ALBERTA CHEMISTRY 30 · UNIT A · 25 QUESTIONS

Thermochemistry — Practice Test

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1 **Which of the following statements correctly compares photosynthesis and cellular respiration?**

- **A** Photosynthesis is exothermic, and cellular respiration is endothermic.
- **B** Photosynthesis is endothermic, and cellular respiration is exothermic.
- **C** Both photosynthesis and cellular respiration are endothermic.
- **D** Both photosynthesis and cellular respiration are exothermic.

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2 **The reaction of nitrogen gas with oxygen gas to form nitrogen monoxide gas is represented by the following equation.**

$N_2(g) + O_2(g) \rightarrow 2\ NO(g) \quad \Delta H = +180.6\ kJ$

Which of the following statements about this reaction is correct?

- **A** The reaction is exothermic, and energy is released to the surroundings.
- **B** The reaction is endothermic, and the products have less potential energy than the reactants.
- **C** The reaction is endothermic, and energy would be written as a reactant in the equation.
- **D** The reaction is endothermic, and the value of ΔH is -180.6 kJ.

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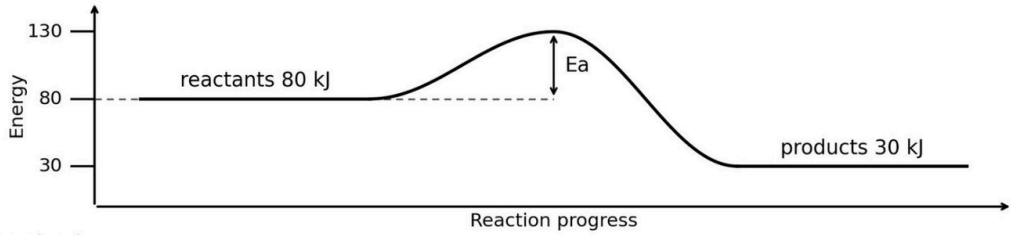
3 **A chemical reaction occurring in a calorimeter releases energy that is absorbed by 250.0 g of water, raising the temperature of the water by 8.0°C. The energy transferred to the water, in kJ, is ____.**

ANSWER _____

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4 **The diagram shows the potential energy profile for a chemical reaction. The enthalpy change and the classification of the reaction are shown in row**

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Question 4

The diagram shows the potential energy profile for a chemical reaction. The enthalpy change and the classification of the reaction are shown in row

A) Enthalpy change : − 50 kJ; Classification : exothermic

B) Enthalpy change : + 50 kJ; Classification : endothermic

C) Enthalpy change : − 50 kJ; Classification : endothermic

D) Enthalpy change : + 50 kJ; Classification : exothermic

A Enthalpy change: -50 kJ; Classification: exothermic

B Enthalpy change: +50 kJ; Classification: endothermic

C Enthalpy change: -50 kJ; Classification: endothermic

D Enthalpy change: +50 kJ; Classification: exothermic

A Enthalpy change: -50 kJ; Classification: exothermic

B Enthalpy change: +50 kJ; Classification: endothermic

C Enthalpy change: -50 kJ; Classification: endothermic

D Enthalpy change: +50 kJ; Classification: exothermic

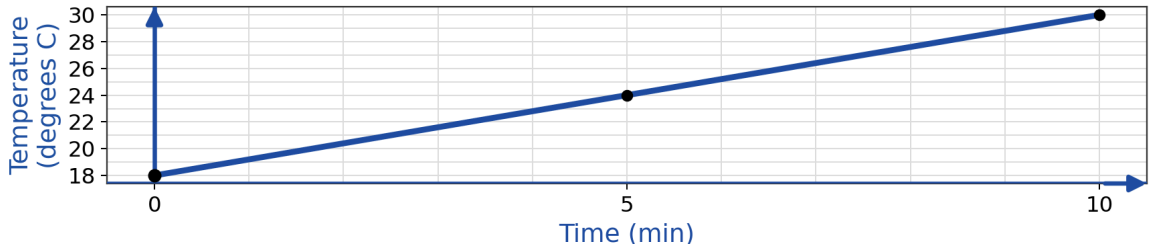
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5 **A catalyst increases the rate of a chemical reaction by**

- **A** increasing the potential energy of the products
- **B** decreasing the enthalpy change of the reaction
- **C** increasing the activation energy of the reaction
- **D** providing an alternative pathway with a lower activation energy

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6 **The graph shows the temperature of water in a calorimeter as energy is transferred to the water. The water has a mass of 200.0 g, and c = 4.184 J/(g· ° C). The energy transferred to the water, in kJ, is ____.**



ANSWER _____

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7 **Use the following equations to answer this question.**

I $C(s) + O_2(g) \rightarrow CO_2(g) \quad \Delta H = -393.5\ kJ$

II $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g) \quad \Delta H = -283.0\ kJ$

The enthalpy change for the reaction $C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g)$ is

A -676.5 kJ

B +110.5 kJ

C -55.3 kJ

D -110.5 kJ

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8 **The complete combustion of propane gas is represented by the following equation.**

$C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(g)$

The molar enthalpy of formation for $C_3H_8(g)$: -103.8 kJ/mol, for $CO_2(g)$: -393.5 kJ/mol, and for $H_2O(g)$: -241.8 kJ/mol. The enthalpy change for the reaction is

- A -2043.9 kJ
- B -2219.9 kJ
- C -2147.7 kJ
- D +2043.9 kJ

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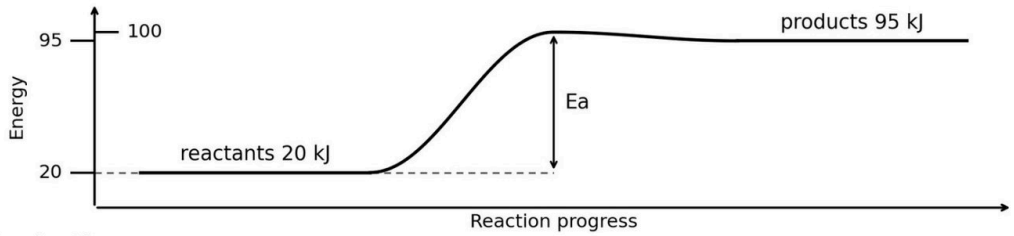
9 **A student burns 0.500 g of ethanol, $C_2H_5OH(l)$, (molar mass 46.08 g/mol) in a calorimeter containing 100.0 g of water. The temperature of the water increases by 12.4°C. The energy released per mole of ethanol burned, in kJ/mol, is ____.**

ANSWER _____

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10 **The diagram shows the potential energy profile for a chemical reaction. The activation energy for the reverse reaction, compared with the activation energy for the forward reaction, is**

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Question 10

The diagram shows the potential energy profile for a chemical reaction. The activation energy for the reverse reaction, compared with the activation energy for the forward reaction, is

A) greater than the forward activation energy

B) less than the forward activation energy

C) equal to the forward activation energy

D) impossible to determine from the diagram

A greater than the forward activation energy

B less than the forward activation energy

C equal to the forward activation energy

D impossible to determine from the diagram

A greater than the forward activation energy

B less than the forward activation energy

C equal to the forward activation energy

D impossible to determine from the diagram

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11 **Use the following equations to answer this question.**

I $C(s) + O_2(g) \rightarrow CO_2(g) \quad \Delta H = -393.5\ kJ$

II $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \quad \Delta H = -285.8\ kJ$

III $CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(l) \quad \Delta H = -890.3\ kJ$

The molar enthalpy of formation of methane, $CH_4(g)$, is

A -965.1 kJ/mol

B +74.8 kJ/mol

C -74.8 kJ/mol

D -1855.4 kJ/mol

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12 **The combustion of acetylene gas is represented by the following equation.**

$2\ C_2H_2(g) + 5\ O_2(g) \rightarrow 4\ CO_2(g) + 2\ H_2O(g) \quad \Delta H = -2511.6\ kJ$

The energy released when one mole of $C_2H_2(g)$ burns completely, in kJ, is ____.

ANSWER

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13 **Methanol can be produced by the following reaction.**

$CO(g) + 2\ H_2(g) \rightarrow CH_3OH(l) \quad \Delta H = -128.1\ kJ$

If the molar enthalpy of formation of CO(g) is -110.5 kJ/mol, then the molar enthalpy of formation of $CH_3OH(l)$ is

A -17.6 kJ/mol

B -238.6 kJ/mol

C -128.1 kJ/mol

D +238.6 kJ/mol

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14 **A student designs an experiment to compare the molar enthalpies of combustion of three different fuels. In each trial, a sample of fuel is burned to heat the same mass of water in the same calorimeter. The variables in this experiment are shown in row**

A Manipulated variable: the mass of water Responding: temperature change of the water; Controlled: the type of fuel

B Manipulated variable: the type of fuel Responding: temperature change of the water; Controlled: the mass of water

C Manipulated variable: the type of fuel Responding: the mass of water; Controlled: the temperature change of the water

D Manipulated variable: the temperature change of the water Responding: the type of fuel; Controlled: the mass of water

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15 **A student mixes 50.0 mL of 1.00 mol/L HCl(aq) with 50.0 mL of 1.00 mol/L NaOH(aq) in a calorimeter. The total mass of the resulting solution is 100.0 g, and its temperature increases by 6.6°C. The energy released per mole of water formed in this neutralization, in kJ/mol, is ____.**

ANSWER _____

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16 **Which of the following equations represents the formation reaction for carbon dioxide gas?**

- **A** $C(s) + O_2(g) \rightarrow CO_2(g)$
- **B** $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$
- **C** $2\ C(s) + 2\ O_2(g) \rightarrow 2\ CO_2(g)$
- **D** $CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g)$

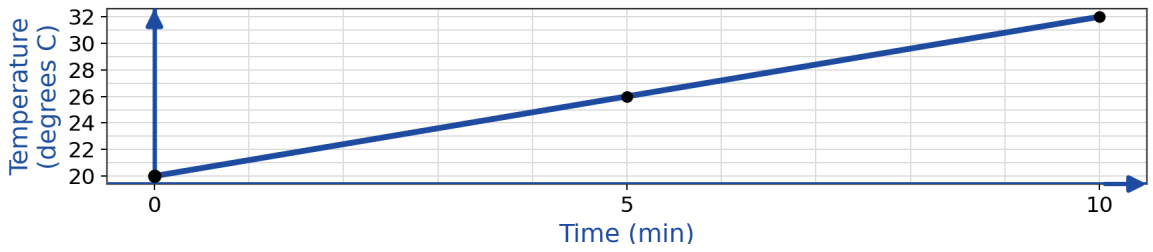
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17 **The balanced equation for the complete combustion of butane, $C_4H_{10}(g)$, and the sign of the enthalpy change for the reaction are shown in row**

- **A** $2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$ Sign of Δ H: negative
- **B** $C_4H_{10}(g) + 9\ O_2(g) \rightarrow 4\ CO_2(g) + 5\ H_2O(g)$ Sign of Δ H: negative
- **C** $2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$ Sign of Δ H: positive
- **D** $2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2(g)$ Sign of Δ H: negative

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18 **The graph shows the temperature of water in a calorimeter during a combustion reaction. The water has a mass of 400.0 g, and c = 4.184 J/(g· ° C). The energy transferred to the water, in kJ, is ____.**



ANSWER _____

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19 **Ammonia gas reacts with oxygen gas as represented by the following equation.**

$4\ NH_3(g) + 5\ O_2(g) \rightarrow 4\ NO(g) + 6\ H_2O(g)$

The molar enthalpy of formation for $NH_3(g)$: -45.9 kJ/mol, for NO(g): +90.3 kJ/mol, and for $H_2O(g)$: -241.8 kJ/mol. The enthalpy change for the reaction is

A -1089.6 kJ

B -1273.2 kJ

C +906.0 kJ

D -906.0 kJ

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20 **Photosynthesis is represented by the following equation.**

$6\ CO_2(g) + 6\ H_2O(l) \rightarrow C_6H_{12}O_6(s) + 6\ O_2(g) \quad \Delta H = +2803\ kJ$

The energy absorbed when 36.0 g of glucose (molar mass 180.16 g/mol) is produced by this process is

A 1.68×10^4 kJ

B 5.60×10^2 kJ

C 2.80×10^3 kJ

D 9.34×10^1 kJ

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21 **Use the following equations to answer this question.**

I $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ $\Delta H = -285.8$ kJ

II $H_2O_2(l) \rightarrow H_2O(l) + \frac{1}{2}O_2(g)$ $\Delta H = -98.0$ kJ

The enthalpy change for the formation of hydrogen peroxide, $H_2(g) + O_2(g) \rightarrow H_2O_2(l)$, is

A -383.8 kJ

B +187.8 kJ

C -187.8 kJ

D -98.0 kJ

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22 **When methane is burned in a calorimeter, the temperature of the water increases. The water gains i energy, and the reacting methane system loses ii energy. The types of energy are shown in row**

A i: potential; ii: kinetic

B i: kinetic; ii: potential

C i: kinetic; ii: kinetic

D i: potential; ii: potential

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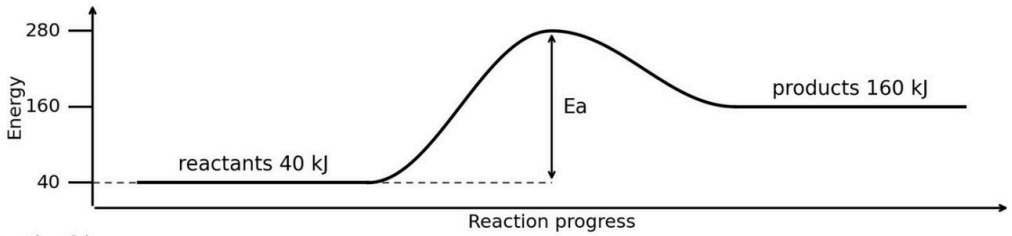
23 **Ethanol, $C_2H_5OH(l)$, has a molar enthalpy of combustion of -1367 kJ/mol and a molar mass of 46.08 g/mol. A 2.30 g sample of ethanol is burned completely to heat 750.0 g of water in a calorimeter. The increase in the temperature of the water, in °C, is ____.**

ANSWER _____

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24 **The diagram shows the potential energy profile for a chemical reaction. The enthalpy change for the reaction shown, in kJ, is**

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Question 24

The diagram shows the potential energy profile for a chemical reaction. The enthalpy change for the reaction shown, in kJ, is

A) +120 kJ

B) −120 kJ

C) +240 kJ

D) −240 kJ

A +120 kJ

B -120 kJ

C +240 kJ

D -240 kJ

A +120 kJ

B -120 kJ

C +240 kJ

D -240 kJ

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25 **A chemical reaction has an enthalpy change of +120 kJ and an activation energy of 240 kJ for the forward reaction. The activation energy for the reverse reaction is**

A 360 kJ

B 240 kJ

C 60 kJ

D 120 kJ

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ANSWER KEY

1.	B	**10.**	B	**19.**	D
2.	C	**11.**	C	**20.**	B
3.	8.37	**12.**	1256	**21.**	C
4.	A	**13.**	B	**22.**	B
5.	D	**14.**	B	**23.**	21.7
6.	10.04	**15.**	55.2	**24.**	A
7.	D	**16.**	A	**25.**	D
8.	A	**17.**	A		
9.	478	**18.**	20.1		

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