Structure of the atom and the periodic table

1. $Na_2CO_3 + 2HNO_3$ ____ $2NaNO_{3\,(L)} + CO_{(g)} + H_2O_{(C)}$
   Mole ration 1 : 2
   a) Moles of HNO_3 in $20cm^3$ = 20/1000 x 0.25
   = 0.005 moles

   b) Moles of Na_2CO_3 in $25cm^3$ = ½ of 0.005 moles
   = 0.0025

   c) If $25cm^3$ = 0.0025 moles
   in $250cm^3$ = ?
   $\frac{250 \times 0.0025}{25}$
   = 0.025 moles

   RFM of Na_2CO_3 = 106
   I mole of Na_2CO_3 = 106g
   0.025 moles = ?
   $\frac{0.025 \times 106}{1}$
   = 2.65g of Na_2CO_3
2. (a) A= 2.8.1

   B= 2.1
   (b) B
   Strong attraction of the outermost energy level electron to the nucleus make it difficult to remove This is due to smaller atomic radius compared to A
   Or - Outermost electrons are closer to the nucleus hence higher force of attraction
3. $R.A.M = \frac{(62.93 \times 69.09) + (64.93 \times 3091)}{100}$
   $= \frac{4347.834 + 2006.99}{100}$
   = 63.5482
   ≈ 63.5
4. (a) $R.A.M = \frac{(33 \times 2) + (30 \times 1)}{3}$ ✓ 1
   $\frac{99}{3} = 33$ ✓ 1
   (b) Number of electrons of C = 57-31 = 26
   Number of electrons of B is the same as for C = No. of Protons
   B = 26 protons
5. $\frac{69.09}{100} \times 62.93 + \frac{30.91}{100} \times 64.93$ ✓1½
   43.4783 + 20.0698 ✓1
   = 63.548 ≃ 63.55 ✓1
6. $\frac{63x + 65(100 - x)}{100} = 63.55$
   $63x + 6500 - 65x = 6355$
   $2x = 6355 - 6500$
   $2x = -145$
   $X = 72.5$

% abundance of ^{63}M = 72.5%
^{65}M = 27.5%

7. *a) Valency of G is 3*
b) G is a group 3 element

8. *a) i) 11 protons*
ii) 16 protons
b) Formula of compound = T2Z
Mass number of T = 11+ 12 = 23
Mass number of 2 = 16+16 = 32
Formula Mass of T2Z = (23x2) + 32 = 78
c) – When molten
- When in aqueous solution

9. *Silicon (iv) Oxide has giant atomic structure with strong covalent bond holding the atom together. These require a lot of energy to break, hence it has high melting point. Carbon (IV) Oxide has simple molecular structure with weakVan Der Waals forces holding the molecules together which require little energy to break, hence sublimes at low temperature and is a gas at room temperature and pressure*

10. *O_2 2.8 O 2.6*
The oxide ions has 2 extra electrons that causes greater electron repulsion than in oxygen atom

11. *To separate samples of CUO and charcoal in test tubes, dilute mineral acid is added with shakingCuO black dissolves to form blue solution √ ½*
Charcoal does not dissolve in dilute mineral acids

12. $\frac{(90 \times 8) + 10Q}{100} = 28.3$ *(½mk)*
$100 \times \frac{2520 + 10Q}{100} = 28.3 \times 100$
$2520 + 10Q = 2830$ *(½mk)*
$10Q = 2830 - 2520$
$10Q = 310$
$Q = 31$
Electron arrangement of X = 284 (½mk)
Atomic No. = 14 (½mk)
No. neutrons = 31 – 14 = 17 (½mk)

13. *L_3 has delocalised electrons while the others has less*

14. *(a) Is a constant temperature at which a solid changed to a liquid/ A point at which a solid changes to a liquid which a solid changes to a liquid without change in temperature.*

15. *(a) P √½ and S √½ √*
They have the same atomic numbers. √ Both must be there to score 3
(b) 4 (7, -3) √

16. *a) B√½ - its ion has a stronger nuclear charge than that of A√1*
b) D√½ - has the weakest nuclear charge as compared to the other non- metals √1

17. *(a) CA √1*

(b) (i) E √1
(ii) B √1

(c) Period 3, √½ Group 2, √ ½

(d) (i) The atomic radius of F is greater than that of C √1 because F has more energy levels.
(ii) The atomic radius D is smaller than that of C √1 because of increased positive charge

in the nucleus which attracts the electrons more. ✓1

(e) (i) Electrovalent bond ✓ ½
(ii) Covalent bond ✓½

(f) (i) $4C + O_2 \quad 2C_2O$ ✓1
$G + O_2 \quad GO_2$ ✓1
(ii) C_2O is basic while ✓1
GO_2 is acidic. ✓1

18. *(a) B – ammonia gas ✓1*
C - nitrogen (II) oxide (NO) ✓1
E – water ✓1
F – unreacted gases ✓1

(b) The mixture of ammonia and air is passed through heated/ catalyst where ammonia (II) is oxidized to nitrogen (II) oxide. ✓1

(c) Gases are cooled and air passed through heated/ catalyst where ammonia is further oxidized to nitrogen(IV) oxide. ✓1

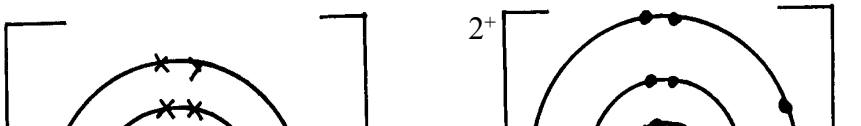
(d) Fractional distillation, ✓½
Water with a lower boiling point ✓½ than nitric (V) acid, distills left leaving the concentrates acid.

19. *(a) (i) C* ✓1
(ii) D or E ✓1
(iii) F ✓1
(iv) D or E
(v) A ✓1
(vi) D ✓1

(b) Atomic radius of Y is smaller than that of X. The effective nuclear charger in Y is greater than in X hence outer electrons strongly ✓½ *pulled to the centre reducing the radius.* ✓½

(b) (i) ✓½
(ii) Period – 3 ✓½ *Group – IV*
(c) (i) On the grid (period 2 Group 7) ✓1
(ii) Halogen ✓1
(iii) – Used in hospitals with patients with breathing difficulties ✓1
- Used by mountain climbers and deep sea divers
(iv) Basic ✓1

20. *A (i) P – ionic configuration - 2*
- Formula of oxide – PO
Q – Atomic number – 20
R- Atomic number – 19
T – Ionic configuration – 2.8.8
Formula of oxide – TO2
(ii) R – Has the largest atom with one outer electron hence easily loses it.
(iii) S – is the smallest atom of a non-metal with a deficit of only one electron hence easily gains.
(iv)

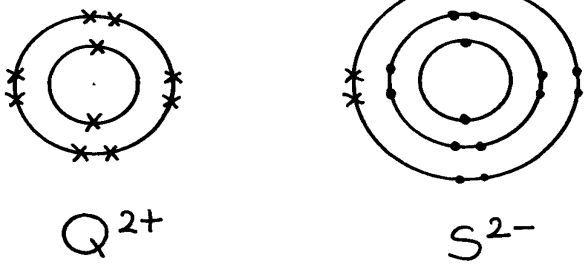


Q^{2+} $2Cl^-$

(v) T is insoluble – It has a molecular structure/non-metal
(B)(i) It is coated with an un reactive layer of aluminium oxide which prevents it form reacting.
(ii) Valency – The number of electrons an atom gains or loses during a reaction.
Oxidation number – The resultant charge of an atom has after gaining or loosing electrons.

21. a) +3 + P = (-2x3)= 0
+3+P – 6 = 0
P = +3✓
b) Mg- its oxidation state increases from Zero to +2 ✓ 1 mark

22. a) Group 1 – Because √½ it has 1 electron in its outermost energy level.
Group 7 – It requires √½ 1 electron to fill its outermost energy level.
b) Alkaline earth metals √1
c) PV_2 √1
d) Q has higher √½ m.p than J. Q has a giant metallic structure and strong metallic bonds. √½
While J has molecular structure and Vander
Waals forces which are easy to break. √½
e) R. √1
f) T(s) + O_2(g) TO_2(g) √1
g)



h) – Filling electric light bulb √1 accept any other correct one.

23. (a) (i) X Rj: If actual symbols are given.

(ii) Q. Rj. Actual symbols.
Explanation: It looses the outermost energy level most readily.

(iii) Halogens

(iv) I). Moving across a period there is increased nuclear charge.
II). Going down a group the energy levels increase in number.

(v) V- Explanation It has a complete outermost energy level/ Has a stable octet.

(vi) Z_2R Rej. Interchange of letters, RZ_2.

24. *a) i) I S √1- It readily gain one electron on ionization √1*
II Q - It readily give out one electron on ionization √1

ii) Alkali metals √1
iii) WS_3 √1
iv) Bond - covalent √½
Structure – Giant atomic structure √½
v) It is stable. Cant remove nor add electrons on its outermost energy level
vi) T has a smaller radius than Q because it has fewer energy levels than Q

25. *The melting point increases from A to C this is due to increase in number delocalized electron hence increase in the strength of metallic bond.*
D forms a giant structure with strong covalent bonds. Hence high melting.
It exhibits allstrophy ie may exist as two different form in the same state.
C2 $(SO_4)_3$
Noble gases or inert
Used in filament bubls
Used to produce an inert atmosphere in high temperature inetallurgical processes e.g welding.
C is amphoteric oxide
F acidic it is non –metal oxide.

Ethene

Acidified potassium Manganate VI abromine water it from a colourless solution

$CH_2CH_2 + H_2$ CH_3CH_3
Nickel catalyst

26. *a) 2 : 8*
b) W_2O_3
27. *i) Delocalized electrons*
ii) Mobile ions
iii) Mobile ions

28. *- Sodium has a larger raius than aluminium*
- Aluminium has more protons than sodium hence a more effective nuclear charge than sodium
29. *a) 2.5*
b) Q Group 1 ✓½, Period 4 ✓½
R Group 2 ✓½, Period 3 ✓½
30. *Ethanol contains molecules ✓1 which are not ✓1 responsible for electrical conductivity. (2 mks)*
31. *a (i) Q*
(ii) R
32. *(a) K and N because they have the same number of electrons on their outermost energy level ✓*
(b) L_2O_7
(c) L_1 because it has 7 electrons on the outermost energy level or reacts by gaining electrons ✓ or the ionic radius is larger than the atomic radius (½mk)
33. *a) Formula; J_5G_2 √1*
b) E form ironic structures due to ionic bonding in its oxide. While G form molecular

structure due to covalent bonding in it oxide