JUNE 2022 GR.12 SCIENCE JUNE P 2 MEMO

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

2.1 The change in volume (of carbon dioxide) per unit time. ✓✓ (2 or 0) (2)

2.2.1 Temperature. ✓ (1)

2.2.2 Experiment 1. ✓

- Experiment 1 takes place at a hotter temperature.
- ∴ The average kinetic energy / movement of the particles is greater in experiment 1 (than in experiment 2). ✓
- This results in more effective collisions per unit time in experiment 1. ✓ (3)

2.3.1 40 s. ✓ (1)

2.3.3 Average Rate = $\frac{19,2-0}{90-0}$ √ $= 0,21\ dm^3.s^{-1}$ ✓ (2)

2.4 ✓ for (at least one) of $n = \frac{m}{M}$, $c = \frac{n}{V}$ or $n = \frac{V}{V_m}$

$n_{Na_2CO_3} = \frac{m}{M} = \frac{132,5}{2(23)+1(12)+3(16)} = \frac{132,5}{106} = 1,25\ mol$ ✓

$n_{HCl} = c.V = (1,25)(1,6) = 2\ mol$ ✓

∴ HCl is the limiting reactant.

$n_{CO_2} = \frac{1}{2}(n_{HCl}) = \frac{1}{2}(2) = 1\ mol$ ✓ +marking for correct ratio

$V_{CO_2} = n.V_m = (1)(24) = 24\ dm^3$ ✓ (5)

2.5.1 Curve B. ✓ (1)

2.5.2 Curve A. ✓

- Experiment 2 happens at a lower temperature / has particles with a smaller average kinetic energy (than experiment 1) (which makes the peak of the curve more to the left on the Maxwell-Boltzmann graph). ✓

- Experiment 2 has a smaller concentration / fewer number of particles (than experiments 3 and 4) (which makes the area underneath the curve smaller on the Maxwell-Boltzmann graph). ✓ (3)

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3.1 A dynamic equilibrium when the rate of the forward reaction equals the rate of the reverse reaction. ✓✓ (max 1/2 if "dynamic" is omitted) (2)

3.2 TO THE RIGHT. ✓ (1)

3.3 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓✓ (2 or 0) (2)

3.4 $K_c = \frac{[[Co(H_2O)_6]^{2+}].[Cl^-]^4}{[[CoCl_4]_2^-]}$ ✓ (1)

3.5.1 REVERSE. ✓ (1)

3.5.2 FORWARD. ✓ (1)

3.5.3 REVERSE. ✓ (1)

3.6 Adding table salt (NaCℓ) increases the chloride ion ($C\ell^-$) concentration. ✓ (1)

3.7 ENDOTHERMIC. ✓

- A decrease in temperature (always) favours the exothermic reaction since it produces heat. ✓
- The reverse reaction was favoured (since the equilibrium shifted towards the reactants (dark blue)). ✓
- ∴ The reverse reaction is exothermic which means the forward reaction is endothermic. (3)

3.8 $n_{NH_3} = \frac{m}{M}$ √ $= \frac{4,42}{14+3(1)}$ √ $= 0,26\ mol$ (at equilibrium)

	N_2 (g)	3 H_2 (g)	2 NH_3 (g)	
n_i (mol)	0,6		0	
Δn (mol)	−0,13	−0,39	+0,26	✓ all Δn
n_{eq} (mol)	0,47		0,26	
$c_{eq} = \frac{n}{V}$ (mol.dm^{-3})	$\frac{0,47}{2} = 0,235$		$\frac{0,26}{2} = 0,13$	✓ conc N2 & NH3

$K_c = \frac{[NH_3]^2}{[N_2].[H_2]^3}$ ✓

$3,864 = \frac{(0,13)^2}{(0,235).[H_2]^3}$

$\therefore [H_2] = 0,265 \ldots mol.dm^{-3}$ (at equilibrium) ✓

	N_2 (g)	3 H_2 (g)	2 NH_3 (g)	
n_i (mol)	0,6	0,92 ✓	0	
Δn (mol)	−0,13	−0,39	+0,26	✓ all Δn
n_{eq} (mol)	0,47	0,53 ✓	0,26	
$c_{eq} = \frac{n}{V}$ (mol.dm^{-3})	$\frac{0,47}{2} = 0,235$	0,265 …	$\frac{0,26}{2} = 0,13$	✓ conc N2 & NH3

(9)

$m_{H_2} = n.M = (0{,}92)(2) = 1{,}84\ g$ (initial) ✓

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4.1 30 – 10 = 20 cm^3 ✓ (1)

4.2 Na_2CO_3: n = cV ✓ = 1 x 0,02 ✓ = 0,02 mol

H_2SO_4: n = 0,02 mol ✓

c = n/V = 0,02 / 0,04 ✓ = 0,5 $mol.dm^{-3}$

$n(H_2SO_4) : n(H_3O^+)$ = 1 : 2 ✓ ; $[H_3O^+]$ = 1 $mol.dm^{-3}$ ✓

pH = - log $[H_3O^+]$ ✓

pH = - log (1) = 0 ✓ (8)

4.3 acidic (1)
4.4 Methyl orange (1)
4.5 Red to yellow / orange (1)
4.6 strong (1)
4.7 It fully ionizes in water or It produces a high $[H_3O^+]$ in H_2O. (1)

4.8 NaOH: n = cV = 0,1(0,018) ✓ = 1,8 x 10^{-3} mol

CH_3COOH: n = 1,8 x 10^{-3} mol ✓

c = n / V = 1,8 x 10^{-3} / 0,02 ✓ = 0,09 $mol.dm^{-3}$

c (titration) = c (dilution) = 0,09 $mol.dm^{-3}$ ✓

n (dilution) = c V = 0,09 (0,1) ✓ = 9 x 10^{-3} mol = n (10mℓ sample) ✓

c (10mℓ sample) = n / V = 9 x 10^{-3} / 0,01 ✓ = 0,9 $mol.dm^{-3}$

c(vinegar) = 0,9 $mol.dm^{-3}$ ✓ (8)

4.9 c = 0,9 $mol.dm^{-3}$ = 0,09 mol.(100 mℓ)$^{-1}$ ✓

n = m / M ✓
0,09 = m / [2(12) + 4 + 2(16)] ✓
m = 5,4 g < 5,8 g Not true ✓ (4)

5.1 Increase in the oxidation numbers ✓ ✓ (2)

5.2.1 No reaction ✓ (1)

5.2.2 Oxidised. ✓ (2)

$Mn \rightarrow Mn^{2+} + 2e^-$ ✓ (double arrow -1)

5.3 $NO_3^- + 2H^+ + e^- \rightarrow NO_2(g) + H_2O$ (2)

OR

$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O$ ✓ ✓

5.4.1 Hydrogen (gas) ✓ (1)

5.4.2 $2H_2O + 2e^- \rightarrow H_2(g) + 2OH^-$ ✓ ✓ (2)

5.4.3 It uses electricity that is generated by burning coal✓, which releases CO_2, a greenhouse gas which contributes to global warming ✓ (2)

6.1 Voltaic/galvanic ✓ (1)

6.2 A porous membrane stopper✓ (cotton wool plugs) to stop the Na_2SO_4 (aq) from running out✓. (2)

6.3 Keep charges neutral in the solutions/beakers. (1)

Completes circuit

Pathway for ions. ✓ (any one)

6.4.1 Magnesium✓ (1)

6.4.2 $Mg \rightarrow Mg^{2+} + 2e^-$ ✓ (1)

6.4.3 $NiSO_4$ (or any Ni (aq) salt) ✓ (1)

6.4.4 $E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓ = -0,27 - (-2,36) ✓ = 2,09 V ✓ (3)

6.5.1 Zn / Zn^{2+} ✓ // ✓ $H_2 / H^+ / Pt$ ✓ (3)

6.5.2 Increases ✓ (1)

6.5.3 Zn is stronger reducing agent than H_2, ✓

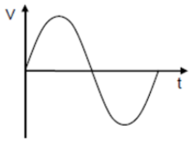
∴ Zn will be oxidised to Zn^{2+} and H^+ will be reduced to H_2 ✓ (3)

∴ $[H^+]$ decreases✓ , ∴ pH will increase

6.5.4 cathode ✓ (1)

7.1.1 AC ✓ (1)

7.1.2



✓ ✓ (-1 for wrong labels, sin/cos graph right) (2)

7.1.3

OPTION 1/*OPSIE 1*

$V_{rms/wgk} = \dfrac{V_{max/maks}}{\sqrt{2}}$ ✓

$= \dfrac{30 \times 10^3}{\sqrt{2}}$ ✓

$= 2,12 \times 10^4$ V

$P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk}$ ✓

$4,45 \times 10^9$ ✓ $= (2,12 \times 10^4)I_{rms/wgk}$

$\therefore I_{rms/wgk} = 2,10 \times 10^5$ A ✓

OPTION 2 / *OPSIE 2*

$P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk}$

$P_{ave/gem.} = \dfrac{V_{max}I_{rms}}{\sqrt{2}} / \dfrac{V_{maks}I_{wgk}}{\sqrt{2}}$ ✓✓

$4,45 \times 10^9$ ✓ $= \dfrac{(30 \times 10^3)I_{rms/wgk}}{\sqrt{2}}$ ✓

$\therefore I_{rms/wgk} = 2,10 \times 10^5$ A ✓

(4)

7.2.1 Electrical to mechanical ✓ (1)

7.2.2 Motor effect ✓ (1)

7.2.3 Electromagnetic induction ✓ (1)

7.3.1 motor ✓ (1)

7.3.2 Sliding contact between moving and stationary parts for current to flow ✓ (1)

7.3.3 ANTI-CLOCKWISE ✓ (1)

7.3.4 More windings on coil
Stronger magnets
Larger current ✓ (any one) (1)

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8.1.1 gradient/m = $\frac{\Delta V}{\Delta I}$

$= \frac{0,65 - 1,5 \checkmark}{1,0 - 0 \checkmark}$

$= -0,85\ \Omega$ ✓ (3)

8.1.2 Internal resistance ✓ in ohms (or Ω) ✓ (2)

8.1.3 1,5 V ✓ (1)

8.1.4 Decreases ✓
When I increases
"Lost volts"/ Ir increases ✓
V_{ext} = <u>emf – Ir decreases</u> ✓ (3)

8.2.1 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ OR $R_p = \frac{R1 \times R2}{R1 + R2}$ (3)

$= \frac{1}{60} + \frac{1}{60}$ ✓

$\therefore R_p = 30\ \Omega$ ✓

8.2.2 (4)

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2:***
R_{ext} = 30 + 25 = 55 Ω ✓	R_{tot} = (30 + 25) ✓+1,5 = 56,5 Ω
Emf/*emk* = I(R + r) ✓	V = IR✓
∴ 12 ✓= I(55 + 1,5) ✓	12✓ = I(56,5) ✓
∴ I = 0,21 A ✓	∴ I = 0,21 A ✓

8.2.3 (3)

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
V = IR ✓ = (0,21)(30) ✓ = 6,3 V ✓	V = IR ✓ = (0,105)(60) ✓ = 6,3 V ✓

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