UK Chemistry Olympiad support resources: introductory questions mark scheme

1. The question about air

(a)

(i) Molar mass of N_2 = 2(14.01) = 28.02 g mol^{-1}; Molar mass of O2 = 2(16.00) = 32.00 g mol^{-1}; Molar mass of Ar = 39.95 g mol^{-1}

(ii) Mass of 1 mole of air = 29.0 g to three significant figures

(b)

(i) Volume of the troposphere = 5.11 x 10^{21} dm^3

(ii) Mass of air in the troposphere = 6.17 x 10^{21} g

If other values given in question were used then:

Volume of troposphere/ dm^3	Molar mass of air / g mol-1	Mass of air in troposphere / g
5.11 x 10^{21}	30.0	6.38 x 10^{21}
6.00 x 10^{21}	29.0	7.24 x 10^{21}
6.00 x 10^{21}	30.0	7.49 x 10^{21}

(c)

(i) $Mg + ½\ O2 \rightarrow MgO$

(ii) Minimum volume of air = 23.5 dm^3

(d)

(i) $3Mg + N_2 \rightarrow Mg_3N_2$

(ii) $100 - x$

(iii) MgO: $\frac{40.31}{24.31}$ x

Mg_2N_3: $\frac{100.95(100-x)}{3(24.31)}$

(allow equivalent expressions)

(iv) Mass of Mg which reacts to form MgO = 78.8 g

2. The question about bromine and its isotopes

(a)

(i) 0.25 (allow 25%)
(ii) 0.25 (allow 25%)
(iii) 0.5 (allow 50%)

(b)

Abundance of bromine-79 = 60%
Abundance of bromine-81 = 40%

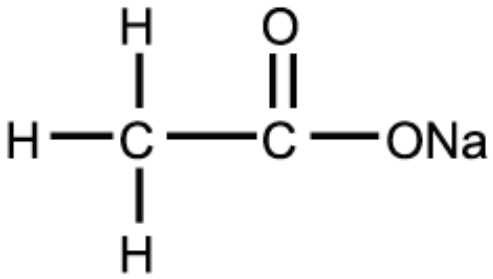
(c)

(i) 247, 248, 249, 250, 251, 252, 253 and 254 (allow 247–254)
(ii) 0.125 (allow 12.5%)
(iii) 0.375 (allow 37.5%)
(iv) 0.3 (allow 30%)

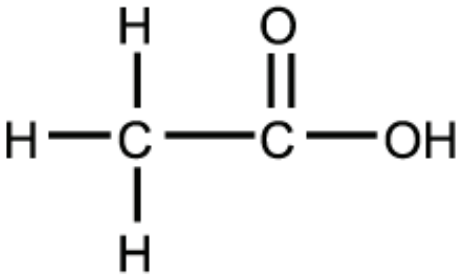
(d)

(i) C_3H_6O
(ii)

A:



B:



(e)

$CHBr_3$