A-LEVEL PAPER 3 PP12 MS

1. (a) (Measure the) <u>volume of gas</u> / <u>mass of the container + contents</u> **1**

Suitable named piece of equipment

Gas syringe (or inverted burette or measuring cylinder, as long as student has referred to the cylinder being filled with water) / balance.

Equipment must be correct for the measurement stated. **1**

(b) Any **one** of:

- Mass of magnesium

  Allow amount of magnesium.

- Surface area of magnesium **1**

(c) (i) Gravity: Conical flask or beaker and funnel /

Vacuum: Sealed container with a side arm and Buchner or Hirsch funnel

Must be either gravity filtration (with a V-shaped funnel) or vacuum filtration (with a side-arm conical flask) appropriately drawn. **1**

Filter paper

Must show filter paper as at least two sides of a triangle (V-shaped) for gravity filtration or horizontal filter paper for vacuum filtration. **1**

(ii) Wash with / add (a small amount of cold) water

Ignore filtering. **1**

[6]

2. (a) Weak acid / (acid) only slightly / partially dissociated / ionised

Ignore rate of dissociation. **1**

$[CN^-]$ very low

Allow (very) few cyanide ions.

Mark independently. **1**

(b) (i) $H_2C{=}CH{-}CH_3 + NH_3 + \frac{3}{2}O_2 \longrightarrow H_2C{=}CH{-}CN + 3H_2O$

OR

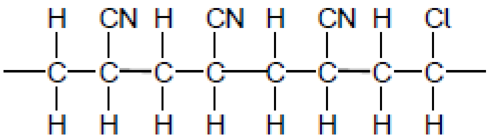
$H_2C{=}CH{-}CH_3 + NH_3 + 3O_2 \longrightarrow H_2C{=}CH{-}CN + 3H_2O_2$

OR doubled.

Allow C_3H_6 and CH_2CHCN or C_3H_3N on this occasion only.

1

(ii)

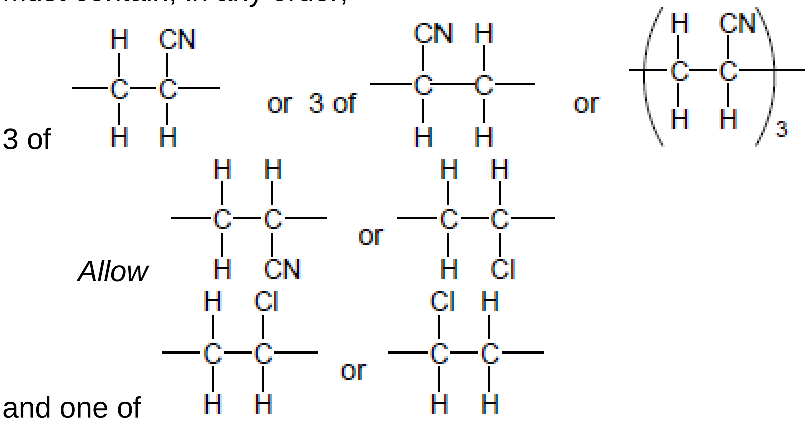


Ignore n.

Must show trailing bonds.

Do not penalise C–NC bond here on this occasion.

Must contain, in any order,



Allow –$CH_2CH(CN)CH_2CHCl$– etc.

1

(iii) Addition (polymerization)

Allow self-addition.

Do not allow additional.

1

[5]

3. (a) $C_2H_6 \rightarrow C_2H_4 + H_2$ (1)

(b) −1 for each error

$PV = nRT$; or $n = PV/RT$ (1)

$n = 110{,}000 \times 25 \times 10^{-6} / 8.31 \times 332$ (1)

$= (1.0$ to $9.96(8)) \times 10^{-4}$ (moles) (1)

(c) (i) *Calculation* $3 \overset{(1)}{\times} (1.0 \text{ to } 9.968) \times 10^{-4}$

$= (3.0 \text{ to } 2.99) \times 10^{-3}$

Allow conseq as 3× answer to (b)

Equation $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$ (1)

Penalise if an incorrect structural formula given

(ii) $2KI + Br_2 \rightarrow 2KBr + I_2$ or an ionic equation (1)

(iii) *Number of moles of iodine formed*

Moles thio $= 22.1 \times 0.250 / 1000 = (5.52 \text{ to } 5.53) \times 10^{-3}$ (1)

Moles I_2 = Moles thio / 2 (1)

$= (2.76 \text{ to } 2.77) \times 10^{-3}$

Number of moles of bromine which reacted with ethene

$2.99 \times 10^{-3} - 2.76 \times 10^{-3} = (2.25 \text{ to } 2.41) \times 10^{-4}$ (1)

Mark conseq even if answer is negative

(iv) % Ethene = (moles ethene / total moles gas) × 100 (1)

$= (2.25 \text{ to } 2.41) \times 100 / (1.0 \text{ to } 9.965) \times 10^{-4}$

$= (22.4 \text{ to } 24.2)\%$ (1)

Mark conseq as $\frac{C(iii) \times 100}{(b)}$

Notes

Correct answer scores (5)

If there is no subtraction in b(iii) part two score max(3) two in c (iii) part and plus one in c (iv) for first point

Answer in b(iv) must be a %

Negative final % or answers over 100% lose the last mark.

[12]

4. (a)		**A**	$Cr(H_2O)_3(OH)_3$ or $Cr(OH)_3$ or correct name	1
		B	CO_2 or name	1
		$2[Cr(H_2O)_6]^{3+} + 3CO_3^{2-} \rightarrow 2Cr(H_2O)_3(OH)_3 + 3CO_2 + 3H_2O$ (or gives $2Cr(OH)_3 + 3CO_2 + 9H_2O$)		1

(b)	(i)	At least one $H_2NCH_2CH_2NH_2$ with correct structure and bonding to Cr via N	1
		6 co-ordination with 3en	1
		Correct 3+ charge	1
	(ii)	Same (or similar) types of bonds broken and made	1
		Same number of bonds broken and made	1
	(iii)	Entropy change (or ΔS) is positive (or increase in disorder)	1
		because there are more product particles than reactant particles	1
(c)	(i)	Ethanal (or CH_3CHO but not CH_3COH)	1
	(ii)	Ethanoic acid (or correct formula)	1

[12]

5. (a) Initiation $Cl_2 \rightarrow 2Cl\cdot$ (1)

$CH_4 + Cl\cdot \rightarrow CH_3\cdot + HCl$ (1)

$CH_3\cdot + Cl_2 \rightarrow CH_3Cl + Cl\cdot$ (1)

$CH_3Cl + Cl\cdot \rightarrow CH_2Cl\cdot + HCl$ (1)

$CH_2Cl\cdot + Cl_2 \rightarrow CH_2Cl_2 + Cl\cdot$ (1) 5

(b) $CH_3CHClCH_3$ (1)

$CH_3CHClCH_3 + KOH \xrightarrow{\text{Aqueous KOH}} CH_3CHOHCH_3 + KCl$ (1)

(1)

$CH_3CHClCH_3 + KOH \xrightarrow{\text{Alcoholic KOH}} CH_3CHCH_2 + KCl + H_2O$ (1) 4

Note *Solvent mark only allowed if a correct product given*

(c) Both form complex aqua ions, $[Fe(H_2O)]_6^{n+}$ (1)

Charge/size ratio greater for Fe^{3+} than Fe^{2+} (1)

Hence more OH bonds broken in $[Fe(H_2O)]_6^{3+}$

or more polarising ion or more hydrolysis occurs (1) 3

[12]

6. (a) Proton (or H^+) acceptor (1)

(b) Electron (or lone) pair donor (1)

(c) $NH_3 + H^+ \rightarrow NH_4^+$ (1)

(or $NH_3 + H_3O^+ \rightarrow NH_4^+ + H_2O$)

(allow Cl^- as a spectator)

(d) $4NH_3 + [Cu(H_2O)_6]^{2+} \rightarrow [Cu(NH_3)_4(H_2O)_2]^{2+} + 4H_2O$

Correct copper species (both) (1)

(allow no square brackets or other shapes of brackets)

balanced equation (1)

(only with correct species)

colour of reagent: Blue (1)

Colour of product: (Dark) blue (1)

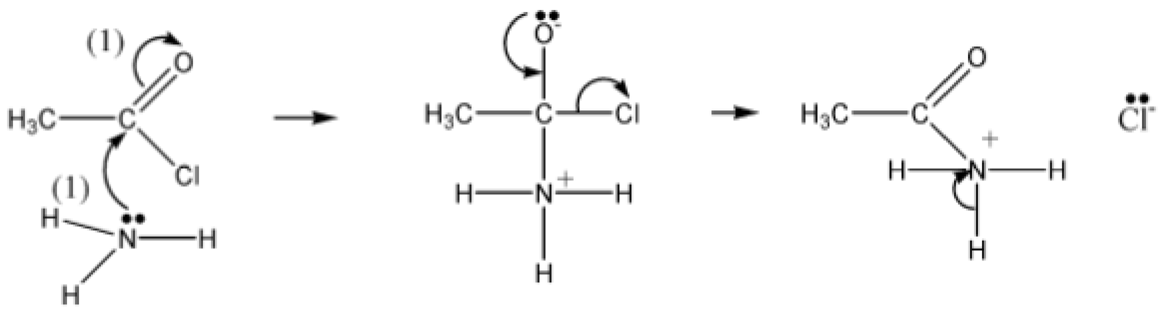
(note NOT purple, NOT blue ppt)

(Note mark colours independently correct)

(e) $CH_3COCl + 2NH_3 \rightarrow CH_3CONH_2 + NH_4Cl$ (1)

(allow $CH_3COCl + NH_3 \rightarrow CH_3CONH_2 + HCl$)

(nucleophilic) addition-elimination (1)



ion (1) 3 arrows and lone pair (1)

(final Cl^- not essential)

(ignore final proton donation to base even if arrow etc wrong)

arrow from lone pair on ammonia to C (1)

arrow from C=O to O (1)

intermediate with + and – charges (1)

3 arrows and lone pair on O (1)

(Total 13 marks)

7. D [1]

8. B [1]

9. D [1]

10. B [1]

11. C [1]

12. A [1]

13. A [1]

14. D [1]

15. C [1]

16. C [1]

17. A [1]

18. C [1]

19. B [1]

20. A [1]

21. B [1]

22. D [1]

23. D [1]

24. C [1]

25. C [1]

26. D [1]

27. C [1]

28. D [1]

29. D [1]

30. D [1]

31. D [1]

32. D [1]

33. D [1]

34. D [1]

35. D [1]

36. D [1]