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PHYSICAL SCIENCE

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Paper 4 Extended Theory

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MARK SCHEME

Maximum Mark: 80

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Question	Answer	Marks
1(a)(i)	use of gradient of the graph ; (correct read off of points and use of $\Delta y / \Delta x =$) 9.6 ; correct unit m/s^2 ;	3
1(a)(ii)	$F = ma$ or 0.15×9.6 ; $= 1.44$ (N) ;	2
1(a)(iii)	$W = f \times d$ or 1.44×4.2 ; 6.05 ;	
1(b)(i)	gradient decreases ;	1
1(b)(ii)	frictional force / air resistance increases (increases with increasing speed) ;	1

Question	Answer	Marks
2(a)	7 electrons in the <u>outer</u> / <u>valence</u> shell ;	1
2(b)(i)	1:2 ratio $\text{Cl}_2 : 2\text{HCl}$; (volume of $\text{Cl}_2 =$) 5 dm^3 ; OR 1:1 ratio $\text{Cl}_2 : \text{H}_2$; (volume of $\text{Cl}_2 =$) $5 (\text{dm}^3)$;	2
2(b)(ii)	(sunlight) provides the energy (for the reaction to occur) / Cl_2 absorbs the UV light / Cl_2 molecule is split by UV ;	1

Question	Answer	Marks
2(c)(i)	$2\text{AgBr} \rightarrow 2\text{Ag} + \text{Br}_2$; ; 1 for reagents and products (products in any order) 1 for balancing	2
2(c)(ii)	<i>any two from:</i> exposure (of AgBr) to light ; metallic silver causes darkening ; gain an electron (from bromine) ; by silver ions ; unexposed silver bromide is removed ;	max 2

Question	Answer	Marks
3(a)	(nuclear) fusion ;	1

Question	Answer	Marks
3(b)(i)	<p><i>max two from:</i></p> <p>nuclei merge ;</p> <p>to form larger nucleus ;</p> <p>reference to mass energy ;</p> <p><i>max two from:</i></p> <p>collision of (two) <u>nuclei</u> ;</p> <p>nuclei small ;</p> <p>nuclei very fast moving ;</p>	3
3(b)(ii)	<p>$E = mc^2$;</p> <p>(correct substitution $E =$) $4 \times 10^7 \times (3 \times 10^8)^2$;</p> <p>$= 3.6 \times 10^{24}$ (J) ;</p>	3

Question	Answer	Marks
4(a)	alkane ;	1
4(b)	wax/polish ;	1
4(c)(i)	C_2H_4 ;	1
4(c)(ii)	<p>high temperatures ;</p> <p>high pressure ;</p>	2
4(c)(iii)	increase the rate (of reaction) ;	1

Question	Answer	Marks
4(d)	<i>test:</i> bromine water / Br ₂ (aq) ; <i>result with unsaturated HC:</i> decolourises ; <i>result with saturated HC:</i> no change / stays orange-brown ;	3

Question	Answer	Marks
5(a)	material 1 and material 2 different suitable metals ; material 1 and material 3 the same suitable metals ;	2
5(b)	9.2 – 1.1 or 8.1 or alternate methods ; 8.1 / 100 = 0.081 V / deg ; T = –14 (°C) ;	3
5(c)(i)	<i>situation where:</i> high or low temperatures / rapidly changing temperatures / remote reading of temperature / measurement of temperature at a point ;	1
5(c)(ii)	metals have high melting points / junction very small / not much energy needed to raise its temperature / hostile environment / junction very small ;	

Question	Answer	Marks
6(a)	does not conduct AND covalent	1

Question	Answer	Marks
6(b)(i)	<p><i>any two from:</i></p> <p>each carbon atom attached to 4 others ;</p> <p>atoms arranged <u>tetrahedrally</u> / <u>tetrahedral</u> ;</p> <p>giant molecular / macromolecular ;</p>	max 2
6(b)(ii)	<p><i>any three from:</i></p> <p>graphite structure is in layers ;</p> <p>weak forces (between layers) ;</p> <p>layers slide over each other</p> <p>each carbon atom attached to (only) 3 others ;</p> <p>(thin) layer(s) of graphite left on paper ;</p>	max 3
6(c)	carbon + oxygen → carbon dioxide	1
6(d)	gain in oxygen ;	1

Question	Answer	Marks
7(a)	ray emerging with an angle of refraction > ray 1 but < ray 3 ;	1
7(b)(i)	c correctly identified and marked ;	1
7(b)(ii)	total internal reflection (with $i \approx r$) ;	1

Question	Answer	Marks
7(c)	$n = \sin i / \sin r$ ($1.34 = \sin 38 / \sin r$) ; $\sin r = \sin 38 / 1.34$ or 0.46 ; $r = 27^\circ$;	3

Question	Answer	Marks
8(a)	(calcium) reacts more quickly (than magnesium) ; calcium more reactive / calcium above magnesium in reactivity series ;	max 2
8(b)	aluminium has an oxide / Al_2O_3 / protective layer ;	1
8(c)	<i>any two from:</i> low density ; can be alloyed ; resists corrosion / resists weathering ; malleable ;	max 2
8(d)	(aluminium is) more reactive than carbon / higher in reactivity series ;	1
8(e)	amphoteric ;	1

Question	Answer	Marks
9(a)(i)	0.53 (A) ;	1

Question	Answer	Marks
9(a)(ii)	use of $V = IR$ ($\rightarrow R = 3 \div 0.53$); 5.7 (Ω);	2
9(a)(iii)	3.2 (Ω);	1
9(b)(i)	100 (cm);	1
9(b)(ii)	use of $P = VI$ or 3×0.77 ; 2.31 (W);	2

Question	Answer	Marks				
10(a)	<table border="1"> <tbody> <tr> <td>carbon monoxide</td> <td>incomplete combustion (of carbon containing substances / of fuel in cars);</td> </tr> <tr> <td>sulfur dioxide</td> <td>combustion of fossil fuels/ combustion of fuels with sulfur impurities;</td> </tr> </tbody> </table>	carbon monoxide	incomplete combustion (of carbon containing substances / of fuel in cars);	sulfur dioxide	combustion of fossil fuels/ combustion of fuels with sulfur impurities;	2
carbon monoxide	incomplete combustion (of carbon containing substances / of fuel in cars);					
sulfur dioxide	combustion of fossil fuels/ combustion of fuels with sulfur impurities;					
10(b)	acid rain / smog;	1				

Question	Answer	Marks
10(c)(i)	<p><i>any three from:</i></p> <p>(NO) converted to nitrogen ;</p> <p>reaction with carbon monoxide ;</p> <p>by reduction / loss of oxygen ;</p> <p>speeds up the removal (of the harmful gases) ;</p> <p>honeycombed surface / large surface area ;</p> <p>(which contains a) coating or layer of catalysts ;</p>	3
10(c)(ii)	carbon dioxide / CO ₂ ;	1
10(d)	triple bond ;	1

Question	Answer	Marks
11(a)(i)	84 ;	1
11(a)(ii)	125 ;	1
11(b)	<p>nucleon number for Pb = 205 ;</p> <p>${}^4_2\alpha$ correct ;</p>	2