Chemistry

Standard level

Paper 1A

Practice paper

Topic: Thermodynamics

1. Which of the following describes an endothermic reaction?
   A. Heat is released to the surroundings.
   B. ΔH is positive and the system gains energy.
   C. The potential energy of the products is lower than the reactants.
   D. The standard enthalpy of formation of the products is negative.

2. Which process is exothermic?
   A. $H_2O(s) \rightarrow H_2O(l)$
   B. $Cl_2(g) \rightarrow 2Cl(g)$
   C. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$
   D. $NH_4NO_3(s) + H_2O(l) \rightarrow NH_4^+(aq) + NO_3^-(aq)$

3. A sample of water increases in temperature from 293 K to 298 K when 6.27 kJ of heat is added. What is the mass of the water?
   (Specific heat capacity of water = 4.18 J g^{-1} K^{-1})
   A. 0.3 g
   B. 300 g
   C. 3.0 kg
   D. 30.0 g

4. Which enthalpy change is defined as the heat energy released when one mole of a substance is burned completely in excess oxygen?
   A. Enthalpy of formation
   B. Enthalpy of reaction
   C. Enthalpy of combustion
   D. Enthalpy of neutralization

5. Which statement about bond enthalpies is correct?
   A. They are always exothermic.
   B. They represent the energy to break one mole of bonds in the liquid state.
   C. Bond breaking is endothermic (+ΔH).
   D. Multiple bonds are weaker than single bonds between the same atoms.

6. Using the following data:
   $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -394$ kJ
   $CO(g) + 1/2\ O_2(g) \rightarrow CO_2(g)$ $\Delta H = -283$ kJ
   What is the enthalpy change for $C(s) + 1/2\ O_2(g) \rightarrow CO(g)$?
   A. -677 kJ
   B. +111 kJ
   C. -111 kJ

D. +677 kJ

7. Which of the following conditions represents standard state?
I. 100 kPa pressure
II. 298 K temperature
III. 1 mol dm^{-3} concentrations for solutions
A. I and II only
B. I and III only
C. II and III only
D. I, II and III

8. average bond enthalpies for C-H and C-C are 414 and 346 kJ mol^{-1}. Which process is the most endothermic?
A. breaking one mole of C-C bonds
B. breaking one mole of C-H bonds
C. forming one mole of C-C bonds
D. forming one mole of C-H bonds

9. For the reaction: A + B → C (ΔH = -50 kJ), what is the activation energy of the reverse reaction C → A + B if the forward activation energy is 70 kJ?
A. 20 kJ
B. 50 kJ
C. 70 kJ
D. 120 kJ

10. Which statement is correct according to the first law of thermodynamics?
A. Energy can be created during nuclear fission.
B. The entropy of a system always increases.
C. The total energy of an isolated system is constant.
D. Heat cannot be converted into work.

11. Which processes are endothermic?
I. $I_2(s) \rightarrow I_2(g)$
II. $2H(g) \rightarrow H_2(g)$
III. $H_2O(l) \rightarrow H_2O(g)$
A. I and II only
B. I and III only
C. II and III only
D. I, II and III

12. What is the value of q in Joules when 50.0 g of copper (c = 0.385 J g^{-1} K^{-1}) cools from 350 K to 300 K?

A. 963 J
B. -963 J
C. 19.25 J
D. -19.25 J

13. Which combination of results from a calorimetry experiment for the reaction between NaOH and HCl would yield the most accurate ΔH?

A. Using a glass beaker and a mercury thermometer.
B. Using a polystyrene cup and correcting for heat loss by extrapolation of the cooling curve.
C. Assuming the density of the solution is twice that of water.
D. Ignoring the heat capacity of the calorimeter.

14. If the standard enthalpy of formation of HI(g) is +26.5 kJ mol^{-1}, what is ΔH for the reaction: $H_2(g) + I_2(g) \rightarrow 2HI(g)$?

A. +26.5 kJ
B. -26.5 kJ
C. +53.0 kJ
D. -53.0 kJ

15. Which statement describes an exothermic reaction?

I. The products are more stable than the reactants.
II. The enthalpy of the reactants is higher than the enthalpy of the products.
III. The temperature of the surroundings increases.

A. I and II only
B. I and III only
C. II and III only
D. I, II and III

16. What is the enthalpy change for the reaction $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ given bond enthalpies:

H-H = 436, O=O = 498, O-H = 463?

A. -482 kJ
B. +482 kJ
C. -5 kJ
D. +5 kJ

17. In which of the following is ΔH positive?

A. Condensing steam

B. Burning a candle
C. Producing H atoms from H_2 molecules
D. Adding Na to water

18. Which of the following is true for a Hess's Law cycle?
A. The enthalpy change is independent of standard conditions.
B. The total enthalpy change for a reaction depends only on the number of steps.
C. The total enthalpy change for a reaction is the same regardless of the route taken.
D. Only gaseous reactions follow Hess's Law.

19. Which experimental setup would likely show the smallest temperature increase for the same reaction?
A. 50 cm^3 of reactants in an open glass beaker.
B. 50 cm^3 of reactants in a sealed polystyrene cup.
C. 100 cm^3 of reactants in an open glass beaker.
D. 100 cm^3 of reactants in a sealed vacuum flask.

20. Which statement about standard enthalpy of formation is false?
A. It is zero for all elements in their standard states.
B. It relates to the production of one mole of compound.
C. It can be determined using Hess's Law.
D. It is always negative for stable compounds.