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SET 4 –

1. Gibbs free energy (G) is defined as –
   a) G = H – TS
   b) G = H + TS
   c) G = U – PV
   d) G = H – PV

2. The SI unit of Gibbs free energy is –
   a) Joule
   b) J mol^{-1}
   c) kJ mol^{-1}
   d) Both (b) and (c)

3. Gibbs free energy change (ΔG) is given by –
   a) ΔG = ΔH – TΔS
   b) ΔG = ΔH + TΔS
   c) ΔG = TΔH – ΔS
   d) ΔG = ΔH / ΔS

4. For a spontaneous reaction, ΔG is –
   a) Negative
   b) Positive
   c) Zero
   d) Constant

5. For a non-spontaneous reaction, ΔG is –
   a) Negative
   b) Positive
   c) Zero
   d) Infinite

6. For a reversible reaction at equilibrium, ΔG =
   a) Positive
   b) Negative
   c) Zero
   d) Constant

7. When ΔH is negative and ΔS is positive, ΔG will be –
   a) Always negative
   b) Always positive
   c) Zero
   d) Variable

8. When ΔH is positive and ΔS is negative, ΔG will be –
   a) Always negative

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b) Always positive
c) Zero
d) Temperature dependent

9. If both ΔH and ΔS are positive, the reaction is spontaneous at –
   a) High temperature
   b) Low temperature
   c) Zero temperature
   d) Never spontaneous

10. If both ΔH and ΔS are negative, the reaction is spontaneous at –
   a) High temperature
   b) Low temperature
   c) All temperatures
   d) Never spontaneous

11. If ΔG < 0, the reaction –
   a) Is spontaneous
   b) Is non-spontaneous
   c) Is at equilibrium
   d) Stops

12. If ΔG > 0, the reaction –
   a) Is spontaneous
   b) Is non-spontaneous
   c) Is equilibrium
   d) Is reversible

13. If ΔG = 0, the reaction –
   a) Is at equilibrium
   b) Is spontaneous
   c) Is non-spontaneous
   d) Absorbs energy

14. The relationship between ΔG° and equilibrium constant K is –
   a) $\Delta G^\circ = -RT \ln K$
   b) $\Delta G^\circ = RT \ln K$
   c) $\Delta G^\circ = K \ln R$
   d) $\Delta G^\circ = -KRT$

15. When K > 1, ΔG° is –
   a) Positive
   b) Negative
   c) Zero
   d) Undefined

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16. When $K < 1$, ΔG° is –
    a) Positive
    b) Negative
    c) Zero
    d) Infinite

17. When $K = 1$, ΔG° is –
    a) Zero
    b) Positive
    c) Negative
    d) Constant

18. A reaction at equilibrium has –
    a) $\Delta G = 0$
    b) $\Delta G^\circ = 0$
    c) $\Delta H = 0$
    d) $\Delta S = 0$

19. For spontaneous reaction at constant temperature and pressure –
    a) $\Delta G < 0$
    b) $\Delta H < 0$
    c) $\Delta S < 0$
    d) All of these

20. Gibbs free energy combines –
    a) Enthalpy and entropy
    b) Internal energy and pressure
    c) Volume and entropy
    d) Temperature and enthalpy

21. If $\Delta G = \Delta H - T\Delta S$, then for $\Delta G = 0$,
    a) $\Delta H = T\Delta S$
    b) $\Delta H = -T\Delta S$
    c) $\Delta S = 0$
    d) $\Delta H = 0$

22. When $\Delta H = 0$ and $\Delta S > 0$, reaction is –
    a) Always spontaneous
    b) Never spontaneous
    c) At equilibrium
    d) None

23. When $\Delta S = 0$ and $\Delta H < 0$, reaction is –
    a) Always spontaneous
    b) Never spontaneous
    c) At equilibrium

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d) Endothermic

24. Gibbs free energy change determines –
    a) Spontaneity
    b) Rate
    c) Mechanism
    d) Energy only

25. ΔG° for a reversible cell reaction equals –
    a) –nFE°cell
    b) +nFE°cell
    c) 0
    d) RT lnK

26. ΔG° = –nFE°cell relates –
    a) Gibbs energy and cell potential
    b) Work and pressure
    c) Entropy and enthalpy
    d) None

27. For a galvanic cell, spontaneous reaction occurs when –
    a) E°cell > 0
    b) E°cell < 0
    c) E°cell = 0
    d) E°cell undefined

28. In an electrolytic cell, reaction is –
    a) Non-spontaneous
    b) Spontaneous
    c) Equilibrium
    d) None

29. In a galvanic cell, chemical energy is converted to –
    a) Electrical energy
    b) Light energy
    c) Sound energy
    d) Heat energy

30. In an electrolytic cell, electrical energy is converted to –
    a) Chemical energy
    b) Mechanical energy
    c) Thermal energy
    d) None

31. The quantity of electricity required to deposit one mole of a univalent ion is –
    a) 96500 C
    b) 1 C

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c) 1000 C
d) 6.022×10^{23} C

32. One faraday is equal to –
a) 96500 C mol^{-1}
b) 1 C mol^{-1}
c) 96500 J mol^{-1}
d) 1 J mol^{-1}

33. The amount of substance deposited in electrolysis is proportional to –
a) Quantity of electricity passed
b) Current strength
c) Time
d) All of these

34. Relation between ΔG and equilibrium constant K at any temperature is –
a) ΔG = ΔG° + RT lnQ
b) ΔG = RT lnK
c) ΔG° = RT lnK
d) ΔG = –RT lnK

35. If ΔG° = –RT lnK, then K =
a) e^(–ΔG°/RT)
b) e^(ΔG°/RT)
c) RT/ΔG°
d) None

36. If ΔG° < 0, then K is –
a) > 1
b) < 1
c) = 1
d) 0

37. If ΔG° > 0, then K is –
a) > 1
b) < 1
c) = 1
d) 0

38. For a cell reaction at equilibrium,
a) ΔG = 0
b) Ecell = 0
c) K = Q
d) All of these

39. The term “reversible process” means –
a) Occurs infinitesimally slowly

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b) Can be reversed by infinitesimal change
c) Is in equilibrium throughout
d) All of these

40. A spontaneous process occurs –
a) Without any external influence
b) With external work
c) At constant volume
d) Only in solids

41. The spontaneity of a process depends on –
a) Enthalpy and entropy
b) Pressure and volume
c) Work and heat
d) None

42. Which combination is always spontaneous?
a) ΔH negative, ΔS positive
b) ΔH positive, ΔS negative
c) Both positive
d) Both negative

43. For ice melting at 0°C, ΔH and ΔS are –
a) Both positive
b) Both negative
c) ΔH negative, ΔS positive
d) ΔH positive, ΔS negative

44. For freezing of water, ΔH and ΔS are –
a) Both negative
b) Both positive
c) ΔH positive, ΔS negative
d) ΔH negative, ΔS positive

45. A spontaneous process is one that –
a) Proceeds without external help
b) Requires external help
c) Is reversible
d) Is exothermic only

46. At 0 K, the entropy of a perfect crystal is –
a) Zero
b) Infinite
c) Positive
d) Negative

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47. The process $H_2O(l) \rightarrow H_2O(g)$ is –
    a) Endothermic and entropy increases
    b) Exothermic and entropy decreases
    c) Exothermic and entropy increases
    d) Endothermic and entropy decreases

48. ΔG gives the measure of –
    a) Maximum useful work
    b) Minimum work
    c) Heat absorbed
    d) Random motion

49. The process with ΔG = 0 represents –
    a) Reversible equilibrium
    b) Non-spontaneous
    c) Spontaneous
    d) Isothermal

50. The thermodynamic criterion for equilibrium is –
    a) ΔG = 0
    b) ΔS = 0
    c) ΔH = 0
    d) ΔE = 0

✅ ANSWER KEY – SET 4

1–a	2–d	3–a	4–a	5–b	6–c	7–a	8–b	9–a	10–b
11–a	12–b	13–a	14–a	15–b	16–a	17–a	18–a	19–a	20–a
21–a	22–a	23–a	24–a	25–a	26–a	27–a	28–a	29–a	30–a
31–a	32–a	33–d	34–a	35–a	36–a	37–b	38–d	39–d	40–a
41–a	42–a	43–a	44–a	45–a	46–a	47–a	48–a	49–a	50–a

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