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A' Level Chemistry

Year 1

Unit 2: AOS PV=nRT

Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.

Grade Accelerator

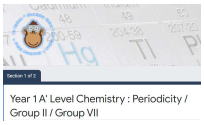
Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs

Quizlet Classes

Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker

Condensed Notes

Keywords & Definitions
Key Concepts
Application
Key Skills



Online Forms

Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.

1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!
2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy.**

If you struggle with the questions in the pack, **STOP!** and complete some more revision.

If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
																	(18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass **symbol** name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	96.0 Mo molybdenum 42	[97] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La * lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac † actinium 89	[267] Rf rutherfordium 104	[270] Db dubnium 105	[269] Sg seaborgium 106	[270] Bh bohrium 107	[270] Hs hassium 108	[278] Mt meitnerium 109	[281] Ds darmstadtium 110	[281] Rg roentgenium 111	[285] Cn copernicium 112	[286] Nh nihonium 113	[289] Fl flerovium 114	[289] Mc moscovium 115	[293] Lv livermorium 116	[294] Ts tennessine 117	[294] Og oganesson 118

140.1 Ce cerium 58	140.9 Pr praseodymium 59	144.2 Nd neodymium 60	[145] Pm promethium 61	150.4 Sm samarium 62	152.0 Eu europium 63	157.3 Gd gadolinium 64	158.9 Tb terbium 65	162.5 Dy dysprosium 66	164.9 Ho holmium 67	167.3 Er erbium 68	168.9 Tm thulium 69	173.0 Yb ytterbium 70	175.0 Lu lutetium 71
232.0 Th thorium 90	231.0 Pa protactinium 91	238.0 U uranium 92	[237] Np neptunium 93	[244] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[247] Bk berkelium 97	[251] Cf californium 98	[252] Es einsteinium 99	[257] Fm fermium 100	[258] Md mendelevium 101	[259] No nobelium 102	[262] Lr lawrencium 103

* **58 – 71** Lanthanides

† **90 – 103** Actinides

0 8 . 2 When 250 mg of sodium were added to 500 cm^3 of water at 25 °C a gas was produced.

Give an equation for the reaction that occurs.
Calculate the volume, in cm^3, of the gas formed at 101 kPa

The gas constant, R = 8.31 J K^{-1} mol^{-1}

[6 marks]

Equation _____

Volume _____ cm^3

0 8 . 3 Calculate the concentration, in mol dm^{-3}, of sodium ions in the solution produced in the reaction in Question **08.2**.

[1 mark]

Concentration _____ mol dm^{-3}

08.1 cont.	Level 0 0 marks	Insufficient correct chemistry to gain a mark.		
08.2	M1 $Na + H_2O \rightarrow NaOH + ½ H_2$		Allow multiples	1
	M2 (Mass Na = 0.250 g so moles Na = 0.250/23.0) = 0.0109		CE: If not divided by 23, max 3/5 calculation marks – M3, M4 and M5 AE: If not divided by 1000 and final answer is 1.33 x 10^5 cm^3 4/5	1
	M3 moles H_2 = 5.43 x 10^{-3} to 5.45 x 10^{-3}		M3 = M2 /2 CE: If incorrect ratio used max 3/5 calculation marks – M2, M4 and M5	1
	M4 T = 298 (K) and P = 101000 (Pa)			1
	M5 V = nRT/P or (5.435 x 10^{-3} x 8.31 x 298)/101000 or 1.33 x 10^{-4} (m^3)			1
	M6 V = 133 – 134 cm^3		Allow to 2 significant figures or more	1
08.3	Conc = 0.0109/ 500 x 10^{-3} = 0.0217-0.022 (mol dm^{-3})		Allow M2 from question 08.2 / 0.5	1

1 0 . 1 A student added 627 mg of hydrated sodium carbonate ($Na_2CO_3.xH_2O$) to 200 cm^3 of 0.250 mol dm^{-3} hydrochloric acid in a beaker and stirred the mixture.
After the reaction was complete, the resulting solution was transferred to a volumetric flask, made up to 250 cm^3 with deionised water and mixed thoroughly.
Several 25.0 cm^3 portions of the resulting solution were titrated with 0.150 mol dm^{-3} aqueous sodium hydroxide. The mean titre was 26.60 cm^3 of aqueous sodium hydroxide.

Calculate the value of x in $Na_2CO_3.xH_2O$
Show your working.
Give your answer as an integer.

[7 marks]

Value of x _____

7

END OF QUESTIONS

Question	Answers	Additional Comments/Guidance	Mark
10.1	M1 HCl added = 0.050 mol and NaOH used in titration = 3.99 x 10^{-3} mol		1
	M2 So moles that would be needed to neutralise total excess HCl = 3.99 x 10^{-3} **x 10** = 3.99 x 10^{-2} mol	Alternative: divide moles HCl by 10 = 0.005 and 0.005 - 3.99 x 10^{-3} = 0.00101	1
	M3 Therefore the moles of HCl reacted with the $Na_2CO_3.xH_2O$ = 0.050 **-** 3.99 x 10^{-2} = 0.0101 mol	Alternative: 0.00101 x 10 to produce 0.0101	1
	M4 So moles $Na_2CO_3.xH_2O$ reacted with the HCl = 0.0101 **/2** = 5.05 x 10^{-3} mol		1
	M5 Conversion of mg to g = 0.627 (g) or 627 x 10^{-3} (g)		1
	M6 xH_2O = 0.627/5.05 x 10^{-3} -106.0 = 18 (.16)	Alternative: mass Na_2CO_3 that reacted with the HCl 5.05 x 10^{-3} x106.0 = 0.5353 g and mass H_2O = 0.627- 0.5353 = 0.0917 g	1
	M7 so *x* =**1**	Alternative: 0.0917 /18.0 = 5.094 x 10^{-3} so ratio Na_2CO_3 to H_2O = 1:1.009 ie 1:1 so x = **1**	1
Total			7

Do not write outside the box

0 6 . 6 Iodine vaporises easily.

Calculate the volume, in cm^3, that 5.00 g of iodine vapour occupies at 185 °C and 100 kPa

The gas constant R = 8.31 J K^{-1} mol^{-1}

Give your answer to 3 significant figures.

[4 marks]

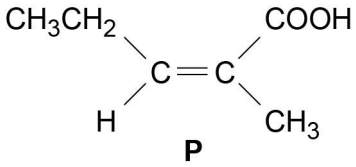
Volume _____ cm^3

16

06.6	M1: n = (5.00/253.8) = 0.0197 mol M2: T = 458 K and P = 100 000 Pa M3: V = $\frac{nRT}{P}$ or $\frac{0.0197 \times 8.31 \times 458}{100\,000}$ or 7.50×10^{-4} (m^3) M4: V =750 (cm^3)	Allow 254 If 126.9 or 127 used lose M1 only M3 If rearrangement incorrect can only score M1 and M2 M4: Allow M3 x 10^6 M4: Allow 749	1 1 1 1

1 0 This question is about six isomers of $C_6H_{10}O_2$

1 0 . 1 Give the full IUPAC name of isomer **P**.



P

[1 mark]

1 0 . 2 A sample of **P** was mixed with an excess of oxygen and the mixture ignited. After cooling to the original temperature, the total volume of gas remaining was 335 cm^3

When this gas mixture was passed through aqueous sodium hydroxide, the carbon dioxide reacted and the volume of gas decreased to 155 cm^3

Both gas volumes were measured at 25 °C and 105 kPa

Write an equation for the combustion of **P** in an excess of oxygen and calculate the mass, in mg, of **P** used.

The gas constant $R = 8.31$ J K^{-1} mol^{-1}

[5 marks]

Mass of **P** used _____ mg

Question	Answers	Mark	Additional Comments/Guidance
10.1	Z-2-methylpent-2-en (-1-) oic acid	1	Ignore missing hyphens or extra commas, spaces, hyphens
10.2	$C_6H_{10}O_2 + 7½\ O_2 \rightarrow 6CO_2 + 5H_2O$	M1	Allow multiple
	Volume of CO_2 formed = 180 cm^3	M2	If incorrect volume:155 gives 125mg / 335 gives 270mg could score M1,M3,M4 – max 3 If incorrect volume from AE then penalise M2 and mark on (Final answer is 0.806 x their volume)
	Mol carbon dioxide = pV/RT = $\frac{105000 \times (180 \times 10^{-6})}{8.31 \times 298}$ = 7.632×10^{-3}	M3	If unit error in p, V or T lose M3 and M5 If incorrect rearrangement lose M3 and M5 If both errors seen then no further marks
	Mol **P**, $C_6H_{10}O_2$ used = $7.632 \times 10^{-3} / 6 = 1.272 \times 10^{-3}$	M4	M3 divided by 6 If wrong no further marks
	Mass **P** used = $1.272 \times 10^{-3} \times 114(.0)$ g = 145 mg	M5	Mark for answer (allow ans to 2 sf) **Check chemical equation before awarding final mark**

Do not write outside the box

0 4 . 4 Iron reacts with dilute hydrochloric acid to form iron(II) chloride and hydrogen.

$$Fe(s) + 2\,HCl(aq) \rightarrow FeCl_2(aq) + H_2(g)$$

A 0.998 g sample of pure iron is added to 30.0 cm^3 of 1.00 mol dm^{-3} hydrochloric acid.

One of these reagents is in excess and the other reagent limits the amount of hydrogen produced in the reaction.

Calculate the maximum volume, in m^3, of hydrogen gas produced at 30 °C and 100 kPa.

Give your answer to 3 significant figures.

In your answer you should identify the limiting reagent in the reaction.

The gas constant, R = 8.31 J K^{-1} mol^{-1}

[6 marks]

Volume of hydrogen _____ m^3

Turn over ►

Question	Answers	Additional comments/Guidelines	Mark
04.4	M1 Amount of Fe = 0.998 ÷ 55.8 = 0.0179 mol		1
	M2 Amount of HCl = 0.0300 mol		1
	M3 HCl is the limiting reagent	M4 = M2÷2	1
	M4 Amount of H_2 produced = 0.0150 mol		1
	M5 T = 303 K P = 100 000 Pa		1
	M6 $V \left(= \frac{0.0150 \times 8.31 \times 303}{100\,000} \right) = 3.78 \times 10^{-4}\ (m^3)$	M6 $V \left(= \frac{M4 \times 8.31 \times 303}{100\,000} \right) (m^3)$	1

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(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass **symbol** name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
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