Sample Paper 7: Paper 1

Question 8 (50 marks)

Question 8 (a) (i)

$x + y = 15....(\mathbf{1})(\times 0.4)$

$0.4x + 0.25y = 0.3 \times 15 \Rightarrow 0.4x + 0.25y = 4.5...(\mathbf{2})$

$$\begin{array}{l} 0.4x + 0.4y \;\; = 6 \\ 0.4x + 0.25y = 4.5 \\ \hline 0.15y = 1.5 \Rightarrow y = 10 \text{ l} \end{array}$$

$x + 10 = 15 \Rightarrow x = 5 \text{ l}$

Question 8 (a) (ii)

There is 4.5 l of acid in 15 l of the solution $(15 \times 0.3 = 4.5)$.
When 1 l of water is added, there is now 16 l of solution.

Concentration of acid in solution $= \dfrac{4.5}{16} \times 100\% = 28.125\%$

Question 8 (b)

	pH value	$[H^+]$
Acidic	< 7	$> 10^{-7}$
Alkaline	> 7	$< 10^{-7}$
Neutral	$= 7$	$= 10^{-7}$

$\text{pH} = -\log_{10}[H^+]$

$\text{pH} = 7$

$\therefore 7 = -\log_{10}[H^+]$

$-7 = \log_{10}[H^+]$

$\therefore 10^{-7} = [H^+]$

Question 8 (c) (i)

Apple juice: $[H^+] = 0.00028$ moles per litre

$\text{pH} = -\log_{10}[H^+] = -\log_{10}(0.00028) = 3.55 < 7$ (Acidic)

Ammonia: $[H^+] = 1.32 \times 10^{-9}$ moles per litre

$\text{pH} = -\log_{10}[H^+] = -\log_{10}(1.32 \times 10^{-9}) = 8.88 > 7$ (Alkaline)

Question 8 (c) (ii)

Distilled water: $\text{pH} = 7 \Rightarrow [H^+] = 10^{-7}$ moles per litre

$\text{pH} = 3.22$

$\therefore 3.22 = -\log_{10}[H^+]$

$-3.22 = \log_{10}[H^+]$

$10^{-3.22} = [H^+]$

$\therefore [H^+] = 6 \times 10^{-4}$ moles/litre

Question 8 (d) (i)

pH values: 2.0, 2.5, 3.0, 3.5, 4.0, 4.5.
After five hours the pH value is 4.5.

Or

pH values: 2.0, 2.5, 3.0,.....

$a = 2,\ d = 0.5,\ n = 6$

$T_n = a + (n-1)d = 2 + 5(0.5) = 4.5$

Question 8 (d) (ii)

Arithmetic sequence: 2, 2.5, 3, 3.5,....

Geometric sequence: $10^{-2}, 10^{-2.5}, 10^{-3}$,.....

$a = 10^{-2},\ r = \dfrac{10^{-2.5}}{10^{-2}} = 10^{-0.5}$

$\therefore 10^{-8.7} = 10^{-2}(10^{-0.5})^{n-1}$

$10^{-6.7} = 10^{-0.5n+0.5}$

$-6.7 = -0.5n + 0.5$

$0.5n = 0.5 + 6.7 = 7.2$

$\therefore n = \dfrac{7.2}{0.5} = 14.4$ hours

Therefore, the pH value is 8.7 after 13.4 hours.