Kirkcaldy High School

Chemistry

National 5

Unit 3 – Chemistry in Society

TUTORIAL ANSWERS

(a) Metals

1. Metallic bonding is an array of positive ions surrounded by a "sea" of free-moving, negatively charged electrons. A metal therefore has charged particles that are free to move and conduct electricity.
2. Can be hammered or pressed into shape.
3. They conduct heat energy
4. It saves energy and saves metal (which is a finite resourse).
5.

   (a) A mixture of metals
   (b) Steel, brass, etc.
   (c) To create a metallic substance with specific properties.

6.

   (a) B
   (b) E, D
   (c) E
   (d) A, F
   (e) C

7.

   (a) It reacts with water and oxygen in the air
   (b) Hydrogen
   (c) Caesium hydroxide
   (d) Caesium + water → Caesium hydroxide + hydrogen
   $2Cs + 2H_2O \rightarrow 2CsOH + H_2$

8.

   (a) Sodium + water → Sodium hydroxide + hydrogen
   $2Na + 2H_2O \rightarrow 2NaOH + H_2$

   (b) Magnesium + Hydrochloric acid → Magnesium chloride + hydrogen
   $Mg + 2HCl \rightarrow MgCl_2 + H_2$

   (c) Calcium + Oxygen → Calcium oxide
   $2Ca + O_2 \rightarrow 2CaO$

   (d) Lithium + Oxygen → Lithium oxide

$2Li + O_2 \rightarrow Li_2O$

9. Sodium, magnesium, aluminium, iron, lead, copper, silver, gold.
10.

(a) Magnesium

(b) Magnesium + Hydrochloric acid → Magnesium chloride + hydrogen

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

(c) It is higher in the electrochemical series..

11. Chemical energy to electrical energy
12.

(a) B

(b) C

(c) D

(d) A

13. Silver has charged particles that can move (electrons). In phosphorus, all the charged particles are held in place.
14. Lead/acid, nickel/cadmium etc.
15.

(a) Zn→ Cu

(b) To act as an electrolyte (allow charge to flow).

(c) Electrons

(d) Silver or gold

16.

(a) Hexane is a covalent compound and therefore cannot conduct electricity.

(b) The size of the reading will decrease.

17.

(a) Magnesium to tin

(b) To complete the circuit and allow ions to flow

(c) $Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$

(d) direction of the current would reverse

size of the voltage would decrease.

(e) Oxidation is:

gain of oxygen

loss of electrons

loss of hydrogen

Reduction is:

loss of oxygen

gain of electrons

gain of hydrogen

(f) The magnesium electrode.

18.

(a) Displacement

(b) Copper Metal

(c) $Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

19. B, D

20.

(a) $Al(s) \rightarrow Al^{3+}(aq) + 3e^-$

(b) $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$

(c) $Na(s) \rightarrow Na^+(aq) + e^-$

(d) $Ag^+(aq) + e^- \rightarrow Ag(s)$

(e) $Li^+(aq) + e^- \rightarrow Li(s)$

(f) $K(s) \rightarrow K^+(aq) + e^-$

21. a cell producing an electric current direct from a chemical reaction

22. The chemicals are constantly being replaced

23.

(a) Diatomic

(b) Electrolysis

(c)

(i) The chemicals are constantly being replaced.

(d) Electrolysis of water

(e) Increases the rate of a chemical reaction

24.

(a) To complete the circuit and allow current to flow

(b) Tin bromide, tin chloride, tin iodide or tin sulfate

(c) Any metal lower than tin in the electrochemical series.

25.

(a) B to A through the wire

(b) Reduction

(c) Formation of a dark solid

(d) $2I^-(aq) \rightarrow I_2(s) + 2e^-$

26.

(a) A compound where a metal is chemically bound to another substance

(b) It is very unreactive

(c) The metal ions in the ore gain electrons

27.

(a) A, D

(b) B, E

(c) C, F

28. Least reactive Z, X, Y Most reactive. Z is a metal low down in the electrochemical series, X from the middle and Z from the top

29.

(a) Fe_2O_3

(b) $C(s) + CO_2(g) \rightarrow CO(g)$

(c) Calcium is too high in the electrochemical series. Electrolysis would be required to separate it from an ore.

30.

(a) Electrolysis/smelting

(b) It requires electricity to be separated from the ore. Electricity was not discovered until the 19^{th} (1800s) century).

(c) $Al^{3+}(aq) + 3e^- \rightarrow Al(s)$

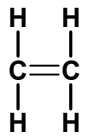
(b) Plastics

1.

(a) It is not made in nature – only by humans

(b) Crude oil

(c)



(d) Cracking

(e) Cannot be broken down naturally

(f) Poisonous gases such as carbon monoxide are produced

(g) Crude oil is non-renewable

2.

(a) It is waterproof (or any other reasonable suggestion)

(b) It is durable (or any other reasonable suggestion)

(c) It is cheap (or any other reasonable suggestion)

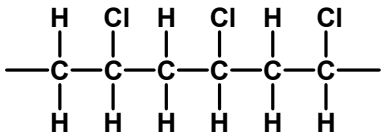
3.

(a) Thermosetting plastic

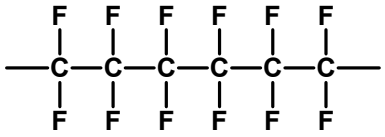
(b) You don't want a pan handle to melt. That would be messy.

4.

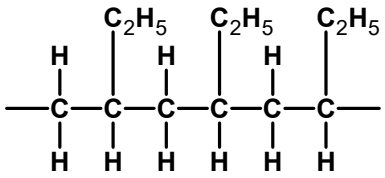
(a)



(b)

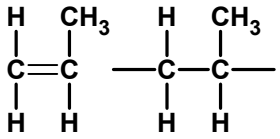


(c)


C2H5
C2H5
C2H5
H
H
H
C
C
C
C
C
C
H
H
H
H
H
H

5. Draw the monomers and repeating units formed from the following polymers.

(a)



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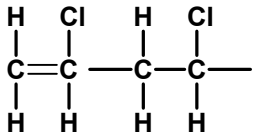
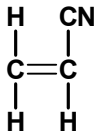


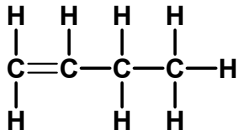
6.



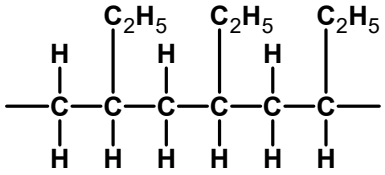
7. Cyanide or carbon monoxide

8.

(a)

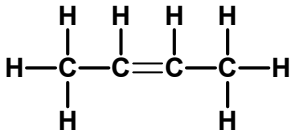


(b)

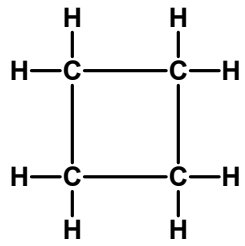


(c)

(i)



(ii)



9. Poly(ethenol) – dissolves in water. Used for biodegradable plastic bags or dissolvable stitches.
   Polyethyne (or polyacetylene) – conducts electricity. Could be used for flat-screen TVs and devices.

(c) Fertilisers

1. Nitrogen, phosphorus and potassium.
2. Nitrate salts tend to be soluble in water
3.

   (a)

   (i) $(NH_4)_3PO_3$
   (ii) $(NH_4)_2SO_4$

   (b) If the salt is reacted with sodium hydroxide then ammonia gas would be released. This would turn wet pH paper blue or purple.
   i.e. $NH_4^+(aq) + OH^-(aq) \rightarrow H_2O(l) + NH_3(g)$

   (c) Soluble, fishy smell, alkaline, less dense than air

4.

   (a) Separation of air
   (b) Oxygen
   (c) Haber process
   (d) Iron
   (e) High pressure, medium-to-high temperature
   (f) Yield of ammonia would be low

5.

   (a) $(NH_4)_2SO_4$, NH_4NO_3
   (b) 21.2 %, 35.00 %.
   (c)

   (i) Nitrogen dioxide
   (ii) $N_2(g) + O_2(g) \rightarrow 2NO_2(g)$
   (iii) When nitrogen is "fixed" by certain plants

   (d) Nitric acid
   (e) The energy requirement is too high

6.

   (a) Ostwald process

(b) Platinum

(c) The reaction is exothermic

7. Shake the gasses up with water. Nitrogen dioxide would dissolve to give an acidic solution. OR React both gases with an alkene. Bromine will decolourise.

8.

(a) A, E

(b) B, E

9.

(a) At high temperatures the yield of ammonia will be low

(b) Cooling of the gases – the ammonia condenses out.

(c) Sodium hydroxide and an ammonium salt.

10.

(a) Their root nodules contain nitrogen fixing bacteria.

(b) The need for fertilisers would be reduced.

11.

(a) April is when many fields are planted and fertilisers added

(b) Growing of algae.

12.

(a) The energy required to “fix” atmospheric ammonia is too high

(b) The reaction does not need to be heated

(c) Platinum.

13.

(a) Nitrogen

(b)

(i) 173 g

(ii) 45.09

(c) Calcium phosphate is insoluble in water.

(d) Nuclear Chemistry

1.

(a) $^{238}_{92}U + {}^{4}_{2}He \rightarrow {}^{239}_{94}Pu + 3{}^{1}_{0}n$

(b) $^{6}_{3}Li + {}^{1}_{0}n \rightarrow {}^{3}_{1}H + {}^{4}_{2}He$

2.

(a) X = Radium, Y = Radon, Z = Polonium

(b) $^{4}_{2}He$ = helium nucleus

3.

(a) $^{238}_{92}U \rightarrow {}^{4}_{2}He + {}^{234}_{90}Th$

(b) $^{238}_{92}U \rightarrow {}^{0}_{-1}e + {}^{238}_{93}Np$

4. $^{228}_{88}Ra \rightarrow {}^{228}_{89}Ac + {}^{0}_{-1}e \rightarrow {}^{228}_{90}Th + {}^{0}_{-1}e \rightarrow {}^{224}_{88}Ra + {}^{4}_{2}He$

5.

(a) In each of the following, state whether or not both species have the same half-life.

(b) Yes

(c) Yes

(d) No

(e) Yes

6. 17190 years

(e) Chemical Analysis

1. Yellow
2. 0.5 mol l^{-1}
3. Copper carbonate
4. 0.04 mol l^{-1}
5. Oxygen
6. Bromine solution
7. Neutralisation
8.
9. Magnesium
10. Silver
11. Method B. As soon as the acid is added to the calcium carbonate then the gas will be given off and the mass will start to drop. Method B ensures that the initial mass does not account for any gas lost.
12.

    (a) Heat

    (b) 0.2 mol l^{-1}.

13.

    (a) 16.0 cm^3

    (b)

        (i) 0.0000125 mol l^{-1}

    (c) It was a rough titration

14. 18.5 cm^3 is the average of the two concordant titres.
15. Slow down the titration towards the end point/use white tile underneath the sample/read the burette at eye level/other reasonable suggestions!
16. Quantitative analysis involves numbers, qualitative analysis is based on observations.
17. There are many ways. One example

    Carry out two experiments with a measured mass of ice cubes in a certain volume of water.
    The mass of ice cubes and the volume of water should be the same for both experiments.
    Add the same mass of salt to both and stir to mix.
    Leave for 5 mins with a thermometer in.
    Measure the two temperatures.

18.

(a) Red

(b) Qualitative analysis

19. 0.156 mol l^{-1}