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Subject Paper code

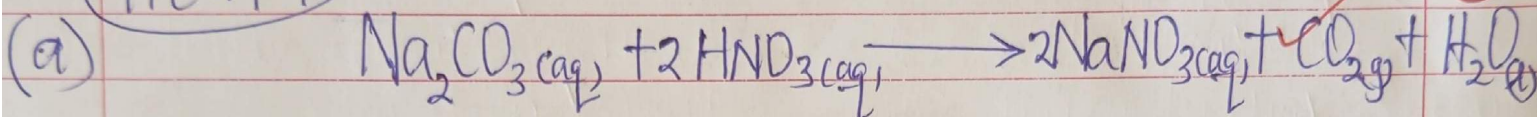
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GUIDE
S.5 CHEM 1 (Physical)

ITEM 1



(b) (i) 1000cm³ of the solution contain 0.1 moles HNO₃
12cm³ of the solution contain $\left(\frac{0.1 \times 12}{1000}\right)$ moles

= 0.0012 moles

(ii) 2 moles of HNO₃ reacts with 1 mole of Na₂CO₃
0.0012 moles of HNO₃ reacts with $\left(\frac{1}{2} \times 0.0012\right)$ moles

= 0.0006 moles of Na₂CO₃

20cm³ of the solution contain 0.0006 moles of Na₂CO₃
1000cm³ of the solution contain $\left(\frac{0.0006 \times 1000}{20}\right)$ moles

= 0.03 moles

(iii) 0.03 moles of Na₂CO₃·nH₂O weigh 8.58g

1 mole of Na₂CO₃·nH₂O weigh $\left(\frac{8.58 \times 1}{0.03}\right)$ g

= 286 g mol⁻¹

From

(iv) $\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O} = 286$
 $23 \times 2 + 12 + 16 \times 3 + n(2 + 16) = 286$

$106 + 18n = 286$

$18n = 180$

$n = 10$

b) Chemical formula is $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ✓ (1)

comment on its nature: — It's a strongly alkaline chemical compound (1)

— When dissolved in soil moisture, it undergoes salt hydrolysis and this reaction releases hydroxide ions (OH^-) that make the soil pH alkaline.

c) — It's efflorescent (readily loses its water of crystallization when exposed to dry air). This causes error during weighing of the salt. (1)

— It has a high percentage of water, majority of the weight you weigh ~~but~~ is just water.

d) (i) Mass of H_2O lost = $12.3 - 6.0$
= 6.3g ✓ (1)

(ii) Moles of anhydrous MgSO_4 = ~~from~~ Moles of H_2O
Mr of $\text{MgSO}_4 = 24 + 32 + 16 \times 4$ Mr of $\text{H}_2\text{O} = 2 + 16$
= 120g = 18g (02)

120g of MgSO_4 contains 1 mole

6.0g of MgSO_4 contains $\frac{1}{120} \times 6.0$
= 0.05 moles ✓ (1)

18g of H_2O contains 1 mole

6.3g of H_2O contains $\left(\frac{1}{18} \times 6.3\right)$
= 0.35 moles ✓ (1)

(iii) Mole ratio $\text{MgSO}_4 : \text{H}_2\text{O}$

$\frac{0.05}{0.05} : \frac{0.35}{0.05}$

1 : 7 ✓

Formula of hydrated salt
is $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ ✓ (02)

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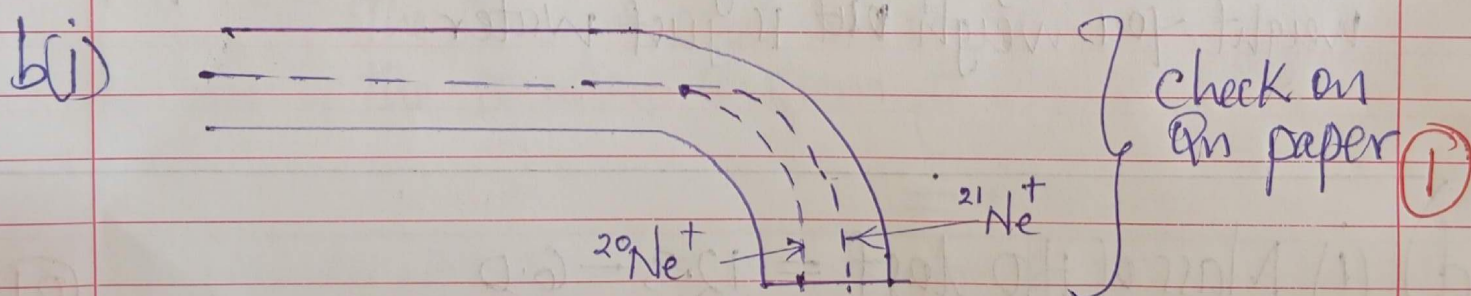
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- ITEM 2
- a(i) Ionization process (A) (B) Acceleration process (C) Deflection process (D) Ion Detection process

(ii) Ionisation of Neon occurs when gaseous Neon atoms are bombarded by high energy electrons from an electron gun. The incoming electron knocks out an electron from a neon atom producing a positively charged ion.

$$\text{Ne(g)} + e^- \longrightarrow \text{Ne}^+(\text{g}) + 2e^-$$


- (ii) $^{20}\text{Ne}^+$ and $^{21}\text{Ne}^+$ ions paths differ in the mass spectrometer because they have different masses, but same charge (+1). Neon
- $^{20}\text{Ne}^+$ ion with smaller mass than $^{21}\text{Ne}^+$ thus it's deflected more strongly. $^{21}\text{Ne}^+$ ion is heavier and is deflected less and follows a path with a larger radius of curvature. Because their m/e values are different, the ions travel along different curved paths.

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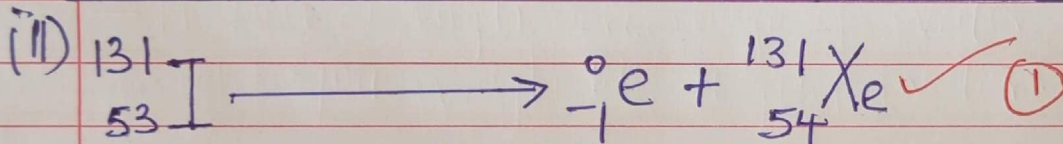
(c) Total relative abundance = $91 + 9 = 100$
 From $RAM = \sum (\text{isotopic mass} \times \text{Relative percentage abundance})$

$$RAM = \left(20 \times \frac{91}{100} \right) + \left(21 \times \frac{9}{100} \right)$$

$$= 20.09$$

(02)

d) (i) Radioactive decay is the natural breakdown of an unstable atomic nucleus into a more stable one by emitting radiations like alpha, beta or gamma rays. (01)



New element is ${}_{54}^{131}\text{Xe}$ (or Xenon-131) (1)

(iii) From $\ln\left(\frac{A_0}{A_t}\right) = \lambda t$

But half life $t_{1/2} = \frac{\ln 2}{\lambda}$
 $= \frac{\ln 2}{8}$
 $= 0.08664 \text{ day}^{-1}$

Where λ = decay constant

hence $\ln\left(\frac{6400}{400}\right) = 0.08664 \times t$

$t = 32 \text{ days}$

Time taken (t) is 32 days. (02)

- (iv) - Soil contamination which reduce soil quality and contaminating crops. mitigated by proper disposal of radioactive waste (1) any one.
- Exposure to radiations can cause mutations and infertility in animals/humans. mitigated by wearing protective gears for radiations
- Water contamination affecting aquatic life. mitigated by containing radioactive leaks treat contaminated water and regular monitoring of water quality