

Question 2		
(a)	<p>Amount of $\text{S}_2\text{O}_3^{2-} = 0.0122 \text{ dm}^3 \times 0.100 \text{ mol dm}^{-3} = 1.22 \times 10^{-3} \text{ mol}$</p> <p>Amount of Cu = $1.22 \times 10^{-2} \text{ mol}$</p> <p>Mass of Cu = $1.22 \times 10^{-2} \text{ mol} \times 63.55 \text{ g mol}^{-1} = 0.775 \text{ g}$</p> <p>Percentage of Cu by mass = $100 \% \times 0.775 \text{ g} / 0.800 \text{ g} = 96.9 \%$</p>	1
(b)	<p>Volume of medal = $\pi r^2 h = \pi \times (4.25 \text{ cm})^2 \times 0.7 \text{ cm} = 39.72 \text{ cm}^3$</p> <p>Density of medal = $(0.925 \times 10.49 \text{ g cm}^{-3}) + (0.075 \times 8.96 \text{ g cm}^{-3}) = 10.38 \text{ g cm}^{-3}$</p> <p>Mass of medal = $39.72 \text{ cm}^3 \times 10.38 \text{ g cm}^{-3} = 412 \text{ g}$</p> <p>[Correct answer scores both marks.]</p>	1

(c)	<p>Mass of Au = 0.067 g</p> <p>Amount of Ag = amount of AgCl = $6.144 \text{ g} / (107.87 + 35.45) \text{ g mol}^{-1} = 4.287 \times 10^{-2} \text{ mol}$ Mass of Ag = $4.287 \times 10^{-2} \text{ mol} \times 107.87 \text{ g mol}^{-1} = 4.624 \text{ g}$ Mass of Cu = $5.000 \text{ g} - 0.067 \text{ g} - 4.624 \text{ g} = 0.309 \text{ g}$</p> <p>Percentage of Au by mass = $100 \% \times 0.067 \text{ g} / 5.000 \text{ g} = 1.34 \%$ Percentage of Ag by mass = $100 \% \times 4.624 \text{ g} / 5.000 \text{ g} = 92.5 \%$ Percentage of Cu by mass = $100 \% \times 0.309 \text{ g} / 5.000 \text{ g} = 6.18 \%$</p> <p>[One mark awarded for each correct percentage. Allow error carried forward in the copper percentage. Allow minor differences due to rounding.]</p>	<p>1 1 1</p>
(d)	<p>$d = \text{tyre diameter} = 0.023 \text{ m}$ $r = (\text{wheel diameter} / 2) - (\text{tyre diameter} / 2) = 0.33 \text{ m} - 0.0115 \text{ m}$ $= 0.3185 \text{ m}$</p> <p>[One mark for correct value of r]</p> <p>$\text{volume} = \pi^2 \times 0.3185 \text{ m} \times (0.023 \text{ m})^2 / 2$ $= 8.314 \times 10^{-4} \text{ m}^3$</p> <p>[Correct answer scores both marks.]</p>	<p>1 1</p>
(e)	<p>(i) $p = 8.27 \times 10^5 \text{ Pa}$; $V = 8.31 \times 10^{-4} \text{ m}^3$; $T = 298 \text{ K}$</p> <p>$n = pV/RT$</p> <p>[One mark for correct method.]</p> <p>$n = (8.27 \times 10^5 \text{ Pa} \times 8.31 \times 10^{-4} \text{ m}^3) / (8.314 \text{ J K}^{-1} \text{ mol}^{-1} \times 298 \text{ K})$ $n = 0.278 \text{ mol}$</p> <p>[Correct answer scores both marks; $n = 0.334 \text{ mol}$ if value of 0.001 m^3 used for volume.]</p>	<p>1 1</p>
	<p>(ii) $N_2 = 28.02 \text{ g mol}^{-1}$; $O_2 = 32.00 \text{ g mol}^{-1}$</p> <p>mass in one tyre = $((0.8 \times 28.02 \text{ g mol}^{-1}) + (0.2 \times 32.00 \text{ g mol}^{-1})) \times 0.278 \text{ mol}$ mass in one tyre = 8.011 g</p> <p>mass of air in both tyres = $8.011 \text{ g} \times 2$ $= 16.02 \text{ g}$</p> <p>[Mass = 19.25 g if value of 0.001 m^3 used for volume. Allow any approximations that are more accurate than this, for example if the student has decided to use 78% N_2, 21% O_2, 1% Ar.]</p>	<p>1</p>
	<p>(iii) $He = 4.003 \text{ g mol}^{-1}$</p> <p>mass = $2 \times 0.278 \text{ mol} \times 4.003 \text{ g mol}^{-1}$ mass = 2.226 g</p> <p>mass reduction = $16.02 \text{ g} - 2.226 \text{ g}$ mass reduction = 13.79 g</p> <p>[Error carried forward: accept answer from (e)(ii) minus 2.226 g or answer from (e)(ii) minus 2.674 g if 0.001 m^3 used for volume.]</p>	<p>1</p>

	<p><i>Although this mass reduction is small, it is significant enough to be considered. Unfortunately being very small, helium escapes through the rubber of tyres much more easily and so is rarely used.</i></p>	
(iv)	$\text{SF}_6 = 32.06 \text{ g mol}^{-1} + (6 \times 19.00 \text{ g mol}^{-1}) = 146.06 \text{ g mol}^{-1}$ <p>mass = $2 \times 0.278 \text{ mol} \times 146.06 \text{ g mol}^{-1}$ mass = 81.209 g</p> <p>mass increase = $81.209 \text{ g} - 16.02 \text{ g}$ mass increase = 65.19 g</p> <p>[Error carried forward: accept 81.209 g minus answer from (e)(ii), or 97.568 g minus answer from (e)(ii) if 0.001 m^3 used for volume.]</p>	1
Total		13