



COMBINED SCIENCE

0653/41

Paper 4 Extended Theory

October/November 2018

MARK SCHEME

Maximum Mark: 80

Published

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GENERIC MARKING PRINCIPLE 2:

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Question	Answer	Marks
1(a)(i)	arrow drawn from the <u>plasma</u> of the blood to the air sac of alveolus ;	1
1(a)(ii)	there is a concentration / diffusion gradient / greater oxygen concentration in alveolus than the blood ;	1
1(a)(iii)	thin wall / flattened cells ; large surface area ; good blood supply ; Max 2	2
1(b)	through <u>placenta</u> ; and then one of by diffusion ; via (umbilical) cord ; Max 2	2
1(c)(i)	carbon dioxide / CO ₂ / produced / present (in smoke) ;	1
1(c)(ii)	causes cancer ; stimulates mucus production ; Max 1	1
1(c)(iii)	mucus cannot be swept out of the lungs ; pathogens / particles (in mucus) more likely to enter lungs ;	2
1(c)(iv)	combines with the haemoglobin / red blood cells ; CO replaces oxygen (on haemoglobin) ; reduces the transport of oxygen by blood / less oxygen available (for cells) ; Max 2	2

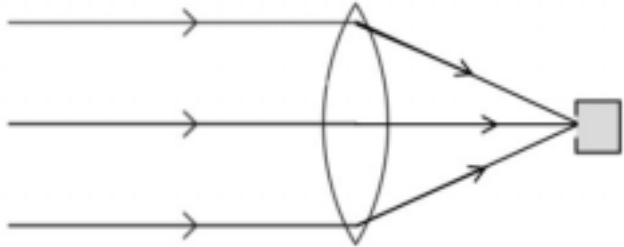
Question	Answer	Marks
2(a)(i)	covalent ;	1
2(a)(ii)	shared (pairs of) electrons ;	1
2(a)(iii)	two bond pairs ; two non-bond pairs on O atom ;	2
2(b)(i)	(electrode X) cathode ; (electrode Y) anode ;	2
2(b)(ii)	(to electrode X) copper ions / Cu^{2+} ; (to electrode Y) chloride (ions) / Cl^- ;	2
2(c)	(negative) lead ; (positive) oxygen ;	2

Question	Answer	Marks
3(a)(i)	weight / gravitational (force) ;	1
3(a)(ii)	yes (<i>no mark</i>) constant speed / no acceleration, (so forces must balance) ;	1

Question	Answer	Marks
3(b)(i)	distance = speed $\times$ time and / or work done = force $\times$ distance or $d = s \times t$ and / or $w = F \times d$ or $200\,000 \times 25 \times (500 - 200)$; $= 1\,500\,000\,000$; J / joules ;	3
3(b)(ii)	(negative) acceleration / deceleration ; not constant (deceleration) / increasing deceleration (becoming constant deceleration) ;	2
3(b)(iii)	evidence of area under graph calculated up to $200\text{ s} / \frac{1}{2} \times 200 \times 25$; 2.5 km ;	2
3(b)(iv)	total distance = $2.5 + (500 - 200) \times 0.025 + 2.8 = 12.8$ km ;	1

Question	Answer	Marks
4(a)(i)	seaweed $\rightarrow$ shellfish $\rightarrow$ crab $\rightarrow$ octopus $\rightarrow$ sea lion $\rightarrow$ killer $\rightarrow$ whale ;;	2
4(a)(ii)	consists of more than 4 trophic levels ;	1
4(b)	protein synthesis / building up molecules ; cell division ; growth ; Max 2	2
4(c)	not all eaten ; not all digested / absorbed / egestion / lost in faeces ; excretion / lost in urine ; Max 2	2

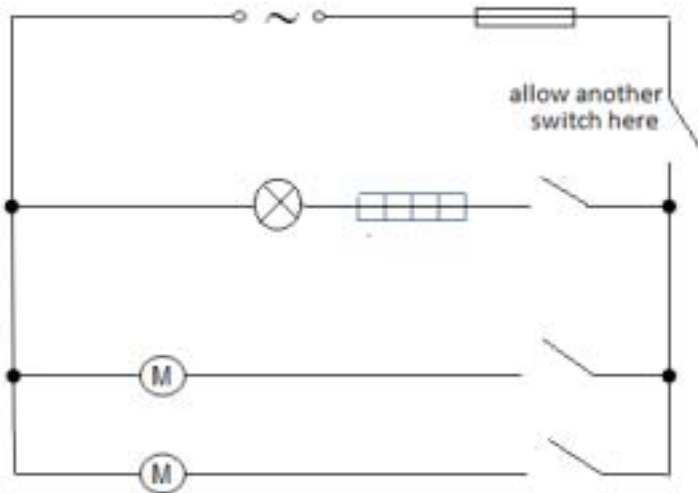
Question	Answer	Marks
5(a)(i)	sulfuric_acid / H_2SO_4 ; calcium oxide / CaO / calcium hydroxide / $\text{Ca}(\text{OH})_2$ calcium carbonate / CaCO_3 ;	2
5(a)(ii)	(technique) filter / filtering / filtration ; (explanation) solid (particles) cannot pass through / remain on filter paper / liquid (particles) can pass through filter paper ;	2
5(b)(i)	(electrical conductor) good (melting point) high ; (both required)	1
5(b)(ii)	2, 8, 8, 2 ;	1
5(c)(i)	more / very rapid / explosive ;	1
5(c)(ii)	any stated value > 25 °C and < 63 °C ;	1
5(d)	(reaction) no (visible) reaction (explanation) copper is less reactive than potassium ; (both required)	1

Question	Answer	Marks
6(a)	(thermal) expansion / expansion on heating / owtte ;	1
6(b)(i)	only ethanol is a liquid at both these temperatures / both fixed points of ammonia / all others are solid at mpt of ammonia / at 78 °C ;	1
6(b)(ii)	typical room temperature / 21 °C is below 30 °C / m.pt. of gallium ; gallium would be a solid at that temperature / (kept above 30) so it does not freeze / owtte ;	2
6(c)(i)	(frequency will) increase ; use of $f = v/\lambda$ to explain increase / as λ decreases frequency increases ;	2
6(c)(ii)	 all three rays extended to meet at the same point at the detector ; (arrows on refracted rays not essential)	1

Question	Answer	Marks
7(a)	$6\text{H}_2\text{O} + 6(\text{CO}_2) \rightarrow \text{C}_6\text{H}_{12}\text{O} + 6(\text{O}_2)$ 1 mark for correct formulae ; 1 mark for balanced (dependent on formulae) ;	2
7(b)	oxygen / gas produced (by the plant and displaces water) ;	1
7(c)(i)	line (meniscus) drawn on Fig.7.1 at a lower position than in Fig. 7.2 ;	1
7(c)(ii)	reference to increased (rate of) photosynthesis ;	1

Question	Answer	Marks
7(d)(i)	due to denaturation of enzymes / damage to leaves / increased soil toxicity ;	1
7(d)(ii)	use cleaner / alternative energy sources / reduce usage of fossil fuels ; remove <u>sulfur dioxide</u> from factory emissions ; catalytic converters ; avp ; Max 2	2

Question	Answer	Marks
8(a)	(size of molecules) P smaller than Q / ora ; (intermolecular forces) P smaller than Q / ora ;	2
8(b)	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$ species ; balancing ;	2
8(c)(i)	alkenes have (one) (carbon-carbon) double bond / $\text{C}=\text{C}$; or alkanes have only (carbon-carbon) single bonds / $\text{C}-\text{C}$;	1
8(c)(ii)	(test) (add) bromine (water) / Br_2 ; (propane) no (visible) change and (propene) decolourises ;	2

Question	Answer	Marks
9(a)(i)	parallel ;	1
9(a)(ii)	 correct lamp symbol ; heater in one branch, a motor in at least one other branch ; switch in series with the component in each branch ; lamp in series with heater only and no short circuits ;	4
9(b)(i)	power = voltage x current / $P = V \times I / I = P / V = 2400 / 240$; = 10 (A) ;	2
9(b)(ii)	total current = $10 + 1.2 + 1.2 = 12.4$ (A) or 12 (A) ;	1
9(b)(iii)	any value from 13 A to 20 A ; fuse value needs to be above max working current of machine, but not too large to put machine components at risk ;	2



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Question	Answer	Marks
1(a)(i)	Z	1
1(a)(ii)	2000 (N) ; constant speed / no acceleration, (so forces must balance) ;	2
1(b)(i)	C on any point on graph line between 50 and 60 s ;	1
1(b)(ii)	distance travelled 20–50 s = speed $\times$ time = $30 \times 3.5 = 105$ m ; distance travelled 50–60 s = $\frac{1}{2} \times 10 \times 3.5 = 17.5$ m ; total distance = $46 + 105 + 17.5 = 168.5$ m ;	3
1(c)(i)	work done = force $\times$ distance / $F \times d$; = $1500 \times 50 = 75\,000$ (J) ;	2
1(c)(ii)	$E = Pt$ / $E = 25\,000 \times 15$; = $375\,000$ (J) ;	2
1(c)(iii)	efficiency = work out / work in ($\times 100$ to give %) / $75\,000 \div 375\,000$ = $0.20 / 20\%$;	2

Question	Answer	Marks
2(a)(i)	(remove MgCO_3) filtration / filtering / filter ; (obtain solid salt) evaporation / crystallisation ;	2
2(a)(ii)	decreases ;	1
2(a)(iii)	(effect) increases ; (explanation) particles collide more frequently / more chance of collisions ;	2
2(b)	exothermic ; chemical (energy changes) to heat / thermal (energy) ;	2

Question	Answer	Marks
2(c)(i)	$(\text{MgCO}_3) + 2(\text{HCl}) \rightarrow \text{MgCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$; formula of magnesium chloride ; all else correct ;	2
2(c)(ii)	(test) (dil. nitric acid and) aqueous silver nitrate / AgNO_3 ; (result) white precipitate / solid;	2

Question	Answer	Marks
3(a)	contains half the full number of chromosomes / half the full amount of genetic material ; the controlling centre of the cell / contains genetic material ;	2
3(b)	<i>tick next to</i> small green or brown flowers ; stigma outside the flowers ; light, smooth pollen grains ;	3
3(c)	<i>any two of</i> A might have a larger (overall) leaf area than B ; A might have more stomata (per leaf) than B ; B might have a thicker / waxy cuticle ; Max 2	2
3(d)(i)	similar line to B drawn below it with a gentler gradient ;	1
3(d)(ii)	rate of transpiration is reduced when the humidity increases ;	1

Question	Answer	Marks
4(a)	P and S ;	1

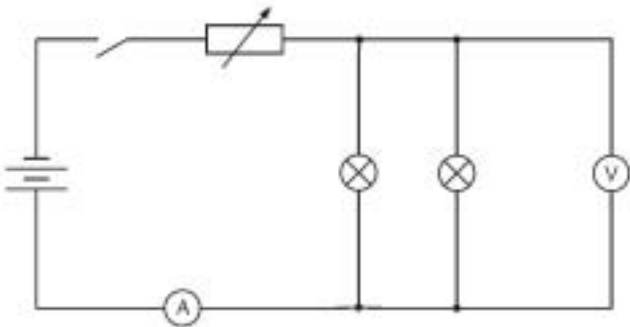
Question	Answer	Marks
4(b)	right ; lower ; left ; shorter ;	3
4(c)(i)	X umbilical cord ; Y amniotic fluid ;	2
4(c)(ii)	reference to the loss of protection (of fetus) ; higher risk of physical damage / infection / premature birth ;	2
4(c)(iii)	oxygen / glucose / any named dissolved nutrient ; carbon dioxide ;	2

Question	Answer	Marks
5(a)(i)	covalent ;	1
5(a)(ii)	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $ C – C single bond ; six correctly located C-H single bonds ;	2
5(b)(i)	<u>fractional</u> distillation ;	1
5(b)(ii)	gasoline molecules • are smaller ; • have lower boiling points ; • have weaker intermolecular attractive forces ;	3
5(c)	cracking ;	1
5(d)	2,4 ;	1

Question	Answer	Marks
6(a)	In liquids: in liquids molecules further apart / not tightly packed / in solids molecules are tightly packed ; in liquids attractive forces are low / in solids attractive forces are high ; in liquids molecules are able to move around / slide past each other / in solids molecules (only) vibrate (around a fixed point) ;	3
6(b)	thermometer ;	1
6(c)	ticks in first, second, and fourth box, cross in 3rd box ;	2
6(d)(i)	Conduction and convection require a medium / can't travel through a vacuum / radiation can travel through a vacuum ;	1
6(d)(ii)	highest frequency ;	1

Question	Answer	Marks
7(a)	glucose / starch / sugar ;	1
7(b)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ 1 mark for formulae ; 1 mark for balanced ;	2
7(c)(i)	<i>any two from</i> not all of the rabbit is eaten ; not all of the rabbit is digested / absorbed by the fox / egestion in fox ; excretion / production / loss of urine in fox ; some energy wasted as heat / respiration / carbon dioxide in fox ; Max 2	2
7(c)(ii)	decomposers / named type of decomposer e.g. bacteria / fungi ; feed on / break down (carbon compounds in the fox's) body ; carbon dioxide released by respiration (of decomposers) ; Max 2	2

Question	Answer	Marks
8(a)	lead bromide is solid / needs to be molten / liquid ; so that ions are mobile / can move ;	2
8(b)(i)	high density / high melting point / (element or compound) act as catalysts ;	1
8(b)(ii)	(to the anode) bromide / Br^- ; (to the cathode) copper(II) / Cu^{2+} ;	2
8(c)(i)	carbon / C / coke ;	1
8(c)(ii)	carbon monoxide / CO / carbon / C ;	1

Question	Answer	Marks
9(a)	to control / vary the current through / voltage across the lamp ;	1
9(b)	the idea that lamp less bright because lower power / energy output ; use of power = $V \times I$ e.g. $V \times I$ reduces in value from expt. 1 to expt. 4 ;	2
9(c)(i)	 lamp in parallel as shown ;	1
9(c)(ii)	0.38 A ; because lamps are identical current divides equally / they have the same / equal resistance ;	2



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

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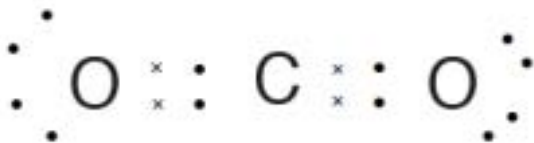
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1(a)	(B) cilia ; removes mucus from airway ; (C) cytoplasm ; place where chemical reactions / respiration takes place ;	4
1(b)(i)	feathery / large surface area ; for collecting pollen ;	2
1(b)(ii)	no need to attract insects ; because they are not needed for pollination / pollination is by wind / not by insects ;	2

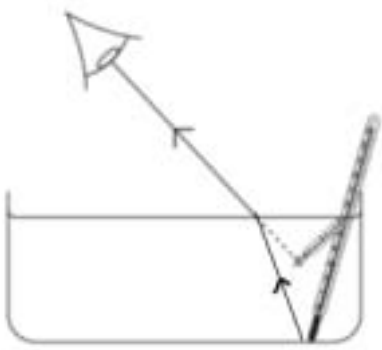
Question	Answer	Marks
2(a)(i)	 Two bonding pairs between C atom and each O atom ; correct non-bonding electrons on each O atom ;	2
2(a)(ii)	covalent ;	1
2(a)(iii)	(test) (step 1) add acid and (step 2) reference to use of limewater ; (observations) (limewater turns) milky / cloudy / white ppt. / solid ;	2
2(a)(iv)	the idea that thermal (energy) / heat (changes) to chemical (energy) ;	1
2(b)(i)	2, 8, 8, 2 shown as crosses or clear dots ;	1
2(b)(ii)	loss of electrons ; (reference to loss of) two electrons ;	2

Question	Answer	Marks
3(a)(i)	C at any point on graph line between 5.7 and 10 s ;	1
3(a)(ii)	average speed = total distance / total time = 20 / 30 ; = 0.67 (m / s) ;	2
3(b)(i)	Z ;	1
3(b)(ii)	X and Z equal / same (20–25) s ; X > Z for (25–30) s ;	2
3(c)	KE = $\frac{1}{2} mv^2$ / $\frac{1}{2} \times 20 \times 0.8^2$; = 6.4 J ;	2
3(d)	efficiency = [energy out / energy in] ($\times 100\%$) or energy in = energy out / 0.2 or 2400 / 0.2 / energy in = 2400 $\times 100$ / 20 ; = 12 000 (J) ;	2

Question	Answer	Marks
4(a)	produces irritation / cough / more mucus production ;	1
4(b)(i)	thin layer of carbon reduces the amount of light (energy) reaching leaves / chlorophyll ; (chlorophyll) traps less light (energy) ; less conversion to chemical energy ; reduces rate of photosynthesis ; Max 3	3
4(b)(ii)	oxygen used during combustion (of wood) ; oxygen not produced by plants ;	2
4(c)	methane ; infra-red ; global warming ;	3

Question	Answer	Marks
5(a)(i)	(most) A C B (least) D ;	1
5(a)(ii)	(effect) increase ; (explanation) two out of (particles) move faster / gain more kinetic energy ; (particles) collide more often / frequently ; (particles) collide with more energy ; Max 3	3
5(b)(i)	air ; allow oxygen coke ; allow carbon	2
5(b)(ii)	loss / removal of oxygen / O ;	1
5(c)(i)	(aluminium is) too reactive / more reactive than carbon ;	1
5(c)(ii)	electrolysis ;	1

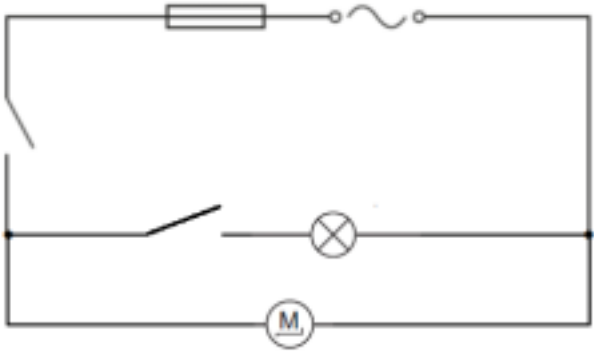
Question	Answer	Marks
6(a)	any three of distances between molecules greater / molecules further apart in gases molecules are closer together in liquids ; forces between molecules of gases are weaker / forces between molecules of a liquid are stronger ; molecules can move freely in gas / molecules rolling / sliding over each other in liquids ; gas volume greater for same mass / liquid volume is smaller for the same mass ; Max 3	3
6(b)(i)	faster / more energetic molecules escape (from surface) ; average speed of remaining molecules less / water has less energy (leading to cooling) ;	2

Question	Answer	Marks
6(b)(ii)	less / slower cooling and less / slower mass loss ; less surface area for evaporation ;	2
6(c)(i)	refraction ;	1
6(c)(ii)	 ray from thermometer bulb to meet ray to eye at water surface;	1

Question	Answer	Marks
7(a)(i)	to supply the heart muscle / tissue ; with oxygen / glucose / oxygenated blood ; for respiration ;	2
7(a)(ii)	fatty deposits ;	1
7(a)(iii)	<i>any two of</i> take plenty of exercise ; eat a diet with little (saturated) fat ; try to reduce stress ; stop / do not smoke ; Max 2	2
7(b)(i)	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$ formulae ; balanced ;	2

Question	Answer	Marks
7(b)(ii)	<u>contraction</u> ;	1
7(b)(iii)	to transport more glucose / oxygen (to muscles) ; to transport more carbon dioxide / distribute heat ;	2

Question	Answer	Marks
8(a)(i)	(A) ethene ; (B) methane ;	2
8(a)(ii)	(A) decolourises ; (B) no (visible) change ;	2
8(a)(iii)	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$ species ; balanced ;	2
8(b)(i)	cracking ;	1
8(b)(ii)	(difference) <i>[(b.pt of) Q is greater]</i> NOTE: no mark for difference, but must be correct for explanation marks to be awarded (explanation) Q has larger / heavier molecules ; molecules of Q have greater intermolecular attractive forces ;	2

Question	Answer	Marks
9(a)(i)	 correct symbol for lamp ; parallel circuit with motor in one branch, lamp in other branch and no short circuit and no additional components ; switch in series with lamp only ;	3
9(a)(ii)	mains supply / (a.c.) power supply ;	1
9(b)	use of $P = IV$ / $I = P / V$; (total) $P = 40 + 300 = 340 \text{ W}$; $(I = 340 / 240) = 1.42 / 1.4 \text{ (A)}$; or use of $P = IV$ / $I = P / V$; $40 / 240 + 300 / 240$; $= (0.17 + 1.25) = 1.42 \text{ (A)} / 1.4 \text{ (A)}$;	3