



---

**CO-ORDINATED SCIENCES**

**0654/41**

Paper 4 Theory (Extended)

**October/November 2017**

MARK SCHEME

Maximum Mark: 120

---

**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2017 series for most Cambridge IGCSE<sup>®</sup>, Cambridge International A and AS Level components and some Cambridge O Level components.

---

© IGCSE is a registered trademark.

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 <b>and</b> 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 <sub>2</sub> ;	2

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

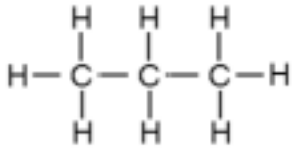
Question	Answer	Marks
7(a)(i)	water lost, by evaporation / as water <u>vapour</u> ; through the stomata ; ref to transpiration ;	max 2
7(a)(ii)	<i>transpiration / water loss from leaf...</i> reduces water potential at top of plant ; (causes) movement of water up xylem ;  ref to cohesion of molecules ; 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

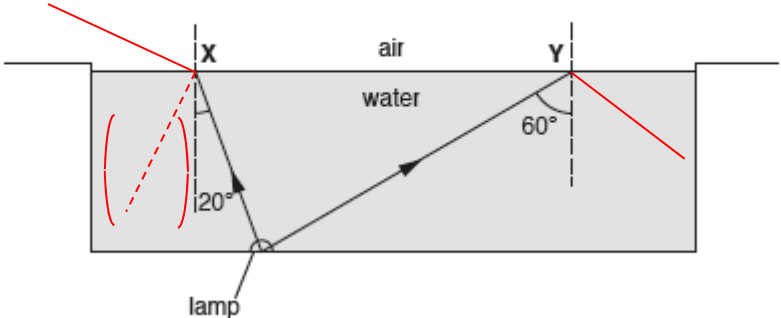
Question	Answer	Marks
8(a)(i)	<p><b>Q</b> – hydrogen  <b>R</b> – none  <b>S</b> – hydrogen  <b>T</b> – carbon dioxide</p> <p>1 correct ;  2 or 3 correct ;  4 correct ;</p>	<b>3</b>
8(a)(ii)	<p><b>R</b> no change in pH because copper does not react with dilute sulfuric acid ;  <b>S</b> pH increases because 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>