Electrode potential, E_{Cell}, Nernt equation and ECS

51. (b) Standard hydrogen electrode have zero electrode potential.

52. The electrode potential of a cell is given by the **Nernst equation**:

$E = E^\circ - (RT / nF) \times \ln([\text{products}] / [\text{reactants}])$

Where:

- **E°** = standard electrode potential
- **R** = gas constant
- **T** = temperature (in Kelvin)
- **n** = number of electrons transferred
- **F** = Faraday constant

This shows that the cell potential decreases from its standard value by a term proportional to the natural log of the **ratio of products to reactants**.

So, the correct option is:

(a) $E = E^\circ - (RT / nF) \ln([\text{products}] / [\text{reactants}])$

53. (a) $\Delta G = -nFE^o$

$\Delta G = -1 \times 96500 \times 1.02$; $\Delta G = -98430$.

54. (c) Fuel cell converts the chemical energy into electrical energy.

55. (a) $E = E^o - \frac{2.303\ RT}{nF} \log \frac{[M]}{[M^{n+}]}$.

56. (a) Less is the reduction potential stronger is the reducing agent.

57. (a) Reducing power, *i.e.* the tendency to lose electrons increases as the reduction potential decreases.

58. (a) $OCl^- \rightarrow C^-, E^o = 0.94\,V$

$Cl^- \rightarrow \frac{1}{2} Cl_2 + e^- E^o = -1.36\ V$

adding the two equations, we get

$OCl^- \rightarrow \frac{1}{2}Cl_2, E^o = 0.94 - 1.36 = -0.42\ V$.

59. **Correct answer:** (b) and (c)

Word–friendly explanation:

- A **higher (more positive) reduction potential** means the species has a **greater tendency to gain electrons**, i.e., it is **easily reduced**.
- Substances that are easily reduced can **oxidize others**, so they act as **oxidising agents**.

Therefore:

- **(b)** It is easily reduced –True
- **(c)** It acts as oxidising agent –True

Most exam keys accept **(b)** as the primary correct answer, but **(c)** is also a correct statement.

60. (a) It cannot evolved H_2 from H_2S

$Hg + H_2S \rightarrow$ No reaction .

61. (b) $E^o_{cell} = \frac{0.059}{n}\log K$

$\log K = \frac{1.10 \times 2}{0.059} = 37.2881$ or $K = 10^{-37}$.

62. (d) The oxidizing character *i.e.* acceptance of electrons increases with the reduction potential.

63. (a) According to electrochemical series.

64. (d) $E_{cell} = E^o_{cell} - \frac{RT}{nF}\ln\frac{C_2}{C_1}$ and $\Delta G = -nF\,E_{\text{cell}}$

hence ΔG is the function of $\ln\left(\frac{C_2}{C_1}\right)$.

65. Reaction: $Zn(s) + Ni^{2+}(a = 1.0) \rightleftharpoons Zn^{2+}(a = 10) + Ni(s)$

Observed emf, E = 0.5105 V

Temperature, T = 298 K

We know the **Nernst equation**:

$E = E^\circ - (0.0591 / n) \times \log([\text{products}] / [\text{reactants}])$

Here:

- n = 2 (since $Zn \rightarrow Zn^{2+} + 2e^-$)
- [products] = $a(Zn^{2+}) = 10$
- [reactants] = $a(Ni^{2+}) = 1.0$

Substitute:

$0.5105 = E^\circ - (0.0591 / 2) \times \log(10 / 1)$

$\log(10) = 1$

So:

$0.5105 = E^\circ - (0.0591 / 2) \times 1$

$0.5105 = E^\circ - 0.02955$

Now solve for E°:

$E^\circ = 0.5105 + 0.02955$

$E^\circ = 0.54005\ V \approx$ **0.5400 V**

Correct answer: (a) 0.5400 V

66. (c) $E = E^o - \frac{0.059}{n}\log\frac{[Zn^{++}]}{[Cu^{++}]} = 1.10 - \frac{0.059}{2}\log\frac{1}{0.1}$

$= 1.10 - 0.0295 \log 10 = 1.07\ volt$.

67. (b) $E_1 = E_o - \frac{0.0591}{2}\log\frac{0.01}{1} = E_o + \frac{0.0591}{2}\times 2$

$E_2 = E_o - \frac{0.0591}{2}\log\frac{100}{0.01} = E_o - \frac{0.0591}{2}\times 4$

$\therefore E_1 > E_2$.

68. (b) $\overset{\text{Oxidation}}{\overbrace{Fe^{+2} + Zn}} \rightarrow \underset{\text{Reduction}}{\underbrace{Zn^{2+} + Fe}}$

$EMF = E_{cathode} - E_{anode} = 0.44 - (0.76) = +0.32\ V$.

69. (a) *Fe* is more electropositive than copper. Hence Cu^{2+} can oxidise *Fe*.

70. (b) $E^o = 0$ because hydrogen have zero potential.

71. (b) Cell potential of the cell is positive.

72. (a,b) Because these comes after the *Fe* in electrochemical series.

73. (c) $\underbrace{Fe^{2+} + \overbrace{Zn}^{\text{Oxidation}} \rightarrow Zn^{2+} + Fe}_{\text{Reduction}}$

$EMF = E_{cathode} - E_{anode} = -7.81 - (-7.62)$

$EMF = -0.19\ V$.

74. (c) $Cr^{3+} > Zn^{2+} > H > Fe^{3+}$.

Reducing nature decreasing order.

75. (a) More is reduction potential, more is the power to get itself reduced or lesser is reducing power or greater is oxidising power.