Thermodynamics

Question 1.
Hesss law is an application of
(a) 1st law of Thermodynamics
(b) 2nd law of Thermodynamics
(c) Entropy change
(d) $\Delta H = \Delta U + P\Delta V$.

▼ Answer

Answer: (a) 1st law of Thermodynamics
Explanation:
Hesss law is an expression of the principle of conservation of energy, also expressed in the first law of thermodynamics, and the fact that the enthalpy of a chemical process is independent of the path taken from the initial to the final state (i.e. enthalpy is a state function).

Question 2.
5 mole of an ideal gas expand isothermally and irreversibly from a pressure of 10 atm to 1 atm against a constant external pressure of 1 atm. W_{irr} at 300 K is:
(a) -15.921 kJ
(b) -11.224 kJ
(c) -110.83 kJ
(d) None of these

▼ Answer

Answer: (b) -11.224 kJ
Explanation:
$P_1V_1 = RT\ \eta$
$10(V_1) = 5(8.3)(300)\ 1$
$V_1 = 150(0.0821)$
$P_1V_1 = P_2V_2$
Therefore, 10(150 x0.0821) = 1 (V2)
Therefore $V_2 = 10(150 \times 0.0821)$
Therefore, -P Therefore V = -(1)(9)(150 × 0.0821) 101.3
= -11224 J = -11.224 KJ

Question 3.
At absolute zero the entropy of a perfect crystal is zero. This statement corresponds to which law of thermodynamics?
(a) Zeroth Law
(b) First Law
(c) Second Law
(d) Third Law

▼ Answer

Answer: (d) Third Law
Explanation:
The third law of thermodynamics states that the entropy of a system approaches a constant value as the temperature approaches absolute zero. The entropy of a system at absolute zero is typically zero, and in all cases is determined only by the number of different ground states it has. Specifically, the entropy of a pure crystalline substance (perfect order) at absolute zero

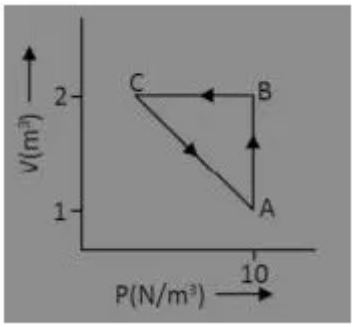
temperature is zero. This statement holds true if the perfect crystal has only one state with minimum energy.

Question 4.
Which of the following has the highest entropy?
(a) Mercury
(b) Hydrogen
(c) Water
(d) Graphite

▼ Answer

Answer: (b) Hydrogen
Explanation:
Gas has the highest entropy.

Question 5.
An ideal gas is taken through the cycle A → B → C → A as shown in figure. If the net heat supplied to the gas in cycle is 5 J, the work done by the gas in the process C → A.



(a) -5 J
(b) -15 J
(c) -10 J
(d) -20 J

▼ Answer

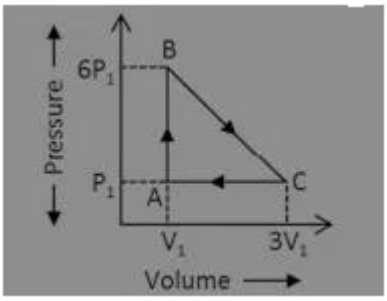
Answer: (a) -5 J
Explanation:
Work done by the gas is negative
Δ U in cyclic process is zero.
Therefore, w = -5J

Question 6.
One mole of which of the following has the highest entropy?
(a) Liquid Nitrogen
(b) Hydrogen Gas
(c) Mercury
(d) Diamond

▼ Answer

Answer: (b) Hydrogen Gas
Explanation:
The measure of randomness of a substance is called entropy. Greater the randomness of molecules of a substance greater is the entropy. Here hydrogen gas has more entropy as it shows more randomness/disorderliness due to less molar mass than all the given substances and also in the gas phase.

Question 7.
An ideal gas is taken around the cycle ABCA as shown in P-V diagram The next work done by the gas during the cycle is equal to:



(a) $12P_1V_1$
(b) $6P_1V_1$
(c) $5P_1V_1$
(d) P_1V_1

▼ Answer

Answer: (c) $5P_1V_1$
Explanation:
Work done = Area under P-V graph = (1/2) $(5P_1)$ $(2V_1)$ = $5P_1$ V_1

Question 8.
Third law of thermodynamics provides a method to evaluate which property?
(a) Absolute Energy
(b) Absolute Enthalpy
(c) Absolute Entropy
(d) Absolute Free Energy

▼ Answer

Answer: (c) Absolute Entropy
Explanation:
The Third Law of Thermodynamics is concerned with the limiting behavior of systems as the temperature approaches absolute zero. Most thermodynamics calculations use only entropy differences, so the zero point of the entropy scale is often not important. However, the Third Law tells us about the completeness as it describes the condition of zero entropy.

Question 9.
Which of the following is/are a reason that water is a desirable heat sink for use in calorimeters?
I) Waters heat specific capacity is very precisely known.
II) Water is readily available.
III) Water has an unusually large specific heat capacity.
(a) I only
(b) I and II
(c) I, II and III
(d) II only

▼ Answer

Answer: (c) I, II and III
Explanation:
Water is a good heat sink for all of the reasons listed above. Moreover, its large heat capacity, liquid state and ready availability enable us to easily set up a calorimeter such that ΔT is large enough that it can be easily measured and small enough that phase transition temperatures are not reached.

Question 10.
In a chemical reaction the bond energy of reactants is more than the bond energy of the products. Therefore, the reaction is
(a) Exothermic
(b) Athermic
(c) Endothermic
(d) Endergonic

▼ Answer

Answer: (c) Endothermic
Explanation:
If the products have a higher energy level than the reactants then the reaction is endothermic.
In an endothermic reaction, the reaction mixture absorbs heat from the surroundings. Therefore, the products will have a higher energy than the reactants and ΔH will be positive.
In an exothermic reaction, the reaction mixture releases heat to the surroundings. Therefore, the products will have a lower energy than the reactants and ΔH will be negative.

Question 11.
In a reversible process the system absorbs 600 kJ heat and performs 250 kJ work on the surroundings. What is the increase in the internal energy of the system?
(a) 850 kJ
(b) 600 kJ
(c) 350 kJ
(d) 250 kJ

▼ Answer

Answer: (c) 350 kJ
Explanation:
$\Delta E = q + w$
$= (600 - 250)$
$\Delta E = 350$ J

Question 12.
Which of the following neutralisation reactions is most exothermic?
(a) HCl and NaOH
(b) HCN and NaOH
(c) HCl and NH_4OH
(d) CH_3COOH and NH_4OH

▼ Answer

Answer: (a) HCl and NaOH
Explanation:
Strong acid + Strong base → Most exothermic.

Question 13.
A student runs a reaction in a closed system. In the course of the reaction, 64.7 kJ of heat is released to the surroundings and 14.3 kJ of work is done on the system. What is the change in internal energy (ΔU) of the reaction?
(a) -79.0 kJ
(b) 50.4 kJ
(c) 79.0 kJ
(d) -50.4 kJ

▼ Answer

Answer: (d) -50.4 kJ
Explanation:
The change in internal energy is given as: ΔU = q + w. In this reaction, q is -64.7 kJ and w is 14.3 kJ. Therefore the correct answer is -50.4 kJ.

Question 14.
Identify the correct statement from the following in a chemical reaction.
(a) The entropy always increases
(b) The change in entropy along with suitable change in enthalpy decides the fate of a reaction
(c) The enthalpy always decreases
(d) Both the enthalpy and the entropy remain constant

▼ Answer

Answer: (b) The change in entropy along with suitable change in enthalpy decides the fate of a reaction
Explanation:
ΔG = ΔH – TΔS
For a reaction to be spontaneous, ΔG should be negative. Therefore, resultant of ΔH and TΔS decide show the reaction will be carried.

Question 15.
2 mole of an ideal gas at 27° C expands isothermally and reversibly from a volume of 4 litres to 40 litre. The work done (in kJ) is:
(a) w = -28.72 kJ
(b) w = -11.488 kJ
(c) w = -5.736 kJ
(d) w = -4.988 kJ

▼ Answer

Answer: (b) w = -11.488 kJ
Explanation:
$w = -2.303\ \eta\ RT \log (V_2/V_1)$
$= -2.303(8 - 3)\ (300)(2) \log (40/4)$
$= -114.8\ 100J$

Question 16.
The latent heat of vapourization of ε liquid at 500 K and 1 atm pressure is 10.0 kcal/mol. What will be the change in internal energy (ΔU) of 3 moles of liquid at the same temperature
(a) 13.0 kcal/mol
(b) −13.0 kcal/mol
(c) 27.0 kcal
(d) −7.0 kcal/mol

▼ Answer

Answer: (c) 27.0 kcal
Explanation:
$3H_2O(l) \rightarrow 3H_2O(g)$;
Δn = 3,
ΔE = ΔH − ΔnRT
$= 30 - 3 \times (2/1000) \times 500$
= 27 kcal

Question 17.
Calculate the heat required to make 6.4 Kg CaC_2 from CaO(s) and C(s) from the reaction: CaO(s) + 3 C(s) → CaC_2(s) + CO (g) given that Δ_f H° (CaC_2) = -14.2 kcal. Δ_f H° (CO) = -26.4 kcal.
(a) 5624 kca
(b) 1.11×10^4 kcal
(c) 86.24×10^3
(d) 1100 kcal

▼ Answer

Answer: (b) 1.11×10^4 kcal
Explanation:
n = (Mass)/ (Molecular weight)
= $(6.4 \times 10^3)/ (64)$
= 100
For 1 mole of CaC_2
$\Delta H = \Delta H_f (CaC) + H_f (CO) - H_f (CaO)$
= -14.2 – 26.4 + 151.6 = 111.1 kcal
For 100 moles, $\Delta H = 1.11 \times 10^4$ Kcal

Question 18.
Entropy of the universe is
(a) Continuously Increasing
(b) Continuously Decreasing
(c) Zero
(d) Constant

▼ Answer

Answer: (a) Continuously Increasing
Explanation:
Energy always flows downhill, and this causes an increase of entropy. Entropy is the spreading out of energy, and energy tends to spread out as much as possible. The universe will have run down completely, and the entropy of the universe will be as high as it is ever going to get.

Question 19.
At absolute zero the entropy of a perfect crystal is zero. This statement corresponds to which law of thermodynamics?
(a) Zeroth Law
(b) First Law
(c) Second Law
(d) Third Law

▼ Answer

Answer: (d) Third Law
Explanation:
The third law of thermodynamics states that the entropy of a system approaches a constant value as the temperature approaches absolute zero. The entropy of a system at absolute zero is typically zero, and in all cases is determined only by the number of different ground states it has. Specifically, the entropy of a pure crystalline substance (perfect order) at absolute zero temperature is zero. This statement holds true if the perfect crystal has only one state with minimum energy.

Question 20.
The bond energy (in kcal mol^{-1}) of a C-C single bond is approximately

(a) 1
(b) 10
(c) 83-85
(d) 1000

▼ Answer

Answer: (c) 83-85
Explanation:
C–C bond 83–85 kcal/mol
It is the energy required to break the bond .It is defined as the standard enthalpy change when a bond is cleaved by homolysis, with reactants and products of the homolysis reaction at 0 K (absolute zero)
