MEMO June 2019

PHYSICAL SCIENCES GRADE 12 P2

QUESTION 1

1.1 D ✓✓
1.2 A ✓✓
1.3 D ✓✓
1.4 B ✓✓
1.5 B ✓✓
1.6 C ✓✓
1.7 B ✓✓
1.8 A ✓✓
1.9 A ✓✓
1.10 D ✓✓

QUESTION 2

2.1 *The boiling point of a substance is the temperature at which the vapour pressure of the substance equals the external (atmospheric) pressure.* ✓✓

2.2 *The boiling point increases from PH_3 to SbH_3.* ✓

2.3 *All three molecules have London forces ✓between their molecules which increase in strength with increasing molecular mass. ✓The stronger the intermolecular forces the more energy needed to break them ✓resulting in an increased boiling point.*

2.4 *NH_3 has hydrogen bonds between its molecules. ✓Hydrogen bonds are stronger than London forces. ✓The stronger the intermolecular forces the more energy needed to break them ✓resulting in an increased boiling point.*

2.5 *NH_3 and water are both polar molecules. ✓Like dissolves like.* ✓

2.6 *LESS THAN. ✓The $H-F$ bond is more polar ✓than the $N-H$ bond resulting in stronger hydrogen bonds between HF molecules and therefore an increased boiling point.*

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QUESTION 3

3.1 *An acid is a proton (H^+) donor.*
OR
An acid is a substance produces hydronium ions (H_3O^+) when it dissolves in water. ✓

3.2 *Carbonic acid / H_2CO_3.* ✓ *It has the smallest ionisation constant (K_a value).* ✓

3.3 *H_2O ✓and CH_3COO^-.* ✓

3.4 *Ampholyte.* ✓

3.5 ✓K_2CO_3 ✓*products* ✓*balanced* *(3/3 if spectator ion not shown)*

3.6 *Hydrolysis.* ✓

3.7

3.7.1.

In $25\ cm^3$ *solution:*

$n_{NaOH} = c.V$ ✓

$n_{NaOH} = (0{,}15)(0{,}04)$

$n_{NaOH} = 0{,}006\ mol$ ✓

$n_{(COOH)_2} = \frac{1}{2}.n_{NaOH} = 0{,}003\ mol$ ✓

In $250\ cm^3$ *solution:*

$n_{(COOH)_2} = 0{,}003 \times \frac{250}{25} = 0{,}03\ mol$ ✓

$n = \frac{m}{M}$ ✓

$0{,}03 = \frac{m}{90}$ ✓

$\therefore m = 2{,}7\ g$ ✓

3.7.2. *Phenolphthalein.* ✓

3.8

Method 1	**Method 2**
$[OH^-] = 2.[Mg(OH)_2] = 7 \times 10^{-5}\ mol.dm^{-3}$ ✓ $[H_3O^+][OH^-] = 1 \times 10^{-14}$ $\therefore [H_3O^+] = 1{,}43 \times 10^{-10}\ mol.dm^{-3}$ ✓ $pH = -\log[H_3O^+]$ ✓ $pH = -\log(1{,}43 \times 10^{-10})$ $\therefore pH = 9{,}85$ ✓ (accept 9,84)	$[OH^-] = 2.[Mg(OH)_2] = 7 \times 10^{-5}\ mol.dm^{-3}$ ✓ $pH = 14 - pOH$ ✓ $pH = 14 + \log(7 \times 10^{-5})$ ✓ (working out pOH) $pH = 9{,}85$ ✓

3.9 $pH = -\log[H_3O^+]$

$9{,}5 = -\log[H_3O^+]$

$\therefore [H_3O^+] = 3{,}16 \times 10^{-10}\ mol.dm^{-3}$ ✓

$[H_3O^+][OH^-] = 1 \times 10^{-14}$

$(3{,}16 \times 10^{-10})[OH^-] = 10^{-14}$

$\therefore [OH^-] = 3{,}16 \times 10^{-5}\ mol.dm^{-3}$ ✓

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4.1.1 volume of gas (CO_2) produced ✓

4.1.2 concentration of acid (HCl) ✓

4.1.3 temperature of acid ✓

4.2 Higher temperature in Exp 3 (compared to Exp 1)

Higher temperature, therefor higher avg E_k of particles. ✓

More particles have sufficient E_k to overcome E_A. ✓

More effective collisions per unit time. ✓

4.3 Exp 3 = B ✓

Exp 4 greater mass $CaCO_3$ – greater yield CO_2 therefor A ✓

Exp 1 faster than Exp 2 – higher acid concentration ✓

Exp 3 faster that Exp 1 – higher temperature ✓

Order of reaction rate (high to low)

Exp 3, Exp 1, Exp 2 ✓

Higher reaction rate; steeper curve ✓

4.4

$CaCO_3$	2HCl	$CaCl_2$	H_2O	CO_2
1	2	1	1	1
n = 0.01556… ✓ n = m/M ✓ m = 0,01556(100)✓ = 1,556..				400 cm^3 =0,4 dm^3 ✓ n = V/V_m ✓ = 0,4/25,7 ✓ = 0,01556…

15g – 1,556…✓=13,44 g ✓

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Question 5

5.1.1 Reaction rate

5.1.2 A change in any of the factors that determine equilibrium conditions will cause the system to change in such a manner as to reduce or counteract the effect of the change.✓✓

5.1.3 a) increase in $[N_2]$ ✓
b) increase in pressure ✓

5.1.4 a) stay the same ✓
b) Only change in temperature affects K_c ✓

5.1.5 The pressure was increased, Le Chatelier states system react to decrease pressure. ✓
Does so by favouring reaction producing low number of moles of gas ✓
Favouring forward reaction. (Shifts equilibrium to the right) ✓

5.1.6 higher than

5.1.7 sealed container ✓
Reversible reaction ✓

5.1.8

	N_2 +	$3H_2$	$2NH_3$
Initial (mol)	x	x	0
Used/Formed (mol)	0,2x	0,6x	0,4x ✓
Equilibrium (mol)	0,8x ✓	0,4x	0,4x ✓
Concentration at Equilibrium ($mol.dm^3$)	0,2x	0,1x	0,1x ✓

$K_c = [NH_3]^2 / ([N_2][H_2]^3$ ✓ $= 1,5 \times 10^3$ ✓

$1,5 \times 10^3 = (0,1x)^2 / [(0,2x)(0,1x)^3$

x = 0,18 mol ✓

n=m/M

0,18257 = m/2 ✓

m = 0,37g ✓

5.1.9 Heating favours endothermic reaction ✓

Reverse reaction is endothermic and will be favoured ✓

Lower K_c ✓

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6.1.1 The reactant that gains electrons ✓

6.1.2 Ni^{2+} is weaker OA than Cl_2 and will not be reduced ✓✓

OR Cl_2 is a stronger OA than Ni^{2+} and will be reduced

6.2.1 The electrode where oxidation occurs ✓ ✓

6.2.2 Ni (right) ✓

6.3 Cl_2 (left) or Pt ✓

6.4 Ni | Ni^{2+} ✓ || ✓ $C\ell_2$ | $C\ell^-$ | Pt ✓

6.5.1 Ni → $Ni^{2+} + 2e^-$ ✓

6.5.2 The Ni electrode corrodes (loses mass). ✓

6.5.3 Completes the circuit OR pathway for ions ✓

7.1 electrical to chemical ✓

7.2 $A\ell^{3+}$ + $3e^-$ → $A\ell$ ✓ ✓

7.3 $2O^{2-}$ → $O_2 + 4e^-$ ✓ ✓ (–1 per error) OR $C + 2O^{2-}$ → $CO_2 + 4e^-$ (–1 per error)

7.4 $C + O_2$ → CO_2 OR $2A\ell_2O_3 + 3C$ → $3CO_2 + 4A\ell$ ✓ ✓

7.5 Less coal is burnt to produce electricity therefore fewer CO2 (greenhouse gas) emissions ✓✓ OR conserving non-renewable fossil fuel OR less poisonous gas emissions (from burning coal to make electricity). (ONE reason only which links to the environment.) Do NOT accept reduces electricity/energy consumption **without a link** to the environment.

7.6 $A\ell^{3+}$ ions are a **weaker oxidising agent** ✓ (have a **more negative E_o**) than H_2O molecules, therefore H_2O will be reduced at the cathode in preference to $A\ell^{3+}$ ions. ✓

$2H_2O + 2e^-$ → $H_2 + 2OH^-$ (–1 per error) ✓

8.1 the minimum energy needed for a reaction to take place. ✓

8.2 65kJ ✓

8.3 185 kJ ✓ ✓

8.4 $\Delta H = H_f - H_i$ ✓ = - 30 - 90 = -120kJ ✓

8.5 Endo ✓

8.6 The activation energy will decrease ✓

9.1.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature ✓✓

9.1.2 $V = RI$ ✓

$12 = 8I$ ✓

$\mathbf{I = 1,5\ A}$ ✓

9.1.3 $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ ✓

$\frac{1}{R_P} = \frac{1}{4} + \frac{1}{8} + \frac{1}{12}$ ✓

$\mathbf{R_P = 2,18\ \Omega}$ ✓

9.1.4 $V = RI$

$12 = 2,18I$ ✓

$\mathbf{I = 5,5\ A}$ ✓

9.1.5 emf = IR + Ir ✓

16,5 = 12 + 5,5 r ✓

r = 0,82 Ω ✓

9.1.6 decrease,✓ emf is constant, R will decrease, I will increase, thus Ir will increase, thus IR (V) will decrease✓