2</b>
1(a)(ii)	'X' on testicle ;	<b>1</b>
1(b)(i)	reduction division ; chromosome number halved ; from diploid to haploid ;	<b>max 2</b>
1(b)(ii)	egg bigger / sperm smaller ; egg non-motile / sperm, motile ;  only sperm has tail / ORA ; egg contains X chromosome <b>and</b> male contains X or Y chromosome ;	<b>max 2</b>
1(b)(iii)	<u>fertilisation</u> ;	<b>1</b>

Question	Answer	Marks
2(a)	2 ;	<b>1</b>
2(b)(i)	number of protons ; in one atom (of an element) / in the nucleus ;	<b>2</b>
2(b)(ii)	mass number of sodium is 23 and mass number of hydrogen is 1; sodium (nucleus) contains neutrons and protons ; protons and neutrons have same mass ; 12 (neutrons) and 11 (protons) and hydrogen has 1 proton ;	<b>max 2</b>
2(c)	2,8,2 ;	<b>1</b>
2(d)	chlorine ; $Cl_2$ ;	<b>2</b>

Question	Answer	Marks
3(a)(i)	<b>B, C and D ;</b>	<b>1</b>
3(a)(ii)	<b>A and E ;</b>	<b>1</b>
3(b)(i)	transformer ;	<b>1</b>
3(b)(ii)	4 seen in calculation ; 2 ( $\Omega$ ) ;	<b>2</b>
3(c)(i)	<u>nuclei</u> are split ;	<b>1</b>
3(c)(ii)	$^{230}\text{Th}$ ; $_{90}\text{Th}$ ; $^4_2\text{He}$ ;	<b>3</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)	more energy / fuel used in cold season (produces more carbon dioxide) ; more photosynthesis in warm season (uses more carbon dioxide) ;	<b>max 1</b>
4(b)	methane ;	<b>1</b>
4(c)(i)	solar radiation enters atmosphere ; reflected from Earth's, surface / atmosphere (as IR), / Earth absorbs shorter wavelengths and warms up then gives out longer wavelength (IR) / radiation (absorbed and) reradiated from Earth's surface / owtte ; carbon dioxide, absorbs radiation / prevents radiation escaping / less radiation emitted than absorbed ;	<b>3</b>
4(c)(ii)	rising sea levels / melting polar ice ; more extreme weather / hurricane / tsunamis / monsoons / forest fires ; flooding ; desertification ; species extinction / migration ; loss of habitat ;	<b>max 2</b>
4(c)(iii)	set limits on carbon dioxide emissions / legislation ; fine industries for excess carbon emissions ; subsidise alternative energy ;	<b>max 2</b>

Question	Answer	Marks
5(a)(i)	78 ;	1
5(a)(ii)	2 from oxygen and noble gases ;	1
5(b)(i)	negative / minus ; $\text{N}_3^-$ ;	2
5(b)(ii)	$M_r$ sodium azide = $23 + (14 \times 3) = 65$ ; moles of sodium azide = $130 \div 65 = 2$ ; 3 moles of nitrogen ; so volume of nitrogen = $3 \times 24 = 72 \text{ (dm}^3\text{)}$ ;	4
5(c)(i)	fractional distillation ; of <u>liquefied</u> air ;	2
5(c)(ii)	nitrogen + hydrogen $\rightarrow$ ammonia ;	1

Question	Answer	Marks
6(a)(i)	all symbols correct ; all connected correctly in series circuit and all else correct ;	2
6(a)(ii)	vibration / oscillation ;	1
6(b)(i)	m=dV OR $1000 \times 0.012$ OR 12 (kg) ;  $(\Delta T) = \frac{E}{mc}$ OR $\frac{2000000}{12 \times 4200}$  40 °C ;  maximum temperature = 40 + 20 °C (= 60 °C) ;	4
6(b)(ii)	thermal energy is lost (to surroundings / casing ) ;	1

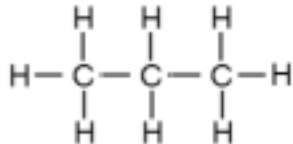
Question	Answer	Marks
7(a)(i)	water lost, by evaporation / as water <u>vapour</u> ; through the stomata ; ref to transpiration ;	max 2
7(a)(ii)	<i>transpiration / water loss from leaf...</i> reduces water potential at top of plant ; (causes) movement of water up xylem ;  ref to cohesion of molecules ; down water potential gradient ;	max 3
7(b)(i)	0.8 (g) ;	1
7(b)(ii)	more stomata on lower surface of leaf ;	1
7(b)(iii)	more, water / mass loss (from leaves A, B, C) ; no / very little, water / mass loss from leaf D ;	2

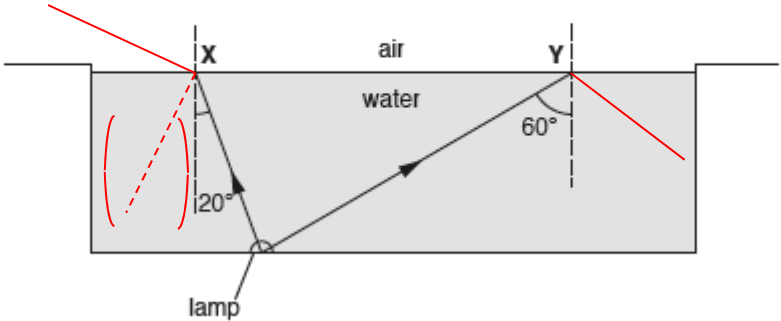
Question	Answer	Marks
8(a)(i)	<p><b>Q</b> – hydrogen  <b>R</b> – none  <b>S</b> – hydrogen  <b>T</b> – carbon dioxide</p> <p>1 correct ;  2 or 3 correct ;  4 correct ;</p>	<b>3</b>
8(a)(ii)	<p><b>R</b> no change in pH because copper does not react with dilute sulfuric acid ;  <b>S</b> pH increases because solution becomes alkaline / calcium hydroxide is produced ;</p>	<b>2</b>
8(a)(iii)	<p>particle K. E. decreases  because reaction endothermic / temperature decreases ;</p>	<b>1</b>
8(b)(i)	<p>the higher the concentration (of acid) the higher the rate of reaction / proportional ;  relationship is direct proportion / or description ;</p>	<b>2</b>
8(b)(ii)	<p>greater concentration of acid causes greater concentration of particles ;  at higher concentration of particles there is a greater collision frequency ;</p>	<b>max 2</b>

Question	Answer	Marks
9(a)(i)	maximum speed = 5.0 m/s ; KE = $\frac{1}{2} mv^2$ OR $\frac{1}{2} \times 75 \times 5 \times 5$ ; = 940 (J) ;	3
9(a)(ii)	$\frac{\Delta v}{t}$ OR 4/10 OR 5/12.5 ;  = 0.4 ; m/s <sup>2</sup> ;	3
9(a)(iii)	F = ma OR = 75 × 0.4 ; = 30 (N) ;	2
9(b)(i)	ultraviolet written in correct box AND infra-red written in correct box ;	1
9(b)(ii)	300 000 (km/s) ; because all electromagnetic waves travel at this speed ;	2
9(c)	latent heat of fusion required to <u>melt</u> snow ; to break bonds (between molecules)/to overcome attractive forces (between molecules) / to increase potential energy of the molecules ;	2



<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)(i)	eaten a meal ;	<b>1</b>
10(a)(ii)	6 (hours) ;	<b>1</b>
10(a)(iii)	pancreas detects rise in blood glucose concentration ; (pancreas) produces insulin ; (causing liver) to convert glucose to glycogen ;	<b>max 2</b>
10(b)	exercise ; starvation ;	<b>max 1</b>
10(c)(i)	a change from, normal / set point ; (causes) response that, cancels out the change / returns system to normal / returns system to a set point ;	<b>2</b>
10(c)(ii)	temperature control ;	<b>1</b>

Question	Answer	Marks
11(a)	reference to long time required to form fossil fuels / AVP ;	1
11(b)(i)	evaporation <i>followed by</i> condensation ;	1
11(b)(ii)	(average) size / surface area of molecules in gasoline is lower ; intermolecular forces / forces between molecules are lower ; lower (thermal) energy / lower temperature required to separate molecules / overcome forces ;	3
11(c)	$x = 7$ and $y = 16$ ;	1
11(d)	propene ;	1
11(d)(ii)	bromine decolourised / orange to colourless ; propene is an alkene / is unsaturated / double bond ;	2
11(d)(iii)	$C_3H_8$ ;  same number of C and H as in formula and correctly bonded ;	2

Question	Answer	Marks
12(a)(i)	20 N ; forwards / to the right ;	2
12(a)(ii)	the swimmers speed increases/ acceleration ; resultant force/ unbalanced force, to right / in direction of movement, /driving force > frictional force ;	2
12(b)(i)	compressions are regions where the particles in air are close together / rarefactions are regions where the particles in air are spread out ; compressions are regions with air at high pressure / rarefactions are regions with air at low pressure ;	max 1
12(b)(ii)	transverse waves oscillate at right angles to direction of wave/energy transfer ; longitudinal waves oscillate parallel to direction of wave/energy transfer ;	2
12(c)	<p>at Y reflection only is shown ; at X refraction (and reflection) is shown ; total internal reflection occurs when angle of incidence exceeds critical angle / angle of incidence = angle of reflection / refraction away from normal when ray travels from denser to less dense medium ;</p> 	3

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
13(a)(i)	regulate/control the temperature ; (prevent) enzyme denaturation / yeast being killed / so that yeast is active ; effect on rate of fermentation / respiration / reaction ;	<b>max 2</b>
13(a)(ii)	enable all <u>yeast</u> to access the nutrients / oxygen ; maintain even temperature in fermenter ;	<b>max 1</b>
13(b)(i)	glucose → ethanol / alcohol + carbon dioxide ;	<b>1</b>
13(b)(ii)	lactic acid produced in animals (but not in yeast) ; ethanol / alcohol / carbon dioxide not produced in animals ;	<b>max 1</b>
13(c)	bread making ;	<b>1</b>