ACIDS BASES AND SALTS
MARKING SCHEME

1. Aluminium chloride hydrolyses in water to form an acidic solution as shown by the equations below ✓ 1

$$Alcl_{3(s)} + 6H_2O_l \rightarrow [Al(H_20)_6]^{3+}_{(aq)} + 3cl^-_{(aq)}$$

$$[Al(H_2O)_6]^{3+}_{aq} \rightarrow [Al(H_2O)_5OH]^{2+}_{aq} + H^+_{aq}$$

The presence of the H^+_{aq} ions in the solution makes it acidic ✓ 1
N/B: The equations may or may not be given

2. Because ethanoic acid is a weak acid while hydrochloric acid is a strong acid. HCl fully ionized while ethanoic partially ionised✓ ½

3. a) Fe^{3+} ✓ 1
   b) It is an oxidizing agent ✓ 1
   c) $2Fe(OH)_{3(s)} \xrightarrow{\text{Heat}} Fe_2O_{3(s)} + 3H_2O_{(l)}$ ✓ (1)

4. $20cm^3$ of water contains 7.5g of solute

   $100cm^3$ of water contains –

$$= \frac{7.5x100}{20}$$ ✓ 1

$$= 37.5g\ of\ \ solute/100g\ of\ water$$

5. Hydrochloric acid solution is completely dissociated giving a high concentration of H^+ (1mk) while ethanoic acid is only partially dissociated being a weak acid. (1mk)

6.(a) 20g water ≥ 7.5g solute

$\therefore$ 100g water ≥ $\frac{100}{75} \times 7.5g = 37.5g$ (1mk)

$\therefore$ Solubility of solute = 37.5g /100g water (1mk)

(b) Presence of $MgSO_{4(aq)}$ and $CaSO_{4(aq)}$ (1mk)

7. Acid is H_2O (1mk)

   Base : NH_3 (1mk)

   Reason : H_2O donates H^+ to NH_3 in the reaction, (1mk)

8.

(a) X

(b)

(i) It removes temperary hardness (Soften the water) by composing the $Ca(HCO_3)_2$ *or* $Mg(HCO_3)_2$ (1mk) thus removing $Mg^{2+}_{(aq)}$ *or* $Ca^{2+}_{(aq)}$ for water

(ii) No significant effect because permanent hardness (due to presence of Mg so_4 of $CaSO_4$) can not be boiling of the water (1mark)

9.a) $Cu^{2+}_{(aq)} + 4NH_{3(aq)} \longrightarrow \left[Cu(NH_3)_4 \right]^{2+}_{(aq)}$ (1)

b) Tetrammine copper II ion (1)

10. a) The pH value of the hydrochloric acid is lower than that of ethanoic acid Hydrochloric acid is a strong acid whereas ethanoic acid is a weak acid

b) pH of ethanoic acid is 4 to 6 (½)
pH of hydrochloric acid is 1 to 3

11. H_2O ½
It accepts a proton to form H_3O^+ ½

12. (a) (i) No^-_3 1 (ii) Pb^{2+} 1

(b) $Pb(NO)_{2(aq)} + 2HCl_{(aq)} \longrightarrow PbCl_{2(s)} + 2HNO_{3(aq)}$ 1

Penalize ½ for wrong symbols

13. (a) Sample III had temporary hardness ½ which was removed by ½ boiling so it require less soap ½ tan before when it was hard. ½

(b) $Mg^{2+}_{(aq)}$, $SO^{2-}_{4(aq)}$, *or* $Ca^{2+}_{(aq)}$, SO^{2-}_4

14. 155 -31 ½ = 124 g ½ in 100g water

In 50g of water = $\frac{124}{2}$ $^{1/2}$ = 62g ½

15. Strong acid is one which dissociates ✓ 1 completely when dissolved in water while concentrated acid is one which contain little or no water.✓1

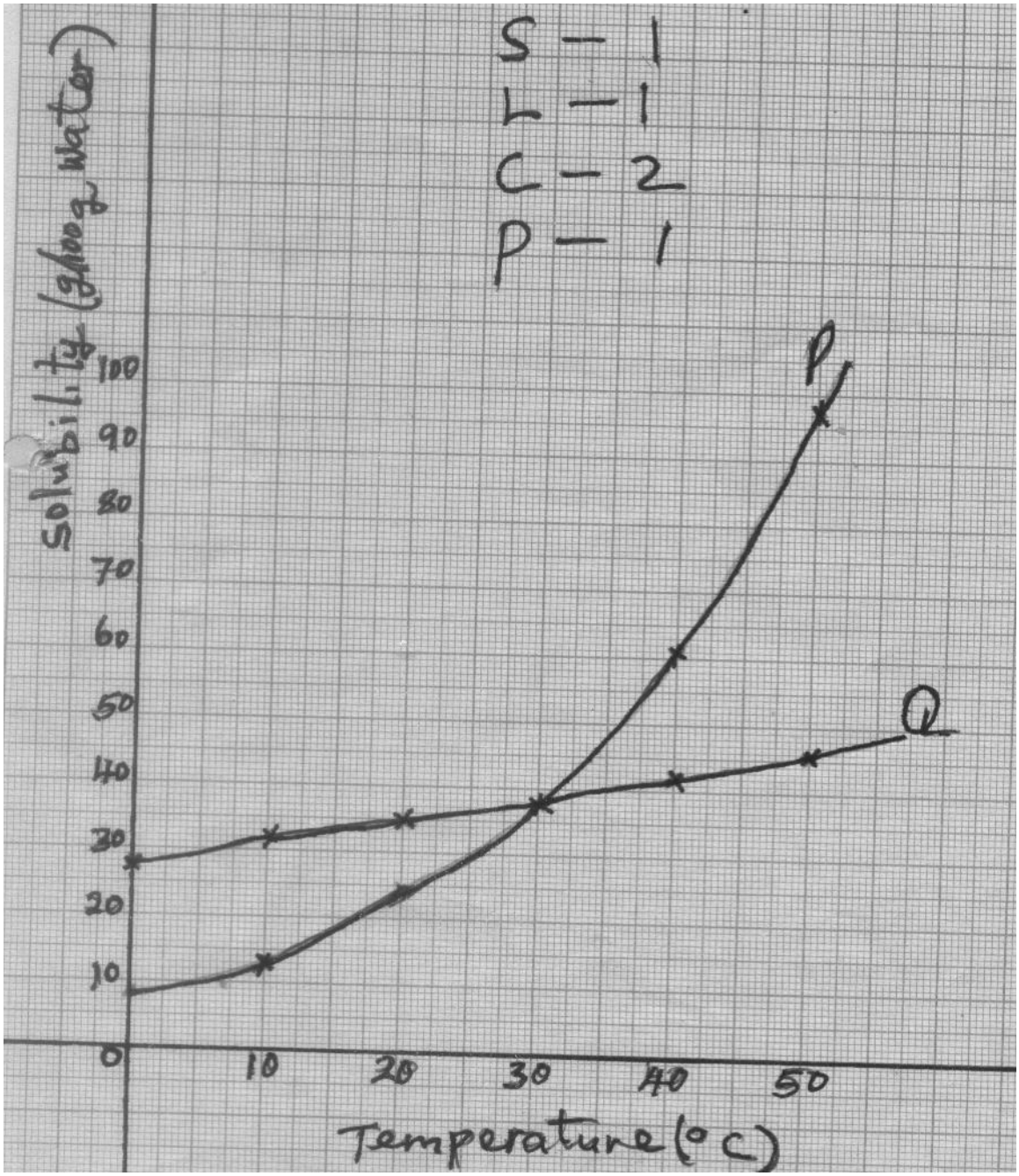
16. a) $CH_3(CH_2)_{15}SO_3^-Na+$ ✓1
It does not form scum with hard water.
b) It provides essential (Ca^{2+}) ions for bone & teeth formation

17. a) The negative Power of hydrogen ion concentration✓1
b) (i) Substance with pH value less than 7✓1
(ii) Substance with pH value greater than 7✓1

18. a) i) Blue precipitate formed✓1 (pale blue)
ii) Deep blue solution formed✓1
b) $[Cu(NH_3)_4]^{2+}$ ✓1

19. a) Water which does not readily form lather with soap✓1
b) Ca^{2+}✓½ and Mg^{2+} ✓½
c) $Na_2X_{(s)} + Ca^{2+}_{(aq)} \longrightarrow CaX_{(s)} + 2Na^+_{(aq)}$
or
$Na_2X_{(s)} + Mg^{2+}_{(aq)} \longrightarrow MgX_{(s)} + 2Na^+_{(aq)}$ *(Any 1 x 1mk)*

20. a)



b) i) P at 25^0C = 30g✓1

ii) 33^0C

c) i) Solubility of 40^0C is 61g/100g water

∴ 35g temperature is 28^0C✓

ii) At 5^0C the solubility is 10g✓ $^1/_2$

The mass is 35g – 10g = 25g✓ $^1/_2$

d) 100g at 50^0C solubility is 46g

∴ 80g at 50^0C the solubility will be $\frac{46\ x\ 80}{100} = 36.8g$ ✓1 $\sqrt{1}$

e) 31^0C✓1

6. b) i) M – 30.5 (± 1) g / 100g of water✓ 1
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N - 36.5 (± 1) g / 100g of water✓ 1

ii) 60.5 (± 1) ✓ 1

c) 60 - 20.7✓ ½ = 39.3✓ ½

c) 13g of m will crystallise✓ 1
Salt N will be in solution✓ 1
Solubility of M is lower than the mass dissolved while N is higher than the mass✓1 dissolved

d) – Extraction of metals✓ 1
- Fractional crystallization of salts ✓ 1