Kirkcaldy High School

Chemistry

Higher

Unit 1 – Chemical Changes and Structure

TUTORIAL ANSWERS

(a) Periodicity

1. B
2. C
3. D
4. D
5. C
6. C
7. D
8. C
9. C
10. B
11. C
12. A
13. C
14. C
15. B
16. A
17. D
18. C
19. B
20. A
21. D
22. D
23.

    (a) Increased nuclear shielding

    (b) $Cl(g) + e^- \rightarrow Cl^-(g)$

24.

    (a) Electronegativity

    (b) Decreases

    (c) K has more occupied energy levels so nuclear shielding is increased.

25.

    (a) Boron and Carbon

    (b) Increased nuclear charge

26.

(a)

(i) Increased nuclear charge

(ii) $Cl(g) \rightarrow Cl^{+}(g) + e^{-}$

(b) They do not form bonds – electronegativity is attraction to electrons in a bond

27.

(a) Electronegativity increases

(b) Silicon

(c) The fourth electron is removed from a full shell

28.

(a)

(i) $Na(g) \rightarrow Na^{+}(g) + e^{-}$

(ii) 1st ionisation energy refers to removal of 1 electron, so Na goes from 2,8,1 to 2,8. Shielding from the inner electron shells reduces the attraction to the single outer electron. The electron removed from the 2nd shell is less shielded and requires breaking a full shell.

(b) 2.54 g

29.

(a) Aluminium – metallic bonding
Silicon – network structure
Phosphorus – covalent bonding
Sulfur – molecular structure

(b) Increased nuclear charge pulls electrons closer to the nucleus.

30.

(a) $K(g) \rightarrow K^{+}(g) + e^{-}$

(b) K has more shells than Cl so outer electron of K is more shielded.
Removal of 1 electron from K leaves a full outer shell.

31.

(a) Fullerene – molecule
carbon, diamond graphite - networks

(b)

(i) 0.004 mol
(ii) 0.47 g

32.

(a) $Na(g) \rightarrow Na^{+}(g) + e^{-}$
(b) 6888 $kJmol^{-1}$
(c) Covalent (network)

33.

(d) Increased nuclear charge in Cl pulls electrons closer to the nucleus
(e) Si^{4+} has 2 electron shells, P^{3-} has 3.

34. Potassium has 4 electron shells, chlorine has 3.
35. Lithium – metallic bonding
Boron – covalent bonding, network structure
Nitrogen – molecular structure

36.

(a) Electronegativity
(b) Increases
(c) The electron being removed from Na^{+} is in a full shell and is closer to the nucleus that the electron removed from Na.

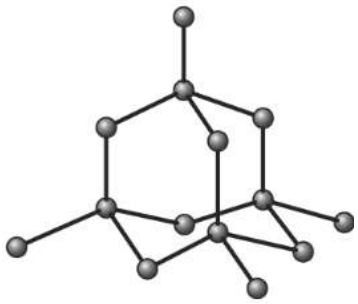
37.

(a) Monoatomic gas: He/Ne/Ar/Kr/Xe/Rn
Covalent network solid: C, Si, B
Discrete covalent molecular gas: H, N, O, F, Cl
Discrete covalent molecular solid: C_{60}, P, S, I

(b) They have delocalised electrons

38.

(a)



(b) London dispersion forces between layers make the graphite soft

39. D

(b) Structure and bonding

1. C
2. B
3. D
4. C
5. C
6. A
7. B
8. A
9. D
10. B
11. B
12. C
13. B
14. B
15. C
16. A
17. D
18. D
19. C
20. D
21. A
22. C
23. C
24. B
25. A
26. C
27. H electronegativity = 2.2, F electronegativity = 4.0

    H-F has a polar covalent bond. The attraction between δ+ H and δ - F leads to Permanent Dipole-Permanent Dipole attractions.

    F-F has no polarity in molecule so only forces are London Dispersion Forces (arising from temporary dipoles). These are weaker than Permanent Dipole-Permanent Dipole so boiling point is lower.

28. Water has very polar molecules resulting in Hydrogen Bonding.
    This means that the water is a polar solvent and will dissolve other polar molecules readily.
    $CHCl_3$ is a polar molecule die to C-Cl polarity and lack of symmetry so has Permanent Dipole-Permanent Dipole interactions
    CCl_4 is symmetrical so only has London Dispersion Forces – therefore non-polar.

29. Boiling point is determined by strength of intermolecular forces. Ethane-1,2-diol as 2 hydroxyl groups so exhibits more hydrogen bonding forces that propan-1-ol.
30. C
31. H electronegativity = 2.2, S electronegativity = 2.5
    Very small difference is electronegativity leads to very weak Permanent Dipole-Permanent Dipole attractions.
    Small number of electrons means weak London Dispersion Forces.
    Stronger intermolecular forces would increase boiling and melting points.

32.

    (c) London Dispersion Forces
    (d) H-F contains Hydrogen Bonding so molecules are bound closely together.

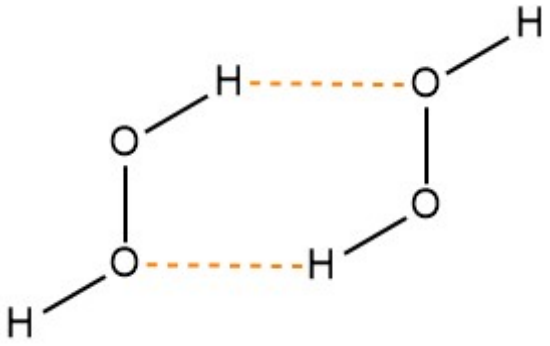
33.

    (a) E
    (b) A, B

34. Hexane is non-polar due to symmetry so only has weak London Dispersion Forces.
    Vinyl Acetate has a polar C=O group so has Permanent Dipole-Permanent Dipole attractions (stronger)

35.

    (a) Hydrogen Bonding
    (b)



    (c) Hydrocarbon GFM close to 34. Ethane C_2H_6.

36.

(a) Group 8/0/18 OR Noble Gases

(b) C electronegativity = 2.5, S electronegativity = 2.5.
Same electronegativity – pure covalent

(c) Increased shielding down the group so weaker attraction between nucleus and outer electron.
Therefore the electronegativity decreases down the group.

37. C electronegativity = 2.5, H electronegativity = 2.2, N electronegativity = 3.0.
Difference in electronegativity means that electrons are pulled more closely to N than C in bond.
This causes δ^- N and δ^+ C permanent dipole so there are Permanent Dipole-Permanent Dipole attractions between the molecules.

38.

(a) Bigger molecules, more electrons, stronger London Dispersion Forces between molecules

(b) Hydrogen Bonding

39.

(a) δ^+ H-Br δ^-

(b) Permanent Dipole-Permanent Dipole attractions

(c) H electronegativity = 2.2, I electronegativity = 2.6, Br electronegativity = 2.8.
There is less of an electronegativity difference between H and I than between H and Br so the dipole on the H-I molecule is smaller than the dipole on H-Br. This leads to weaker Permanent Dipole-Permanent Dipole attractions between the H-I molecules than between the H-Br molecules.

(c) Oxidising and Reducing Agents

1. D
2. D
3. A
4. C
5. A
6. D
7. A
8. D
9. D
10. B
11. C
12. C
13. A
14. D
15. A
16. C
17. A
18. D
19.

(a)

(i) $C_6H_8O + I_2 \rightarrow C_6H_6O_6 + 2H^+ + 2e^-$

(ii) Pipette – rinse with fruit drink

Burette – rinse with iodine

Conical flask – rinse with water

(iii) Allow several repeats on same carton – calculate average.

(iv) 0.2794 g

(b) 80 %

20.

(a) $I_2 + 2e^- \rightarrow 2I^-$

(b)

(i) Sample 1 is rough titre OR
Sample 1 is not concordant with others

(ii) 0.1815 mol l^{-1}

21. $PbO_2(s) + SO_4^{2-} + 2H^+ \rightarrow PbSO_4(s) + 2H_2O$

22. $NO_3^-(aq) + 4H+ + 3e^- \rightarrow NO(g) + 2H_2O$

23. $C_6H_8O_6(aq) \rightarrow C_6H_6O_6 + 2H^+ + 2e^-$

24.

(a) $H_2O_2(aq) + 2H^+ + 2I^- \rightarrow 2H_2O + I_2$

(b) 0.038 g

25.

(a) $2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e^-$

(b) Starch

(c) 0.0126 moles

26.

(a) $(COOH)_2 \rightarrow 2CO_2 + 2H^+ + 2e^-$

(b) Permanganate changes colour/decolourises OR
It is self indicating

(i) Rough titre OR
Not concordant

(c) 0.054 mol

27. 3.3×10^{-3} mol l^{-1}

28.

(a) Use of pipette/burette

Meniscus – bottom of graduations

Pre-rise glassware

Slow addition (dropwise) near end point

(b)

(i) 0.0324 mol l^{-1}

(ii) $2e^- + 2H^+ + NO_2^- \rightarrow NO_3^- + H_2O$

29. $CH_3CH_2OH + O_2 \rightarrow H_2O + CH_3COOH$

30. 1.47×10^{-3} mol l^{-1}

31. $2Cl^- + 2H_2O \rightarrow H_2 + 2OH^- + Cl_2$

32. A

33.

(a) 3.65×10^{-3} mol l^{-1}

(b) Purple to colourless