Hillcrest High School

Grade 11

PHYSICAL SCIENCE P2 Memo

JUNE 2025

Question 1

1.1 C

1.2 A

1.3 B

1.4 B

1.5 B

1.6 B

1.7 C

1.8 B

1.9 B

1.10 B

Question 2

2.1.1 The simplest whole number ratio of elements in a given compound. ✓✓ (2)

2.1.2 $n(C) = \frac{m}{M}$ ✓

$n(C) = \frac{54,55}{12}$ ✓ = 4,55 mol

$n(H) = \frac{9,09}{1}$ = 9,09 mol

$n(O) = \frac{36,36}{16}$ = 2,27 mol

n(C): n(H): N(O)

$\frac{4,55}{2,27} : \frac{9.09}{2,27} : \frac{2,27}{2,27}$ ✓m

2 : 4 : 1✓

Empirical formula: $C_2H_4O_1$ ✓ (6)

2.1.3 Ratio = $\frac{molar\ mass}{formula\ mass}$

Ratio = $\frac{88}{44}$ ✓

Ratio = 2

Molecular formula: $C_4H_8O_2$ ✓ (2)

2.2

NaN_3

$n = \frac{N}{m}$

$n = \frac{55}{65}$ ✓

n = 0,8462 mol

Mole ratio: $NaN_3 : N_2$

2 : 3

$n(N_2) = 0,8462 \times \frac{3}{2}$ ✓m $n(N_2)$ = 1,2693 mol

$V = nV_m$✓

V = (1,2693) (22,4) ✓

$V = 28,43\ dm^3$ ✓ (5)

Question 3

3.1 The amount of solute per dm^3 of solution/per unit volume ✓✓ (2)

3.2 $c = \frac{m}{MV}$ ✓

M = Na_2CO_3

= 2 (23) + 12 + (16 × 3)

= 106 g.mol^{-1}

$0,25 \checkmark = \frac{m}{106\checkmark \times 5x10-1}$ ✓

m = 13,25 g ✓ (4)

or

n = c.V✓

= 0,25 (0,5) ✓

= 0,125 mol

m = n.M

= 0,125 (106) ✓

= 13,25 g ✓

Careful here- remember to add the 2 volumes together to find the final volume.

3.3 $C_1V_1 = C_2V_2$

0,25 (0,04) ✓ = C_2 (0,14) ✓

C_2 =0,07 mol.dm^{-3} ✓ (3)

3.4.1 The substance that is used up first ✓✓ (2)

3.4.2

Na_2SO_4	$CaCO_3$	2C	Na_2CO_3	$2CO_2$	CaS
1	1	2	1	2	1✓
52,54g	45g				
$n = \frac{m}{M}$ $= \frac{52,54}{142}$ ✓ = 0,37 mol✓	$n = \frac{m}{M}$ ✓ $= \frac{45}{100}$ ✓ = 0,45mol				

0,45 mol÷1 x 1✓ = 0,45 mol	1				
∴ Na_2SO_4 is the limiting reactant ✓	$CaCO_3$ is in excess				

(6)

Question 4

If any of the underlined key words/phrases are omitted: minus 1 mark

4.1 The energy absorbed or released per mole in a chemical reaction. ✓✓ (2)

4.2 Endothermic ✓

More energy is absorbed than released ✓ **OR** $\Delta H > 0$ (2)

4.3

4.3.1 544 (kJ/kJ.mol^{-1}) ✓✓ (2)

4.3.2 131 (kJ/kJ.mol^{-1}) ✓✓ (2)

4.3.3 -131 (kJ/kJ.mol^{-1}) ✓ (1)

Question 5

5.1

5.1.1 Sufficient kinetic energy ✓ (molecules move fast enough) during the collisions.

Molecules must be correctly orientated. ✓ (2)

5.1.2 Increased temperature:

More molecules move fast enough or have sufficient E_k. ✓

The are more effective collisions per unit time ✓ / Ek ≥ activation energy. (2)

5.2

5.2.1 Activation energy ✓ (1)

5.2.2 (a) Increase in the concentration of one or both reactants. ✓ (1)

(b) Increase in temperature. ✓ (1)

5.3.1 How will a change in concentration affect the reaction rate

OR

What is the relationship between concentration and reaction rate? (2)

• Identify dependent and independent variable. ✓✓ Ask a question (?) about the relationship between dependent and independent variable. ✓

5.3.2

Option 1	Option 2
$\triangle n = 1{,}0 - 0{,}8$ ✓ $= 0{,}2$ mol $n = \frac{m}{M}$ $0{,}2 = \frac{m}{24}$ ✓ $\therefore m = 4{,}8\ g$ Gem. reaksietempo = $\frac{\triangle m}{\triangle t}$ $= \frac{4{,}8✓}{30-0✓}$ $= 0{,}16\ g.s-1$✓	$n = \frac{m}{M}$ $\quad n = \frac{m}{M}$ $1 = \frac{m}{24}$ ✓ $\quad 0{,}8 = \frac{m}{M}$ ✓ $\therefore m = 24\ g$ $\quad \therefore m = 19{,}2\ g$ Gem. reaksietempo = $\frac{\triangle m}{\triangle t}$ $= \frac{19{,}2-24✓}{30-0✓}$ $= 0{,}16\ g.s-1$✓

(5)

Question 6

6.1.1 Burette. ✓ (1)

6.1.2 Yellow to Blue. ✓ (1)

6.1.3 Equivalence point. ✓ (1)

6.1.4

OPTION 1	**OPTION 2**
(a) c(NaOH) = $\frac{n}{V}$ ✓ 0,2 = $\frac{n}{0,02}$ ✓ = 0,004 mol NaOH (b) $n(H_2SO_4)$ = $\frac{1}{2}$ n(NaOH) = $\frac{1}{2}$ × 0,004 ✓ = 0,002 mol (c) $c(H_2SO_4)$ = $\frac{0,002}{0,025}$ ✓ = 0,08 $mol.dm^{-3}$ ✓	$\frac{Ca \times Va}{Cb \times Vb} = \frac{na}{nb}$ ✓ $\frac{ca \times 25 ✓}{0,2 \times 20 ✓} = \frac{1}{2}$ ✓ $c(H_2SO_4)$ = 0,08 $mol.dm^{-3}$ ✓

OPTION 3

Value read from graph: [Range for pH: 0,7 – 0,9]

(a) pH= -log $[H_3O^+]$ ✓
0,8 = -log $[H_3O^+]$ ✓
$[H_3O^+]$ = 0,1585 $mol.dm^{-3}$ ✓

(b) $[H_3O^+]$: $[H_2SO_4]$
2 : 1 ✓

(c) $[H_2SO_4]$ = 0,079 $mol.dm^{-3}$ ✓
[Range: 0,063 mol.dm-3 – 0,0998 $mol.dm^{-3}$]

6.1.5] H_2SO_4 + $2NaOH \rightarrow$

$n = 0,002$ mol

From 6.1.4

Extra Base (σ)

$C = \frac{n}{V}$ ✓

✓ $0,2 = \frac{n}{0,01}$ ✓ extra added afte

$n = 0,002$ mol

$C_1V_1 = C_2V_2$
option on memo

At (4)

① $n = c.V$

$= 0,2(0,03)$ ✓

$= 0,006$ mol

② Reacted $= 0,002$ mol $\div 1 \times 2$ ✓ m (σ) 0,2(0,02)

$= 0,004$ mol

③ Excess base $= 0,006 - 0,004$ ✓ CA

$= 0,002$ mol

④ $C_{excess\ base} = \frac{n}{V_T}$

$= \frac{0,002}{0,055}$ ✓ m $\div V_T$

$= 0,03636$ mol.dm^{-3}

⑤ $[OH^-] = [NaOH]$

$= 0,03636$ mol.dm^{-3}

⑥ $pOH = -\log[OH^-]$ m ✓

$= -\log(0,03636)$

$= 1,4394$

⑦ $pH + pOH = 14$ ✓

$pH + 1,4394 = 14$

$\therefore pH = 12,56$ ✓

⑥ $[OH^-][H_3O^+] = 1 \times 10^{-14}$ If $[H_3O^+]$ being calcu... m ✓

$[0,03636][H_3O^+] = 1 \times 10^{-14}$

$[H_3O^+] = 2,75 \times 10^{-13}$ mol.dm^{-3}

⑦ $\therefore pH = -\log[H_3O^+]$

$= -\log(2,75 \times 10^{-13})$ ✓ A

$= 12,56$ ✓ A

(7)

Question 7

7.1

7.1.1 NICKEL ✓ (1)

7.1.2 $Cd(s) \rightarrow Cd^{2+}(aq) + 2e^{-}$ ✓✓

7.1.3 $E^{\Theta}_{cell} = E^{\Theta}_{cathode} - E^{\theta}_{anode}$ ✓ (no abbreviations in formula allowed)

$= 0,27$ ✓ $- (-0,4)$ ✓

$= 0,13$ V ✓ (4)

7.2

7.2.1 $Cu(s) + 2Ag^{+}(aq)$ ✓ $\rightarrow 2Ag(s) + Cu^{2+}(aq)$ ✓ bal✓ (3)

7.2.2)

Cathode | Anode

$Cu(s) + 2Ag^{+1}(aq) \rightarrow Cu^{+2}(aq) + 2Ag(s)$

Cathode:

$\Delta c = 1 - 0,5$

$= 0,5$ mol.dm^{-3}

$n = c.V$ ✓

$= 0,5(0,2)$ ✓

$= 0,1$ mol

Anode:

Initial

Initial

$n = c.V$

$= 1(0,2)$ ✓

$= 0,2$ mol

Reacted (added)

$0,1$ mol $\div 2 \times 1$ ✓m

$= 0,05$ mol

(7)

$\therefore c_{final} = \frac{n}{V}$

$= \frac{0,2 + 0,05}{0,2}$ ✓✓

$= 1,25$ mol.dm^{-3} ✓

Question 8

8.1.1 $2Cl^-(aq) \rightarrow Cl_{2(g)} + 2e^-$ ✓ (2)

8.1.2 $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ ✓✓

(2)

8.2 S

Oxidation occurs there/ Cl^- is oxidized at S/ Cl^- is a reducing agent✓ (2)

8.3.1 Q = I△t

= (2,5) (5 × 60 × 60) ✓ OR (2,5) (18 000)

= 45 000 C ($4,5 \times 10^4$ C) ✓ (2)

8.3.2 n = $\frac{Q}{e}$ OR n = $\frac{Q}{qe}$

= $\frac{45\ 000}{1,6 \times 10^{-19}}$ ✓ **Positive marking from Q8.3.1**

= $2,8125 \times 10^{23}$ (electrons)

n (Cu atoms) = $\frac{2,8125 \times 10^{23}}{2}$

= $1,40625 \times 10^{23}$ ✓ (Use ratio)

n (Cu atoms) = $\frac{No}{NA}$

$\frac{1,40625 \times 10^{23}}{6,02 \times 10^{23}}$

= 0,23356 mol ✓

m(Cu) = nM

= (0,23356) (63,5) ✓

= 14,83g ✓ (Answer range: 14,61g – 14,83g). (5)

8.4.1 Cu is a stronger agent✓ than Cl^- ✓ and thus Cu will be oxidized from Cu to Cu^{2+} ✓.
(no Cl_2 gas formed but Cu will be dissolved/ break up). (3)

Question 9

9.1 the temperature at which the vapour pressure of a substance equals the atmospheric pressure. ✓✓ (2 or 0) (2)

9.2 What is the relationship between molecular mass and boiling point? ✓✓ (of the hydrides of the group V elements) (2)

9.3

9.3.1 Dipole-dipole forces. ✓

Molecular shape is trigonal pyramidal✓ (one lone pair).

Molecule is polar. ✓ (3)

9.3.2 PH_3✓ has the lowest boiling point✓ (2)

The main issue with Q9 is leaners not writing the key words. I have highlighted them to assist. Also refer to the summary you are given on answering IMF questions.

9.3.3 As the relative **molecular mass increases**, the size of the atom increases forming **stronger Van der Waals, dipole-dipole forces**. ✓

Strength of the intermolecular forces increases. ✓

More energy required to overcome the intermolecular forces✓ (3)

9.4 **Hydrogen bonding between molecules of NH_3**. ✓

Dipole-dipole forces between molecules of PH_3, ASH_3 and SbH_3.✓

Intermolecular forces therefore unusually **stronger between NH_3 molecules**. ✓

More energy required to overcome the intermolecular forces in NH_3. ✓ (4)

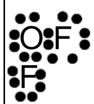
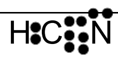
Pls do not say – to break bonds (rather say to weaken IMF)

9.5

9.5.1 Remains the same ✓ (1)

9.5.2 decreases✓ (1)

Question 10

10.1	A group of two or more atoms covalently bonded and it functions as a unit. ✓✓	(2)
10.2		
10.2.1	Tetrahedral	(1)
10.2.2	Ben/angular	(1)
10.3		
10.3.1	 ✓✓	(2)
10.3.2	 ✓✓	(2)
10.4	The nitrogen (N) atom in NH_3 contains a lone pair electrons.✓ No lone pair in CCl_4 Nitrogen (N) atom in NH_3 can donate its lone pair into the vacant orbital of H^+ ✓	(2)

Total 150