CO-ORDINATED SCIENCES **0654/41**

Paper 4 Theory (Extended) **October/November 2017**

MARK SCHEME

Maximum Mark: 120

Published

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

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

Question	Answer	Marks
2(a)	2 ;	**1**
2(b)(i)	number of protons ; in one atom (of an element) / in the nucleus ;	**2**
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 ;	**max 2**
2(c)	2,8,2 ;	**1**
2(d)	chlorine ; Cl_2 ;	**2**

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

Question	Answer	Marks
4(a)	more energy / fuel used in cold season (produces more carbon dioxide) ; more photosynthesis in warm season (uses more carbon dioxide) ;	max 1
4(b)	methane ;	1
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 ;	3
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 ;	max 2
4(c)(iii)	set limits on carbon dioxide emissions / legislation ; fine industries for excess carbon emissions ; subsidise alternative energy ;	max 2

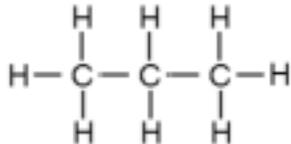| Question	Answer	Marks
5(a)(i)	78 ;	1
5(a)(ii)	2 from oxygen and noble gases ;	1
5(b)(i)	negative / minus ; N_3^- ;	2
5(b)(ii)	M_r sodium azide = 23 + (14 × 3) = 65 ; moles of sodium azide = 130 ÷ 65 = 2 ; 3 moles of nitrogen ; so volume of nitrogen = 3 × 24 = 72 (dm^3) ;	4
5(c)((i)	fractional distillation ; of <u>liquefied</u> air ;	2
5(c)(ii)	nitrogen + hydrogen → ammonia ;	1

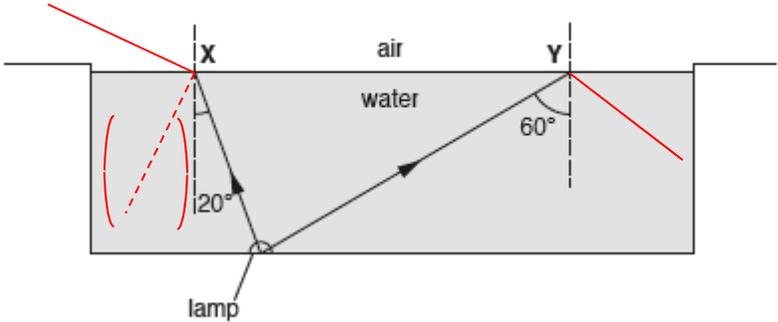| Question	Answer	Marks
6(a)(i)	all symbols correct ; all connected correctly in series circuit and all else correct ;	**2**
6(a)(ii)	vibration / oscillation ;	**1**
6(b)(i)	m=dV OR 1000 × 0.012 OR 12 (kg) ; $(\Delta T) = \dfrac{E}{mc}$ OR $\dfrac{2\,000\,000}{12 \times 4200}$ 40 $^{\circ}$C ; maximum temperature = 40 + 20 $^{\circ}$C (= 60 $^{\circ}$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)	*transpiration / water loss from leaf…* 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)	**Q** – hydrogen **R** – none **S** – hydrogen **T** – carbon dioxide 1 correct ; 2 or 3 correct ; 4 correct ;	**3**
8(a)(ii)	**R** no change in pH because copper does not react with dilute sulfuric acid ; **S** pH increases because solution becomes alkaline / calcium hydroxide is produced ;	**2**
8(a)(iii)	particle K. E. decreases because reaction endothermic / temperature decreases ;	**1**
8(b)(i)	the higher the concentration (of acid) the higher the rate of reaction / proportional ; relationship is direct proportion / or description ;	**2**
8(b)(ii)	greater concentration of acid causes greater concentration of particles ; at higher concentration of particles there is a greater collision frequency ;	**max 2**

Question	Answer	Marks
9(a)(i)	maximum speed = 5.0 m/s ; KE = ½ mv^2 OR ½ × 75 × 5 × 5 ; = 940 (J) ;	**3**
9(a)(ii)	$\dfrac{\Delta v}{t}$ OR 4/10 OR 5/12.5 ; = 0.4 ; m/s^2 ;	**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**

Question	Answer	Marks
10(a)(i)	eaten a meal ;	**1**
10(a)(ii)	6 (hours) ;	**1**
10(a)(iii)	pancreas detects rise in blood glucose concentration ; (pancreas) produces insulin ; (causing liver) to convert glucose to glycogen ;	**max 2**
10(b)	exercise ; starvation ;	**max 1**
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 ;	**2**
10(c)(ii)	temperature control ;	**1**

Question	Answer	Marks
11(a)	reference to long time required to form fossil fuels / AVP ;	1
11(b)(i)	evaporation *followed by* 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)	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 ;	**3**

Question	Answer	Marks
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 ;	**max 2**
13(a)(ii)	enable all <u>yeast</u> to access the nutrients / oxygen ; maintain even temperature in fermenter ;	**max 1**
13(b)(i)	glucose → ethanol / alcohol + carbon dioxide ;	**1**
13(b)(ii)	lactic acid produced in animals (but not in yeast) ; ethanol / alcohol / carbon dioxide not produced in animals ;	**max 1**
13(c)	bread making ;	**1**