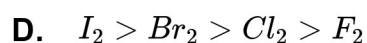
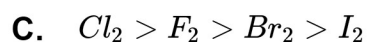
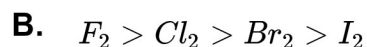


Thermodynamics

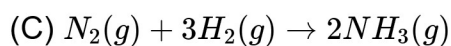
1. The correct order of bond dissociation enthalpy of halogens is



2. During which of the following processes, does entropy decrease?

(A) Freezing of water to ice at $0^\circ C$

(B) Freezing of water to ice at $-10^\circ C$



(D) Adsorption of $CO(g)$ on lead surface

(E) Dissolution of $NaCl$ in water

Choose the correct answer from the options given below.

A. (A) and (E) only

B. (A), (C) and (E) only

C. (A), (B), (C) and (D) only

D. (B) and (C) only

3. The statement that is incorrect about Ellingham diagram is:

A. provides idea about the reaction rate.

B. provides idea about free energy change.

C. provides idea about changes in the phases during the reaction

D. provides idea about reduction of metal oxide

Thermodynamics

4. Which one of the following statements is incorrect?
- Bond dissociation enthalpy of H_2 is highest among diatomic gaseous molecules which contain a single bond
 - Atomic hydrogen is produced when H_2 molecules at a high temperature are irradiated with UV radiation
 - At around 2000 K, the dissociation of dihydrogen into its atoms is nearly 8.1%
 - Dihydrogen is produced on reacting zinc with HCl as well as $NaOH$ (aq)
5. The incorrect expression among the following is:
- For isothermal process $w_{reversible} = -nRT \ln \frac{V_f}{V_i}$
 - $\frac{\Delta G_{system}}{\Delta S_{Total}} = -T_{(at\ constant\ P)}$
 - $\ln K = \frac{\Delta H^\circ - T\Delta S^\circ}{RT}$
 - $K = e^{-\Delta G^\circ/RT}$
6. Enthalpy of sublimation of iodine is $24\ cal\ g^{-1}$ at $200^\circ C$. If specific heat $I_2(s)$ and $I_2(vap)$ are 0.055 and $0.031\ cal\ g^{-1}K^{-1}$ respectively, then enthalpy of sublimation of iodine $250^\circ C$ in $cal\ g^{-1}$ is :
- 2.85
 - 5.7
 - 22.8
 - 11.4

Thermodynamics

7. For silver, $C_p(JK^{-1}mol^{-1}) = 23 + 0.01T$. If the temperature (T) of moles of silver is raised from 300 K to 1000K at 1 atm pressure, the value of ΔH will be close to:
- 62 kJ
 - 16 kJ
 - 21 kJ
 - 13 kJ
8. The enthalpy change on freezing of 1 mol of water at $5^{\circ}C$ is ice at $-5^{\circ}C$ is :
 (Given $\Delta_{fus}H = 6kJ\ mol^{-1}$ at $0^{\circ}C$,
 $C_p(H_2O, l) = 75.3Jmol^{-1}K^{-1}$
 $C_p(H_2O, s) = 36.8J\ mol^{-1}K^{-1}$)
- $5.44\ kJ\ mol^{-1}$
 - $5.81\ kJ\ mol^{-1}$
 - $6.56\ kJ\ mol^{-1}$
 - $6.00\ kJ\ mol^{-1}$
9. A gas undergoes change from state A to state B. In this process, the heat absorbed and work done by the gas is 5J and 8J, respectively. Now gas is brought back at A by another process during which 3J of heat is evolved. In this reverse process of B to A:
- 10 J of the work will be done by the gas.
 - 6 J of the work will be done by the gas.
 - 10 J of the work will be done by the surrounding on gas.
 - 6 J of the work will be done by the surrounding on gas

Thermodynamics

10. $q_{AB} = 2\text{kJ/mol}$
 $\Delta U_{BC} = -5\text{kJ/mol}$
 $W_{AB} = -5\text{kJ/mol}$
 $W_{CA} = 3\text{kJ/mol}$

Heat absorbed by the system during process CA is:

- A.** -5kJ mol^{-1}
- B.** $+5\text{kJ mol}^{-1}$
- C.** 18kJ mol^{-1}
- D.** -18kJ mol^{-1}
11. At 298.2 K the relationship between enthalpy of bond dissociation (in kJ mol^{-1}) for hydrogen (E_H) and its isotope, deuterium (E_D), is best described by
- A.** $E_H \simeq E_D - 7.5$
- B.** $E_H = 2E_D$
- C.** $E_H = \frac{1}{2}E_D$
- D.** $E_H = E_D$
12. Assuming ideal behaviour, the magnitude of $\log K$ for the following reaction at 25°C is $x \times 10^{-1}$. The value of x is ____ (integer answer)
- $$3\text{HC} \equiv \text{CH}_{(g)} \rightleftharpoons \text{C}_6\text{H}_{6(l)}$$
- [Given : $\Delta_f G^0(\text{HC} \equiv \text{CH}) = -2.04 \times 10^5 \text{J mol}^{-1}$;
 $\Delta_f G^0(\text{C}_6\text{H}_6) = -1.24 \times 10^5 \text{J mol}^{-1}$; $R = 8.314 \text{J K}^{-1} \text{mol}^{-1}$]

Thermodynamics

13. The reaction of cyanamide, $NH_2CN(s)$ with oxygen was run in a bomb calorimeter and ΔU was found to be $-742.24 \text{ kJ mol}^{-1}$. The magnitude of ΔH_{298} for the reaction
 $NH_2CN(s) + \frac{3}{2}(g) \rightarrow N_2(g) + CO_2(g) + H_2O(l)$ is _____ kJ. (Rounded off to the nearest integer)
 [Assume ideal gases and $R = 8.314 \text{ J mol}^{-1}K^{-1}$]
14. The ionization enthalpy of Na^+ formation from $Na(g)$ is $495.8 \text{ kJ mol}^{-1}$, while the electron gain enthalpy of Br is $-325.0 \text{ kJ mol}^{-1}$. Given the lattice enthalpy of $NaBr$ is $-728.4 \text{ kJ mol}^{-1}$. The energy for the formation of $NaBr$ ionic solid from $Na(g)$ and $Br(g)$ is $(-)\text{_____} \times 10^{-1} \text{ kJ mol}^{-1}$
15. For a chemical reaction $A + B \rightleftharpoons C + D$ ($\Delta_r H^0 = 80 \text{ kJ mol}^{-1}$) the entropy change $\Delta_r S^0$ depends on the temperature T (in K) as
 $\Delta_r S^0 = 2T(\text{J K}^{-1} \text{ mol}^{-1})$.
 Minimum temperature at which it will become spontaneous is _____ K
 (Integer)
16. Five moles of an ideal gas at 293 K is expanded isothermally from an initial pressure of 2.1 MPa to 1.3 MPa against at constant external pressure 4.3 MPa. The heat transferred in this process is _____ kJ mol^{-1} .
 (Rounded-off to the nearest integer)
 [$R = 8.314 \text{ J mol}^{-1}K^{-1}$]
17. The average $S - F$ bond energy in kJ mol^{-1} of SF_6 is _____. (Rounded off to the nearest integer)
 [Given : The values of standard enthalpy of formation of $SF_6(g)$, $S(g)$ and $F(g)$ are - 1100, 275 and 80 kJ mol^{-1} respectively]

Thermodynamics

18. At 25°C , 50 g of iron reacts with HCl to form FeCl_2 . The evolved hydrogen gas expands against a constant pressure of 1 bar . The work done by the gas during this expansion is _____ J
(Round off to the Nearest Integer).

[Given : $R = 8.314\text{ J mol}^{-1}\text{K}^{-1}$ Assume, hydrogen is an ideal gas]

[Atomic mass of Fe is 55.85 u]

19. The standard enthalpies of formation of Al_2O_3 and CaO are -1675 kJ mol^{-1} and -635 kJ mol^{-1} respectively.
For the reaction,
 $3\text{CaO} + 2\text{Al} \rightarrow 3\text{Ca} + \text{Al}_2\text{O}_3$ the standard reaction enthalpy, $\Delta_r H^{\circ}$
= _____ kJ (Rounded off to the Nearest Integer).

20. For a given chemical reaction $A \rightarrow B$ at 300 K the free energy change is -49.4 kJ mol^{-1} and the enthalpy of reaction is 51.4 kJ mol^{-1} . The entropy change of the reaction is _____ $\text{J K}^{-1}\text{mol}^{-1}$.

21. If the standard molar enthalpy change for combustion of graphite powder is $-2.48 \times 10^2\text{ kJ mol}^{-1}$. the amount of heat generated on combustion of 1 g of graphite powder in kJ is
(Nearest integer)

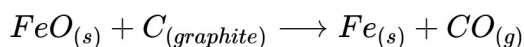
22. For water $\Delta_{\text{vap}}H = 41\text{ kJ mol}^{-1}$ at 373 K and 1 bar pressure. Assuming that water vapour is an ideal gas the that occupies a much larger volume than liquid water, the internal energy change during evaporation of water is _____ kJ mol^{-1} .

[Use : $R = 8.3\text{ J mol}^{-1}\text{K}^{-1}$]

Thermodynamics

23. 200 mL of 0.2 M HCl is mixed with 300 mL of 0.1 M $NaOH$. The molar heat of neutralization of this reaction is -57.1 kJ . The increase in temperature in $^{\circ}C$ of the system on mixing is $x \times 10^{-2}$. The value of x is (Nearest integer)
 [Given: Specific heat of water = $4.18 \text{ J g}^{-1} \text{ K}^{-1}$ Density of water = 1.00 g cm^{-3}]
 [Assume no volume change on mixing]

24. Data given for the following reaction is as follows:



Substance	$\Delta_f H^{\circ}$ (kJ mol^{-1})	ΔS° ($\text{J mol}^{-1} \text{K}^{-1}$)
$FeO_{(s)}$	-266.3	57.49
$C_{(graphite)}$	0	5.74
$Fe_{(s)}$	0	27.28
$CO_{(g)}$	-110.5	197.6

The

minimum temperature in K at which the reaction becomes spontaneous is

25. For the reaction
 $C_2H_6 \rightarrow C_2H_4 + H_2$
 the reaction enthalpy, $\Delta_r H$ _____ kJ mol^{-1} .
 [Round off to the Nearest Integer]
 [Given : Bond enthalpies in kJ mol^{-1}
 C - C : 347, C = C : 611;
 C - H : 414, H - H : 436]

1. (A) $\text{HOCl} + \text{H}_2\text{O}_2 \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^- + \text{O}_2$
 (B) $\text{I}_2 + \text{H}_2\text{O}_2 + 2\text{OH}^- \rightarrow 2\text{I}^- + 2\text{H}_2\text{O} + \text{O}_2^-$

Choose the correct option.

- A.** H_2O_2 acts as oxidising agent in equations (A) and (B).
- B.** H_2O_2 act as oxidizing and reducing agent respectively in equation (A) and (B).
- C.** H_2O_2 acts as reducing agent in equations (A) and (B).
- D.** H_2O_2 acts as reducing and oxidising agent respectively in equations (A) and (B).
2. Which of the following equation depicts the oxidizing nature of H_2O_2 ?
- A.** $2\text{I}^- + \text{H}_2\text{O}_2 + 2\text{H}^+ \rightarrow \text{I}_2 + 2\text{H}_2\text{O}$
- B.** $\text{KIO}_4 + \text{H}_2\text{O}_2 \rightarrow \text{KIO}_3 + \text{H}_2\text{O} + \text{O}_2$
- C.** $\text{Cl}_2 + \text{H}_2\text{O}_2 \rightarrow 2\text{HCl} + \text{O}_2$
- D.** $\text{I}_2 + \text{H}_2\text{O}_2 + 2\text{OH}^- \rightarrow 2\text{I}^- + 2\text{H}_2\text{O} + \text{O}_2$

3. Given below are two statements :

Statement I : H_2O_2 can act as both oxidising and reducing agent in basic medium.

Statement II : In the hydrogen economy, the energy is transmitted in the form of dihydrogen.

In the light of the above statement, choose the correct answer from the options given below:

- A. Both statement I and statement II are false
- B. Statement I is true but statement II is false
- C. Both statement I and statement II are true
- D. Statement I is false but statement II is true

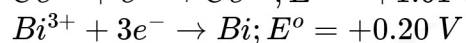
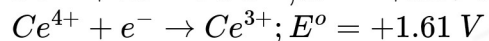
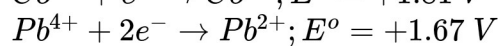
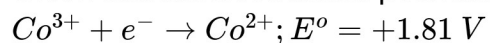
4. An example of a disproportionation reaction is:

- A. $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$
- B. $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$
- C. $2CuBr \rightarrow CuBr_2 + Cu$
- D. $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

5. In order to oxidise a mixture of one mole of each of FeC_2O_4 , $Fe_2(C_2O_4)_3$, $FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ required is :

- A. 2
- B. 1
- C. 3
- D. 1.5

6. Given standard reduction potentials:



oxidizing power of the species will increase in the order:

- A. $Ce^{4+} < Pb^{4+} < Bi^{3+} < Co^{3+}$
- B. $Bi^{3+} < Ce^{4+} < Pb^{4+} < Co^{3+}$
- C. $Co^{3+} < Ce^{4+} < Bi^{3+} < Pb^{4+}$
- D. $Co^{3+} < Pb^{4+} < Ce^{4+} < Bi^{3+}$

7. Given that $E_{O_2/H_2O}^o = +1.23V$;

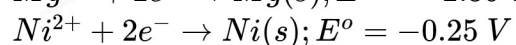
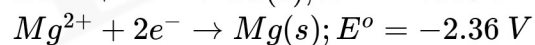
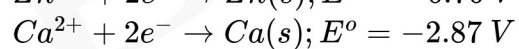
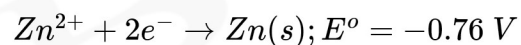
$$E_{S_2O_8^{2-}/SO_4^{2-}}^o = 2.05V$$

$$E_{Br_2/Br^-}^o = +1.09V$$

$$E_{Au^{3+}/Au}^o = +1.4V$$

The strongest oxidising agent is:

- A. Au^{3+}
 - B. O_2
 - C. $S_2O_8^{2-}$
 - D. Br_2
8. Consider the following reduction processes:



The reducing power of the metals increases in the order:

- A. $Ca < Zn < Mg < Ni$
- B. $Ni < Zn < Mg < Ca$
- C. $Zn < Mg < Ni < Ca$
- D. $Ca < Mg < Zn < Ni$

9. In the reaction of oxalate with permanganate in acidic medium, the number of electrons involved in producing one molecule of CO_2 is:
- 1
 - 10
 - 2
 - 5
10. Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y, is
- 5
 - 3
 - 1
 - 7
11. The correct increasing order of the oxidation states of nitrogen in NO , N_2O , NO_2 and N_2O_3 is:
- $NO_2 < NO < N_2O_3 < N_2O$
 - $N_2O < NO < N_2O_3 < NO_2$
 - $NO_2 < N_2O_3 < NO < N_2O$
 - $N_2O < N_2O_3 < NO < NO_2$

12. The pair in which phosphorus atoms have a formal oxidation state of +3 is :-

- A. Pyrophosphorus and pyrophosphoric acids
- B. Orthophosphorus and pyrophosphorus acids
- C. Pyrophosphorus and hypophosphoric acid
- D. Orthophosphorus and hypophosphoric acids

13. The species given below that does *NOT* show disproportionation reaction is:

- A. BrO_3^-
- B. BrO^-
- C. BrO_2^-
- D. BrO_4^-

14. The correct order of following 3d metal oxides, according to their oxidation number is:

- (a) CrO_3
- (b) Fe_2O_3
- (c) MnO_2
- (d) V_2O_5
- (e) Cu_2O

- A. $(a) > (d) > (c) > (b) > (e)$
- B. $(d) > (a) > (b) > (c) > (e)$
- C. $(a) > (c) > (d) > (b) > (e)$
- D. $(c) > (a) > (d) > (e) > (b)$

15. The oxidation states of 'P' in $H_4P_2O_7$, $H_4P_2O_5$ and $H_4P_2O_6$, respectively are:

- A. 5, 4 and 3
- B. 7, 5 and 6
- C. 6, 4 and 5
- D. 5, 3 and 4

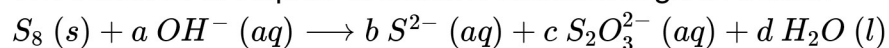
16. In polythionic acid, $H_2S_xO_6$ ($x = 3$ to 5) the oxidation state(s) of sulphur is/are :

- A. 0 and + 5 only
- B. +5 only
- C. +6 only
- D. +3 and + 5 only

17. Hydrogen peroxide reacts with iodine in basic medium to give:

- A. IO_3^-
- B. IO^-
- C. I^-
- D. IO_4^-

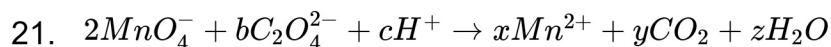
18. The reaction of sulphur in alkaline medium is given below:



The value of a is (Integer answer)

19. Dichromate ion is treated with base, the oxidation number of Cr in the product formed is

20. A 20.0 mL solution containing 0.2 g impure H_2O_2 reacts completely with 0.316 g of $KMnO_4$ in acid solution. The purity of H_2O_2 (in%) is (Nearest integer) (mol.wt.of $H_2O_2 = 34$ mole.wt.of $KMnO_4 = 158$)



If the above equation is balanced with integer coefficients, the value of c is

.....

(Round off to the nearest Integer)

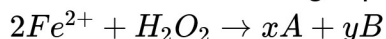
22. When 10 mL of an aqueous solution of Fe^{2+} ions was titrated in the presence of dil H_2SO_4 using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The molarity of the solution containing Fe^{2+} ions is $x \times 10^{-2} M$. The value of x is _____. (Nearest integer)

23. In basic medium, CrO_4^{2-} oxidises $S_2O_3^{2-}$ to form $Cr(OH)_4^-$ and SO_4^{2-} . How many mL (nearest integer) of 0.154 M CrO_4^{2-} are required to react with 40.0 mL of 0.246 M $S_2O_3^{2-}$?

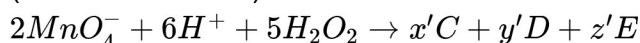
[Hint : $0.0154 M = 0.154 \times 3 N CrO_4^{2-}$ and $0.246 M = 0.246 \times 8 N S_2O_3^{2-}$]

24. The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and K_2FeO_4 , respectively, are x, y and z. The sum of x, y and z is:

25. Consider the following equations:



(in basic medium)



(in acidic medium)

The sum of the stoichiometric coefficients x, y, x', y' and z' for products A, B, C, D and E, respectively, is