2024 Sec 3 (O-level Programme) Term 4 End-Of-Year Examination

Section A

1	2	3	4	5	6	7	8	9	10
B	B	D	D	C	A	C	C	A	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	C	A	C	D	B	B	A	D	C
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
A	A	D	D	C	B	D	C	C	C

Section B

Qn	Answers	Mark	Guidance
1a	oxygen	1	
1b	sulfur dioxide	1	
1c	sulfur dioxide	1	
1d	nitrogen monoxide	1	
1e	argon	1	
2a	80	1	
2b	energy is absorbed to overcome attractive forces between molecules	1	
2c	vibrate faster; (1) about their fixed positions;(1)	2	
3a	(see table below)	3	

	true	false
P has a giant molecular structure, but **Q** has a simple molecular structure.		✓
P is used in drills while **Q** is used as a lubricant.	✓	
Atoms in both **P** and **Q** bond to achieve the electronic configuration of a noble gas.		✓
Both **P** and **Q** are elements.	✓	
Both **P** and **Q** have high melting points.	✓	

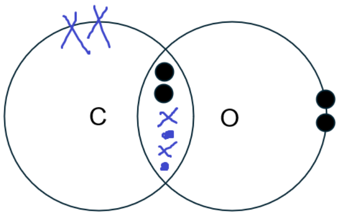
3b

element	B	C
mass /g	78.6	21.4
A_r	11	12
no. of moles /mol	78.6 / 11 = 7.1455	21.4 / 12 = 1.7833
mole ratio	7.1455 / 1.7833 = 4.01 ≈ 4	1.7833 / 1.7833 = 1

empirical formula is B_4C

4a	$PdCl_2$(**<u>s</u>**) + **<u>H_2O</u>** (g) + CO(g) → Pd(s) + 2HC*l*(g) + CO_2(**<u>g</u>**)		

<table>
<tr><td>4bi</td><td><table><tr><th>element</th><th>oxidation state before the reaction</th><th>oxidation state after the reaction</th></tr><tr><td>palladium</td><td>+2</td><td>0</td></tr><tr><td>carbon</td><td>+2</td><td>+4</td></tr></table></td><td></td><td></td></tr>
<tr><td>4bii</td><td>C (in CO) was <u>oxidised</u> + oxidation state of C <u>increased</u> from +2 (in CO) to +4 (in CO_2);

Pd (in $PdCl_2$) was <u>reduced</u> + oxidation state of Pd <u>decreased</u> from +2 (in $PdCl_2$) to 0 (in Pd);</td><td></td><td></td></tr>
<tr><td>4c</td><td>hydrogen chloride</td><td></td><td></td></tr>
<tr><td>4d</td><td>

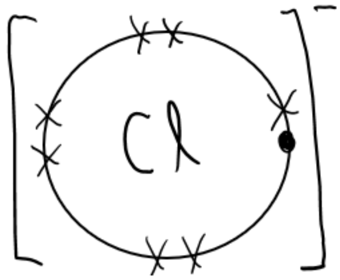
[1] – shared electrons
[1] – lone pair</td><td></td><td></td></tr>
<tr><td>5a</td><td>4</td><td>1</td><td></td></tr>
<tr><td>5bi</td><td><u>atoms</u> of the same element + same number of protons + different number of neutrons;</td><td>1</td><td></td></tr>
<tr><td>5bii</td><td><table><tr><th>isotope</th><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr><tr><td>^{286}Fl</td><td>114</td><td>172</td><td>114</td></tr><tr><td>^{289}Fl</td><td>114</td><td>175</td><td>114</td></tr></table></td><td>2</td><td></td></tr>
<tr><td>5c</td><td>flerovium has <u>giant metallic structure</u> + oxygen has <u>simple molecular structure</u>;

flerovium has <u>higher melting point</u> than oxygen + as more energy needed;

to overcome the <u>strong electrostatic forces of attraction between metal ions / cations / positive ions</u>

<u>and ‘sea of (delocalised/mobile) electrons’</u> (in flerovium) than the <u>weak intermolecular forces of attraction between molecules</u> (in oxygen);</td><td>3</td><td></td></tr>
<tr><td>6a</td><td>potassium chloride:
reagent 2: (aqueous) potassium hydroxide / potassium carbonate;
titration;

lead(II) sulfate:
reagent 2: <u>aqueous</u> lead(II) nitrate;
filtration;</td><td>4</td><td></td></tr>
<tr><td>6b</td><td>40 cm^3 / doubled;</td><td>2</td><td></td></tr>
</table>

	twice the number of moles of H^+ in the sulfuric acid compared to hydrochloric acid (as sulfuric acid is dibasic and hydrochloric		
6c		1	
7ai	$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$;	1	
7aii	No. of moles of HC*l* = $\frac{27.60}{1000}$ x 0.220 = 0.006072 mol; $Mg(OH)_2$: HC*l* 1 : 2 No. of moles of $Mg(OH)_2$ = 0.006072 ÷ 2 = 0.003036 mol + Concentration of $Mg(OH)_2$ = 0.003036 ÷ $\frac{25.0}{1000}$ = 0.12144 mol/dm^3 = 0.121 mol/dm^3;	2	
7b	mass of $Mg(OH)_2$ = 0.12144 x (24 + 16x2 + 1x2) = 7.0435 g = 7.04 g	1	
7c	1 dm^3 of water can dissolve 7.04 g of $Mg(OH)_2$ volume of water needed to dissolve 10.0 g of $Mg(OH)_2$ = 10.0 ÷ 7.0435 = 1.42 dm^3	1	
8a	A: calcium carbonate / $CaCO_3$ C: calcium chloride / $CaCl_2$ D: carbon dioxide / CO_2 E: calcium hydroxide / $Ca(OH)_2$	4	
8b	$Ca^{2+}(aq) + 2OH^-(aq) \rightarrow Ca(OH)_2(s)$	1	
8c	**aqueous barium nitrate:** no observable change; **aqueous silver nitrate:** white precipitate formed;	2	
8di	copper	1	
8dii	metal **B** / copper + causes oxygen to be reduced + oxygen gains electrons (to form O^{2-}) A: metal B / copper + as metal B / copper is itself oxidised + by losing electrons	1	
9a	SCl_2	1	
9bi	$SiCl_4$	1	
9bii	$PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$	1	
9c	student 2 is correct + student 1 is wrong/not completely correct;	3	

	all covalent chlorides hydrolyse + all ionic chlorides dissolve/do not hydrolyse; all non-metal chlorides hydrolyse / all metal chlorides dissolve/do not hydrolyse + except for $AlCl_3$ which hydrolyses;		
9d	pH less than 7 + chloride has hydrolysed + as acidic HCl is produced; pH at 7 + chloride has not hydrolysed + as the chloride is neutral; A: response using Universal Indicator instead	2	

Section C

10a	seawater boils + (pure) water vapour/steam rises; (at the top which is cooler), water vapour condenses (and is collected); salt left behind OWTTE; Stage 1 should take place before distillation + Stage 2, after;	4	
10bi	arrow pointing into lower aperture only	1	
10bii	condenser	1	
10biii	stopper shown in diagram; gases or vapours escape; A: thermometer + stopper shown in diagram; cannot identify distillate/substance collected (in conical flask) based on boiling point;	2	
10biv	water bath cannot exceed 100°C (as water has a boiling point of 100°C); **C** and **D** have a boiling point above 100°C;	2	
11ai	conical flask + gas jar A: measuring cylinder	1	
11aii	no (rubber) bung in second flask + gas jar should not be inverted A: stopper / flask not sealed / should be downward delivery	1	
11aiii	to dry the gas / remove water	1	
11aiv	no + only products of neutralisation are salt and water + chlorine is produced	1	
11bi	shows collection over water; in a measuring cylinder/burette + graduations shown on collection vessel;	2	
11bii	filter (the mixture); wash the residue/magnesium with distilled water + dry with filter paper; evaporate filtrate to dryness; weigh (separately) using (electronic) balance; R: crystallisation	4	