UNIT REVIEW: REDOX – ANSWERS

1. a) +6
   b) +5
   c) +3, +4
   d) -1
2.

Question	Oxidized	Reduced	Oxidizing Ag.	Reducing Ag.
A	I^-	IO_3^-	IO_3^-	I^-
B	Zn	NO_3^-	NO_3^-	Zn

3. a) $Cr_2O_7^{2-} + 3Bi^{+3} + 4OH^{-1} \rightarrow 2Cr^{+3} + 3BiO_3^{-1} + 2H_2O$
   b) $MnO_4^- + 3SO_3^{-1} + 2OH^{-1} \rightarrow MnO_2 + 3SO_4^{2-} + H_2O$
   c) $6Br_2 + 12OH^{-1} \rightarrow 10Br^{-1} + 2\ BrO_3^{-1} + 6H_2O$
   d) $2P + 3PO_4^{-3} + 2H_2O + OH^- \rightarrow 5HPO_3^{-2}$
   e) $7H_2O + Cr_2O_7^{-2} + 3C_2O_4^{-2} \rightarrow 2Cr^{+3} + 6CO_2 + 14OH^{-1}$
   f) $5H_2O + 2CrO_4^{2-} + Cl^- \rightarrow ClO_3^- + 2Cr^{+3} + 10OH^-$
   g) $2MnO_4^- + 3CN^- + H_2O \rightarrow 2MnO_2 + 3CNO^- + 2OH^{-1}$
   h) $2OH^- + SeO_3^{-2} + Cl_2 \rightarrow SeO_4^{-2} + 2Cl^{-1} + H_2O$

4. a) Yes. Cl_2 SRP = +1.36V , Br_2 SRP = +1.09 V , E^o = +0.27 V, spontaneous
   b) No. Al^{3+} SRP = -1.66V, Hg SRP = +0.85, E^o = -2.51V, non-spontaneous

5. Potassium (K) is the stronger reducing agent. Oxidation potential of K (+2.92 V) > Oxidation potential of Cu (-0.15 V). Potassium is an alkali metal, i.e. one valence electron, highly reactive and hence easily oxidized

6. Sulfur has multiple oxidation states ranging from S^{-2} (isoelectronic to Ar) to S^{+6} (isoelectronic to Ne). Hence SO_2 (S oxidation number of +4) can be reduced or oxidized towards an oxidation number of -2 or +6

7. a) $2Cr_2O_7^{2-} + C_2H_5OH + 16H^+ \rightarrow 4Cr^{3+} + 2CO_2 + 11H_2O$
   b) 0.16% alcohol in blood

8. Fe (Iron) is both the oxidant and the reducing agent; Iron is a better reducing agent than chlorine gas and is most commonly found with oxidation numbers of +2 or +3, i.e. oxidized

9. $2Al_{(s)} + 6H^+_{(aq)} + 3O_{2(aq)} \rightarrow 2Al^{+3}_{(aq)} + 3H_2O_{2(aq)}$

10. a) Cu, H_2, Na
    b) Cd, Fe, Zn

11. E^o_{cell} = -0.36 V, negative voltage, non-spontaneous ($dG = -nFE^o$)

12. Electrolytes maintain a balance of charge between anode and cathode such that the cell produces a voltage consistently. Anode has excess positive charge in solution, must be balanced with anions; Cathode has excess negative charge in solution, must be balanced with cations.

13. The presence of salts or acids will increase water's conductivity and hence improve it's ability to carry electrons during the redox reaction.

14. Scandium (Sc, 44.95 g/mol)

15. a) $C_{(s)} \mid Cr_2O_7^{-2}{}_{(aq)} , Cr^{+3}{}_{(aq)} , H^+{}_{(aq)} \parallel Br^{-1}{}_{(aq)} , Br_{2(l)} \mid C_{(s)}$
    b) $Pt_{(s)} \mid NO_{(g)} , NO_3^{-1}{}_{(aq)} , H^+{}_{(aq)} \parallel Fe^{3+}{}_{(aq)} \mid Fe_{(s)}$

16. a) 124 minutes
    b) Water is more easily reduced than Calcium ions in an electrolytic aqueous cell (-0.83V > -2.87 V); Water will be discharged in cell instead, calcium ions do not undergo reduction

17. 41.1 minutes

18. i) $C_6H_8O_6 \rightarrow C_6H_6O_6 + 2H^+ + 2e^-$
    ii) $2Fe^{+3} C_6H_8O_6 \rightarrow 2Fe^{+2} + C_6H_6O_6 + 2H^+$

19. a) $Na^+ + e^- \rightarrow Na$; $2Cl^- \rightarrow Cl_2 + 2e^-$; Electron flow from battery to electrodes; Electron flow at the cathode (reduction of cations); Electron flow at the anode (oxidation of anions)
    b) 0.2 mol of sodium; net equation is $2Na^+ + 2Cl^- \rightarrow 2Na + Cl_2$: For every mol of chlorine gas, 2 mols of solid sodium is formed; (0.1 x 2 = 0.2 mol)
    c) 0.25 mol Cl_2
    d) Hydrogen gas and hydroxide formed at the cathode, Oxygen gas and H^+ at the anode ; $H_2O_{(l)} \rightarrow H_{2(g)} + ½O_{2(g)}$
    e) Potential difference (voltage) obtained when a half-cell of an element is connected with a hydrogen electrode under standard conditions (298K , 1.0 $moldm^{-3}$, 1 atm)

20. a) $Cr_2O_7^{-2} + 3SO_3^{-2} + 8H^+ \rightarrow 2Cr^{+3} + 3SO4^{-2} + 4H_2O$
    b) $H_2O + MnO_4^- + 3VO^{+2} \rightarrow MnO_2 + 3VO_2^{+1} + 2H^+$

21. Water has a greater reduction potential than Na^+ (-0.83V > -2.71V); Water is more easily oxidized than F^- (-1.23V > -2.87 V), hence it is preferred in an electrolytic oxidization reaction at both the cathode and anode

22. a) Na^+, H^+, Ag^+
    b) Ag, H, Na