

1.

(a) (each of i to iv has one mark allocated for the answer being to 4 s.f.)

$$(i) n_{\text{MnO}_4^-} = C_{\text{MnO}_4^-} V_{\text{MnO}_4^-} = 0.02123 \times 0.02763 = 5.866 \times 10^{-4} \text{ mol}$$

$$(ii) n_{\text{MnO}_4^-} : n_{\text{H}_2\text{O}_2} = 2 : 5$$

$$\therefore n_{\text{H}_2\text{O}_2} = \frac{5}{2} \times 5.866 \times 10^{-4} = 1.466 \times 10^{-3} \text{ mol}$$

$$(iii) \text{ In diluted solution: } C_{\text{H}_2\text{O}_2} = \frac{n_{\text{H}_2\text{O}_2}}{V_{\text{H}_2\text{O}_2}} = \frac{1.466 \times 10^{-3}}{0.02000} = 0.07332 \text{ mol L}^{-1}$$

Now to calculate commercial solution (using dilution formula):

$$C_1 = ? \quad C_2 = 0.07332 \text{ mol L}^{-1} \quad V_1 = 0.02500 \text{ L} \quad V_2 = 0.2500 \text{ L}$$

$$C_1 V_1 = C_2 V_2$$

$$\therefore C_1 = \frac{C_2 V_2}{V_1} = \frac{0.07332 \times 0.2500}{0.02500} = 0.7332 \text{ mol L}^{-1}$$

$$(iv) M_{\text{H}_2\text{O}_2} = 34.016 \text{ g mol}^{-1}$$

$$\therefore 0.7332 \times 34.016 = 24.94 \text{ g L}^{-1} \\ = 2.494 \% \text{ w/v}$$

(b) Distilled water

(c) It would be greater if rinsed with distilled water (reason is not required but it is because the permanganate is more dilute so more of it is needed to completely react with the permanganate)

2.

$$(a) \frac{4}{10} = 0.4 \quad (\text{must show working for both marks})$$

(b) **X** is more polar. It has moved the least distance meaning it is the most attracted to the polar stationary phase and more polar substances attract more polar substances.

3.

(a) 2.4 min (anything from 2.35 to 2.45 would be accepted. also this is approx. 2 min 24 sec)

(b) The imitation perfume has no peak where component **D** would be. There is a different peak instead, and since every compound has a unique retention time this means a different compound has been used in the imitation perfume.

4.

(a)

(i) 0.225 (anything from 0.21 to 0.23 would be accepted)

$$(ii) 3.5 \text{ ppb} \therefore 3.5 \mu\text{g L}^{-1} \quad (\text{since } 3.5 \text{ g per billion mL or } 3.5 \text{ g per million L}) \\ \therefore 0.035 \mu\text{g in } 10.0 \text{ mL} \quad (3.5 \div 100 \text{ since there are 100 lots of } 10.0 \text{ mL in } 1 \text{ L})$$

(iii) 0.035 μg in 0.45 g

$$\therefore 7.78 \times 10^{-2} \mu\text{g per g} \quad (\text{divided } 0.035 \text{ by } 0.45)$$

$$\therefore 7.78 \times 10^{-8} \text{ g per g} \quad (\text{multiplied } 7.78 \times 10^{-2} \text{ by } 10^{-6})$$

$$\therefore 77.8 \text{ ppb} \quad (\text{multiplied } 7.78 \times 10^{-8} \text{ by } 10^9 \text{ to get g per billion g})$$

(b) Unique arsenic lamp/wavelength is used, this light is only absorbed by arsenic, not by the elements in sulfuric acid.

(c) Has non zero absorbance for zero concentration of arsenic.

5. (numbered, detailed steps, including a diagram. This could be done with a titration or with AAS)