04 Chemical Formulae, Equations, the Mole and Gases

Set A Concept Practice

Name	Time **55 minutes**	Total **47 marks**	Score ____ / 47

A From the lesson

30 MARKS

1 Which equation is balanced?

A $Na + Cl_2 \rightarrow NaCl$
B $H_2 + O_2 \rightarrow H_2O$
C $2Mg + O_2 \rightarrow 2MgO$
D $CaCO_3 \rightarrow CaO + 2CO_2$

/1

Answer ☐ [1]

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2 Which sample contains the greatest number of **atoms**? (A_r: H 1.0, He 4.0, N 14.0, O 16.0)

A 2.0 g of H_2
B 4.0 g of He
C 16.0 g of O_2
D 14.0 g of N_2

/1

Answer ☐ [1]

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3 2.0 mol of N_2 reacts with 3.0 mol of H_2: $N_2 + 3H_2 \rightarrow 2NH_3$. What is the greatest amount of NH_3 that can form?

A 4.0 mol
B 2.0 mol
C 6.0 mol
D 1.0 mol

/1

Answer ☐ [1]

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4 What volume of carbon dioxide, measured at room temperature and pressure, forms when 0.10 mol of propane, C_3H_8, burns completely?

A 2.4 dm^3
B 4.8 dm^3
C 7.2 dm^3
D 9.6 dm^3

/1

Answer ☐ [1]

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5 Under which conditions does a gas behave most like an ideal gas?

A high pressure, low temperature
B low pressure, high temperature
C high pressure, high temperature
D low pressure, low temperature

/1

Answer ☐ [1]

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6 Balance the equation: $Al + O_2 \rightarrow Al_2O_3$

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[1]

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7 Write the ionic equation for $BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$.

/1

.....

[1]

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8 Calculate the M_r of $(NH_4)_2SO_4$. (A_r: H 1.0, N 14.0, O 16.0, S 32.1)

/1

[1]

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9 Copper is 69% ^{63}Cu and 31% ^{65}Cu. Calculate A_r(Cu).

/1

[1]

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10 **(a)** What is the mass of 0.250 mol of NaOH? (A_r: Na 23.0, O 16.0, H 1.0)

[1]

(b) How many chloride ions are in 0.10 mol of $CaCl_2$?

/2

[1]

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11 A compound is 85.7% C and 14.3% H by mass, and its M_r is 56. Find its molecular formula.

/2

[2]

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12 $CaCO_3 \rightarrow CaO + CO_2$. What mass of CaO forms from 25.0 g of $CaCO_3$? (A_r: Ca 40.1, C 12.0, O 16.0)

/2

[2]

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13 A 5.00 g sample of impure $CaCO_3$ gives 1.76 g of CO_2 when heated. What is its percentage purity?

/2

[2]

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14 **(a)** How many moles of solute are in 25.0 cm^3 of 0.200 mol dm^{-3} solution?

[1]

(b) Express 0.500 mol dm^{-3} sodium chloride (M_r 58.5) in g dm^{-3}.

/2

[1]

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15 **(a)** What volume does 8.0 g of O_2 occupy at room temperature and pressure?

[1]

(b) What volume of O_2 burns 20 cm^3 of CH_4 completely? $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

/2 **[1]**

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16 Convert into SI units.

(a) 25 °C

[1]

(b) 250 cm^3

[1]

(c) 2.00 atm

/3 **[1]**

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17 What volume, in dm^3, does 1.00 mol of an ideal gas occupy at 0 °C and 1.00×10^5 Pa? (R = 8.31 J K^{-1} mol^{-1})

/2 **[2]**

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18 A mixture contains 0.5 mol of He and 1.5 mol of Ar at a total pressure of 200 kPa. Find the partial pressure of He.

/2 **[2]**

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19 Why does helium behave more like an ideal gas than ammonia does?

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..... **[2]**

/2

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B Practice

17 MARKS

20 The relative atomic mass of naturally occurring chlorine is not a whole number. What is the reason for this?

A Chlorine atoms can have different numbers of neutrons.

B Chlorine is unstable.

C Naturally occurring chlorine cannot be obtained pure.

D The mass of the electrons has been included.

/1

Answer ☐ [1]

2024 BLSS O Prelim P1 Q6

21 The element thallium, Tl, has only two isotopes with mass numbers 203 and 205. The relative abundance of Tl-203 is 30%. Which of the following is the relative atomic mass of thallium?

A 203.8 **B** 204.0 **C** 204.4 **D** 204.8

/1

Answer ☐ [1]

2024 Punggol O Prelim P1 Q6

22 A giant molecule contains a large amount of carbon-12 and carbon-13 isotopes. The average relative atomic mass of carbon in the giant molecule is 12.2. What proportion of carbon-12 atoms is present in the giant molecule?

A 20% **B** 50% **C** 60% **D** 80%

/1

Answer ☐ [1]

2024 AES O Prelim P1 Q8

23 Element V has 14 neutrons and 13 protons, while element W has 10 neutrons and 9 protons in its nucleus. What would be the molar mass of the compound formed between V and W?

A 84 g/mol **B** 100 g/mol **C** 168 g/mol **D** 200 g/mol

/1

Answer ☐ [1]

2024 SMSS O Sec3 P1 Q8

24 The rate of diffusion of two gases, methane, CH_4, and propene, C_3H_6, is investigated. Which gas diffuses at a faster rate and why? Each option gives the faster gas, then the reason.

A propene, because it is unsaturated so is more reactive

B propene, because it is lighter so moves faster

C methane, because it has a lower molecular mass

D methane, because it has a lower boiling point

/1

Answer ☐ [1]

Source: 2024 SCGS O Prelim P1 Q2

25 Which substance has 7.2×10^{23} atoms?

A 0.2 mol of magnesium metal
B 0.3 mol of ammonia gas
C 0.4 mol of hydrogen chloride
D 1.2 mol of carbon dioxide gas

/1

Answer [1]

2024 YSS O Prelim P1 Q11

26 An element forms a diatomic molecule, Q, which has a relative molecular mass, x. The Avogadro constant is L. How many atoms are present in 1.0 g of Q?

A $\frac{L}{x}$ **B** $\frac{2L}{x}$ **C** $\frac{L}{2x}$ **D** 2Lx

/1

Answer [1]

2025 TKGS O Prelim P1 Q14

27 A black solid, X, is an oxide of ruthenium. 5.79 g of X contains 1.39 g of oxygen. What is the empirical formula of X?

A RuO **B** RuO_2 **C** Ru_2O **D** RuO_4

/1

Answer [1]

2024 Compassvale O Prelim P1 Q15

28 Aerials in portable radios are made of a mixture of the oxides of calcium and iron known as 'ferrite'. It contains 18.5% calcium and 51.9% iron by mass. Which is the empirical formula of 'ferrite'?

A $CaFe_2O$ **B** $CaFe_2O_4$ **C** Ca_2FeO_2 **D** Ca_4Fe_2O

/1

Answer [1]

2024 NASS O Prelim P1-P2 Q14

29 The relative molecular mass, M_r, of liquid Z is 60. Z contains 40.0% carbon, 6.70% hydrogen and 53.3% oxygen. Which row shows the correct empirical and molecular formulae of Z?

	empirical formula	molecular formula
A	CH_2O	CH_2O
B	CH_2O	$C_2H_4O_2$
C	$C_2H_4O_2$	$C_2H_4O_2$
D	CH_3O	$C_2H_6O_2$

A row A **B** row B **C** row C **D** row D

/1

Answer [1]

2024 Whitley O Prelim P1 Q11

30 On complete combustion, a sample of hydrocarbon gives 11.0 g of carbon dioxide and 9.0 g of water. What is the molecular formula of the hydrocarbon?

A CH_4 **B** C_2H_4 **C** C_3H_6 **D** C_3H_8

/1

Answer [1]

2022 HYSS O Prelim P1 Q10

31 When 4.8 g of magnesium is heated in a crucible, 5.9 g of magnesium oxide is formed. What is the percentage yield of magnesium oxide?

A 53% **B** 74% **C** 80% **D** 81%

/1

Answer [1]

2024 CGS O Prelim P1 Q10

32 Ammonia and excess carbon dioxide can react to form urea and water: $2NH_3 + CO_2 \rightarrow CON_2H_4 + H_2O$. The percentage yield of this reaction is 80%. What mass of ammonia is required to obtain 60.0 g of urea? [M_r: NH_3 17, CO_2 44, CON_2H_4 60, H_2O 18]

A 10.6 g **B** 27.2 g **C** 34.0 g **D** 42.5 g

/1

Answer [1]

2024 Bukit View O Prelim P1 Q16

33 When 42.0 g of sodium hydrogencarbonate, $NaHCO_3$ (M_r = 84), was strongly heated, 3.00 dm^3 of carbon dioxide gas, measured at room temperature and pressure, was released. $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$. What was the percentage yield of carbon dioxide?

A 25% **B** 50% **C** 75% **D** 100%

/1

Answer [1]

2025 JYSS O Prelim P1 Q15

34 What is the concentration of iron(III) ions in 0.01 mol/dm^3 of aqueous iron(III) sulfate?

A 0.01 g/dm^3 **B** 0.02 g/dm^3 **C** 1.12 g/dm^3 **D** 1.68 g/dm^3

/1

Answer [1]

2024 Serangoon O Prelim P1 Q19

35 28 g of gaseous hydrocarbon X has a volume of 12 dm^3 at room temperature and pressure. What is the molecular formula of X?

A C_2H_4 **B** C_3H_8 **C** C_4H_8 **D** C_5H_{10}

/1

Answer [1]

2024 CCHY O Prelim P1-P2 Q16

36 Which fuel produces 144 dm^3 of carbon dioxide, measured at room temperature and pressure, upon complete combustion?

A 0.5 mol of C_6H_{12} **B** 1.5 mol of C_4H_8

C 3.0 mol of C_3H_7OH **D** 6.0 mol of C_2H_6

/1

Answer [1]

2024 Zhonghua O Prelim P1 Q14

10 The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –