CO-ORDINATED SCIENCES **0654/41**

Paper 4 Theory (Extended) **May/June 2018**

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.

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This document consists of **11** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1: Marks must be awarded in line with: • the specific content of the mark scheme or the generic level descriptors for the question • the specific skills defined in the mark scheme or in the generic level descriptors for the question • the standard of response required by a candidate as exemplified by the standardisation scripts.
GENERIC MARKING PRINCIPLE 2: Marks awarded are always **whole marks** (not half marks, or other fractions).
GENERIC MARKING PRINCIPLE 3: Marks must be awarded **positively**: • marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate • marks are awarded when candidates clearly demonstrate what they know and can do • marks are not deducted for errors • marks are not deducted for omissions • answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.
GENERIC MARKING PRINCIPLE 4: Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:
Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6:
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)(i)	**A** ; **C** ;	2
1(a)(ii)	increased surface area / elongated ; for (more) absorption ;	2
1(b)	fatty acids <u>and</u> glycerol ;	1
1(c)	<u>emulsifies</u> fats ; larger surface area ; for, enzyme / lipase, to act ;	max 2
1(d)	coronary heart disease (CHD) ;	1
1(e)	exercise / reduce (overall), food / calorie / energy intake ;	1

Question	Answer	Marks
2(a)(i)	Al_2O_3 ;	1
2(a)(ii)	opposite charges attract ; idea that (ions are highly charged so) attractive force is high ; large amount of thermal energy needed to separate ions / melt ;	max 2
2(a)(iii)	cryolite / sodium aluminium fluoride ; the mixture has lower melting point (than aluminium oxide) / reduces thermal energy required (for melting) / reduces energy cost (of melting) / cryolite has lower mp and dissolves aluminium oxide ;	2
2(a)(iv)	moves / attracted towards cathode / negative electrode ; gains electrons from cathode ; each ion gains three electrons / is discharged / $Al^{3+} + 3e^- \rightarrow Al$;	3

Question	Answer	Marks
2(b)	 all correct bonding electrons ; all correct non-bonding electrons ;	2
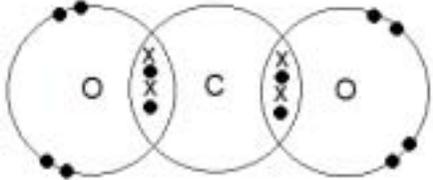
Question	Answer	Marks
3(a)(i)	acceleration = change in speed / time or 6–4 / 12 or 2 / 12 ; = 0.17 (m / s^2) ; force = mass $\times$ acceleration or 4800 $\times$ 0.167 ; = 800 (N) ;	4
3(a)(ii)	KE = ½ mv^2;or suitable substitution ; initial KE = (½ $\times$ 4800 $\times$ 4 $\times$ 4) = 38400 J or final KE = (½ $\times$ 4800 $\times$ 6 $\times$ 6) = 86400 J ; difference in KE = 86 400 – 38 400 = 48 000 (J) ;	3
3(b)	energy input = energy output $\times$ 100 / 25 ; = 2.0 (J) ;	2
3(c)(i)	two converging rays ; coming to a focus at the burning grass ;	2
3(c)(ii)	real image can be projected onto a screen / is formed where the light rays are focussed / ORA ; virtual image is one from which the light rays *appear* to come from that image ;	max 1

Question	Answer	Marks
4(a)(i)	increase and decrease ; peak at 1990 ;	**2**
4(a)(ii)	Increased awareness of link between smoking and lung diseases ; Reference to education / advertising / medical advice ; AVP ;;	**max 2**
4(b)	lung cancer takes years to develop / does not develop straight away ;	**1**
4(c)	 1 correct = 1 mark ; 2 / 3 correct = 2 marks ; 4 correct = 3 marks ;	**3**
4(d)	cilia damaged ; (cilia) can't remove mucus / mucus builds up ; <u>bacteria</u> trapped in the mucus ; bacteria breed / increase, causing infection ;	**max 3**
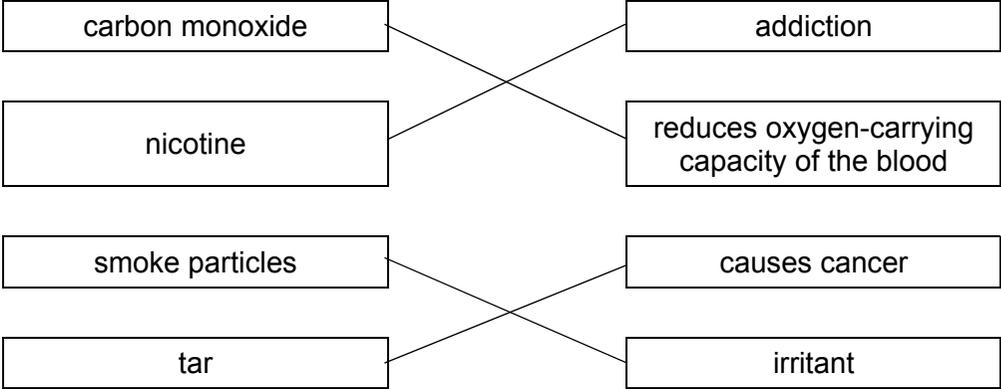
Question	Answer	Marks
5(a)	salt and water ;	**1**

Question	Answer	Marks
5(b)(i)	$HCl\ (aq)\ +\ KOH\ (aq)\ \rightarrow\ KCl\ (aq)\ +\ H_2O\ (l)$ all formulae and correct balancing ; all state symbols correct ;	2
5(b)(ii)	H^+ and OH^- / hydrogen and hydroxide ;	1
5(c)(i)	**step 1** $0.072\ \div\ 24\ =\ 0.003$ moles ; **step 2** 0.003 moles ; **step 3** 0.003×24.0 or $0.072\ (dm^3)$;	3
5(c)(ii)	Avogadro's Constant / Number ;	1

Question	Answer	Marks
6(a)	magnet ; wire coil ;	2
6(b)(i)	lower current ; reduces power / energy losses ;	2
6(b)(ii)	$V_2 = V_1 \times N_2 / N_1$ or $700 \times 440\,000 / 28\,000$; $= 11\,000$ V or 11 kV ;	2
6(c)	louder / increases ;	1
6(d)(i)	region of high pressure / high density ;	1
6(d)(ii)	distance between two (successive) <u>compressions</u> ;	1

Question	Answer	Marks
7(a)(i)	calcium carbonate ;	1
7(a)(ii)	carbon dioxide ;	1
7(b)(i)	1.4 mins ; (idea that this is) the time for half the (max) amount of gas to collect ;	2
7(b)(ii)	idea that collision frequency / chance of collision decreases ; (because) concentration of (reacting / acid) particles / ions, is decreasing / decreasing surface area (for collision) ;	2
7(c)(i)	exothermic – combustion of carbon ; endothermic – decomposition of calcium carbonate ;	2
7(c)(ii)	thermal energy ; to chemical (potential) energy ;	2
7(c)(iii)	nitrogen present in air (used to burn carbon) ; nitrogen unreactive / does not burn / owtte ;	2

Question	Answer	Marks
8(a)(i)	13 + 15 + 33 + 14 = 75 ; 15 / 75 $\times$ 100 = 20 (%) ;	2
8(a)(ii)	discontinuous ;	1
8(a)(iii)	genes / DNA / inherited (only) ;	1
8(b)	mutation ;	1
8(c)	select) brown rabbits and breed them together ; (select) brown offspring ; repeat the process (over many generations) ;	3

Question	Answer	Marks
9(a)(i)	watt ;	1
9(a)(ii)	I = P / V or 2500 / 230 ; = 11 (A) ;	2
9(b)	particles vibrate more when hotter ; vibration / KE passed from particle to particle ;	2
9(c)	SHC = $\Delta E / m \times \Delta T$ = 2 520 000 / 15 000 $\times$ 40 ; = 4.2 ; J / g$^\circ$C ;	3
9(d)	warm day means more energy given to particles ; so more have the energy needed to evaporate / leave surface of water ;	2

Question	Answer	Marks
10(a)	organisms ; environment ;	2
10(b)	at 3rd trophic level when feeding on mayfly nymph / freshwater shrimp ; at 4th trophic level when feeding on dragonfly nymph ;	2
10(c)	energy lost between the trophic level ; by named example e.g. respiration / heat / excretion ; not enough energy to sustain further trophic levels ;	max 2

Question	Answer	Marks
11(a)(i)	44 ;	**1**
11(a)(ii)	17 electrons ; 2, 8, 7 ;	**2**
11(b)	orange to colourless ;	**1**
11(c)(i)	 4 × C singly bonded in a linear chain ; 2 × H singly bonded to each C in chain ; indication that chain continues ;	**3**
11(c)(ii)	addition (polymerisation) ;	**1**
11(c)(iii)	hydrolysis ; acid / alkali ; OR enzyme ; protease ;	**2**
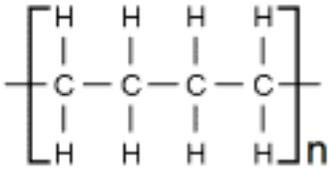
Question	Answer	Marks
12(a)	black surfaces are better absorbers of radiation than white surfaces ;	**1**
12(b)(i)	$R = R_1 \times R_2 / R_1 + R_2$ or $R = 16 \times 8 / 16 + 8$ or $1 / R = 1 / R_1 + 1 / R_2$ or $1 / R = 1 / 16 + 1 / 8$; $5\ (\Omega)$;	**2**

Question	Answer	Marks
12(b)(ii)	I = V / R or 9 / 8 ; = 1.1 (A) ;	2
12(c)(i)	visible light in 4th box and infra-red in 5th box ; | γ-rays		ultraviolet	**visible light**	**infra-red**	microwaves			1
12(c)(ii)	frequency = speed / wavelength or 300 000 000 / 7.5 × 10^{-7} or 300 000 000 / 750 × 10^{-9} ; = 4 × 10^{14} (Hz) ;	2
12(c)(iii)	alpha / α ;	1

Question	Answer	Marks
13(a)	**A** ; **D** ;	2
13(b)	pancreas releases insulin ; (insulin causes) liver to convert glucose to glycogen ;	2
13(c)	negative feedback ;	1
13(d)	carbon, hydrogen and oxygen ;	1