Thermodynamics

Assertion Reason Questions

In the following question no. (12-14), a statement of assertion followed by a statement or reason is given. choose the correct answer out of the following choices:

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

1. Assertion (A): Combustion of all organic compounds is an exothermic reaction. **Reason (R):** All elements have zero enthalpies in their standard state.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A). **Explanation:** The correct reason is that during combustion all the organic compounds undergo exothermic reaction and enthalpy of all elements in their standard state is zero but combustion reactions are exothermic in nature not just because the enthalpy of all elements in their standard state is zero. So, both statements are correct but reasons is not the correct explanation of assertion.

2. Assertion (A): For Isothermal reversible expansion of gas heat is absorbed by the gas. **Reason (R):** The sign of 'W' is negative which makes 'Q' overall positive.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A). **Explanation:** Assertion and reason both are correct statements and reason is correct explanation for assertion.

3. Assertion (A): For Adiabatic process, if expansion occurs then the temperature of the system rises.

Reason (R): For Adiabatic process, heat change is zero during the process.

Ans. (d) (A) is false but (R) is true.

Explanation: Adiabatic process, implies a process in which no heat exchange takes place between the system and the surroundings, i.e. neither heat is supplied nor heat is loosed. For an adiabatic compression (decreasing the volume of the system, like a

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piston), the temperature must increase. Likewise, for an expansion (increasing volume), the temperature must decrease.

4. Assertion (A): Enthalpy of formation of HCL is equal to the bond energy of HCL. **Reason (R):** Enthalpy of formation and bond energy both involve the formation of one mole of HCL from the elements.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).

Explanation: $\frac{1}{2}H_{2(g)} + \frac{1}{2}Cl_{2(g)} \rightarrow HCl$

It represents the enthalpy of formation of HCL, as there only one bond is formed between H and Cl, thus it will also represent its bond enthalpy.

5. Assertion (A): The enthalpy of formation of H_2O (g) is lesser than that of H_2O (l) **Reason (R):** Change in the enthalpy for H_2O (g) - H_2O (l) which is a condensation negative. reaction is

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).

Explanation: We know that gaseous molecules are at highes energy than water so enthalpy change is less negative for the condensation reaction, and because of this, the enthalpy change for the formation of H2O (g) is greater than that of H2O (g) in terms of numerical value.

6. Assertion (A): Combustion of all organic compounds is an exothermic reaction. **Reason (R):** The enthalpies of all elements in their standard state are zero.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A). **Explanation:** In the combustion reaction the enthalpies for the product are lesser than the reactant enthalpies.

7. Assertion (A): The thermodynamic factor which determines the spontaneity of a process is free energy. For a process to be spontaneous the free energy must be negative.

Reason (R): The change in free energy is related to the change in a process that must always be positive if it is spontaneous.

Ans. (c) (A) is true but (R) is false. **Explanation:** For a reaction to be spontaneous



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T\Delta S > \Delta H

\Delta G = \Delta H - T\Delta S

So, \Delta G must be negative.
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8. Assertion (A): For an exothermic reaction the K value will be much larger than one. **Reason (R):** The reaction is more towards the product side.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A). **Explanation:** The reaction shift is determined by the value of K. In the case of exothermic

the K value will be much larger than one, it indicates there will be a shift in the reaction towards the right side that is product side. So, the larger the K value the more the reaction will tend towards the right and thus to completion.

9. Assertion (A): A spontaneous process is irreversible and can only be reversed by an external force.

Reason (R): A decrease in enthalpy is a factor that contributes to spontaneity.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A). **Explanation:** Natural processes are characterised by a loss in energy and an increase in randomness.

