

ANSWER KEY

Chapter 10 Test Answer Key

BLM 10.4.1A

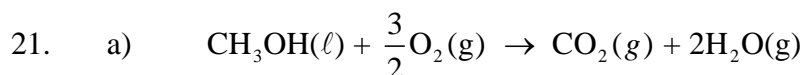
Answers to Multiple-Choice Questions

1. c
2. d
3. d
4. a
5. b
6. c
7. d
8. a
9. c
10. c
11. a
12. d
13. d
14. a
15. b

Answers to Numerical Response Questions

16.	30.2 kJ
17.	NaCl, CO ₂ , O ₂ , C ₂ H ₂
18.	-1161 kJ
19.	-2.99 kJ
20.	1.30 g

Answers to Written Response Questions



$$\begin{aligned}
 \Delta_c H^\circ &= \sum (n\Delta_f H^\circ \text{ products}) - \sum (n\Delta_f H^\circ \text{ reactants}) \\
 &= \left[(1 \text{ mol})(\Delta_f H^\circ \text{ CO}_2(\text{g})) + (2 \text{ mol})(\Delta_f H^\circ \text{ H}_2\text{O}(\text{g})) \right] \\
 &\quad - \left[(1 \text{ mol})(\Delta_f H^\circ \text{ CH}_3\text{OH}(\ell)) + \left(\frac{3}{2} \text{ mol} \right)(\Delta_f H^\circ \text{ O}_2(\text{g})) \right] \\
 &= \left[(1 \text{ mol})(-393.5 \text{ kJ/mol}) + (2 \text{ mol})(-241.8 \text{ kJ/mol}) \right] \\
 &\quad - \left[(1 \text{ mol})(-239.2 \text{ kJ/mol}) + \left(\frac{3}{2} \text{ mol} \right)(0 \text{ kJ/mol}) \right] \\
 &= -637.9 \text{ kJ per mol of CH}_3\text{OH}(\ell)
 \end{aligned}$$

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b) Energy input:

$$\begin{aligned}
 \text{Mass of methanol burned} &= \text{Mass of burner before} - \text{Mass of burner after} \\
 &= 127.35 \text{ g} + 124.28 \text{ g} \\
 &= 207 \text{ g CH}_3\text{OH}(\ell)
 \end{aligned}$$

Using formulas:

$$\begin{aligned}
 n_{\text{CH}_3\text{OH}(\ell)} &= \frac{m}{M} \\
 &= \frac{2.07 \cancel{\text{g}}}{32.05 \frac{\cancel{\text{g}}}{\text{mol}}} \\
 &= 0.06459 \text{ mol}
 \end{aligned}$$

$$\Delta H = n\Delta_c H$$

$$\begin{aligned}
 \Delta H_{\text{CH}_3\text{OH}(\ell)} &= (0.06459 \cancel{\text{mol}}) \left(-637.9 \frac{\text{kJ}}{\cancel{\text{mol}}} \right) \\
 &= -41.2 \text{ kJ}
 \end{aligned}$$

Using dimensional analysis:

$$\begin{aligned}
 \text{x kJ} &= 2.07 \cancel{\text{g CH}_3\text{OH}(\ell)} \times \frac{1 \cancel{\text{mol CH}_3\text{OH}(\ell)}}{32.05 \cancel{\text{g CH}_3\text{OH}(\ell)}} \times \frac{-637.9 \text{ kJ}}{\cancel{\text{mol CH}_3\text{OH}(\ell)}} \\
 &= -41.2 \text{ kJ}
 \end{aligned}$$

Energy output:

$$\begin{aligned}
 \text{Mass of water} &= \text{Mass of aluminium can and water} - \text{Mass of aluminium can} \\
 &= 193.23 \text{ g} - 47.35 \text{ g} \\
 &= 145.88 \text{ g}
 \end{aligned}$$

$$\begin{aligned}
 \text{Temperature change} &= 31.3^\circ\text{C} - 22.5^\circ\text{C} \\
 &= 8.8^\circ\text{C}
 \end{aligned}$$

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$$\begin{aligned}
 Q &= mc\Delta t_{\text{water}} + mc\Delta t_{\text{aluminium}} \\
 &= (145.88 \text{ g}) \left(\frac{4.19 \text{ J}}{\text{g} \cdot ^\circ\text{C}} \right) + (47.35 \text{ g}) \left(\frac{0.897 \text{ J}}{\text{g} \cdot ^\circ\text{C}} \right) (8.8 ^\circ\text{C}) \\
 &= 5.75 \text{ kJ}
 \end{aligned}$$

$$\begin{aligned}
 \text{Efficiency} &= \left| \frac{\text{Energy output}}{\text{Energy input}} \right| \times 100\% \\
 &= \left| \frac{5.75 \text{ kJ}}{-41.2 \text{ kJ}} \right| \times 100\% \\
 &= 14\%
 \end{aligned}$$

- c) The majority of the wasted energy would have been used to heat up the surroundings, which include the air surrounding the burner, the burner itself, the thermometer and stirring rod.