SOLUTION TO 5070/12/M/J/20

QUICK ACCESS GRID

The solution to a particular question can be accessed instantly by clicking on the desired question number in the QUICK ACCESS GRID.

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36	37	38	39	40

S1

D

The pipette should always be filled to the same level as it has been calibrated to measure one particular volume accurately (as can be seen from **one calibration mark** on it).

one calibration mark

BACK TO QUICK ACCESS GRID

S2

D

measuring cylinder: 50 cm^3 aqueous sodium thiosulfate + acid

stop-clock: to measure the time taken for the cross to no longer be seen

thermometer: to measure different temperatures

BACK TO QUICK ACCESS GRID

S3

A

Under the conditions of the experiment, the R_f of Fe^{3+} (aq) is given by $\frac{x}{y}$ and the colour of the precipitate is **red-brown**.

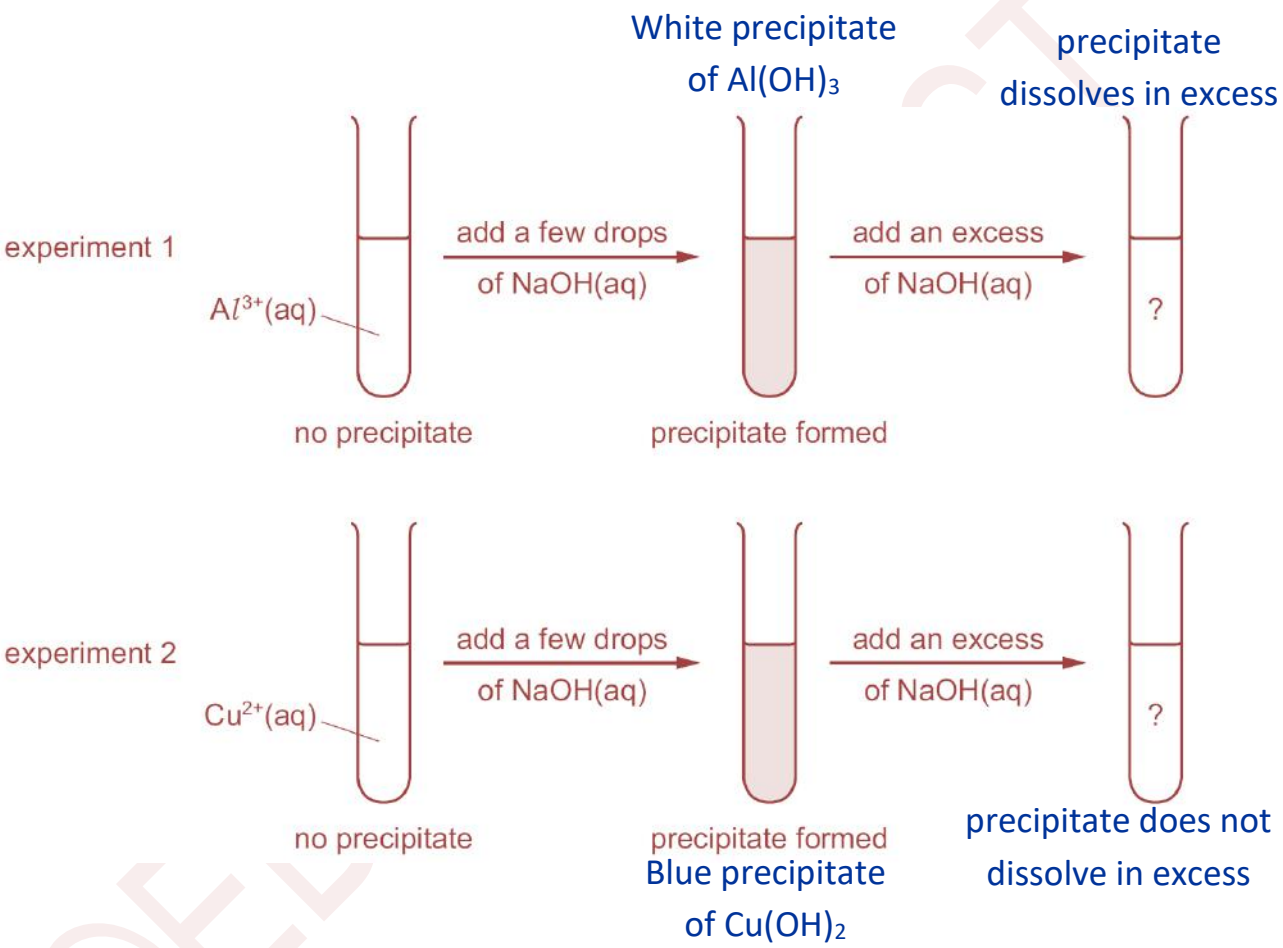
R_f value = distance travelled by solute front ÷ distance travelled by solvent front

Precipitate of Iron (III) hydroxide is red-brown in colour.

BACK TO QUICK ACCESS GRID

S4

C



BACK TO QUICK ACCESS GRID

S5

C

Crystallisation and **distillation** require a change of state from liquid to gas.

In crystallisation, crystals of a soluble compound are obtained by evaporation of the solvent from the solution.
Evaporation is a change of state from liquid to gas.

In distillation, the solution is heated to boiling point.
The solvent boils over and passes through a condensor where the solvent vapours are condensed to obtain the pure liquid.
Boiling is a change of state from liquid to gas.

BACK TO QUICK ACCESS GRID

S6

D

M_r of H_2S = 34

M_r of HCl = 36.5

Lower the M_r, lighter the molecules, faster the rate of diffusion of the gas.

H_2S gas therefore diffuses at a faster rate than HCl gas.

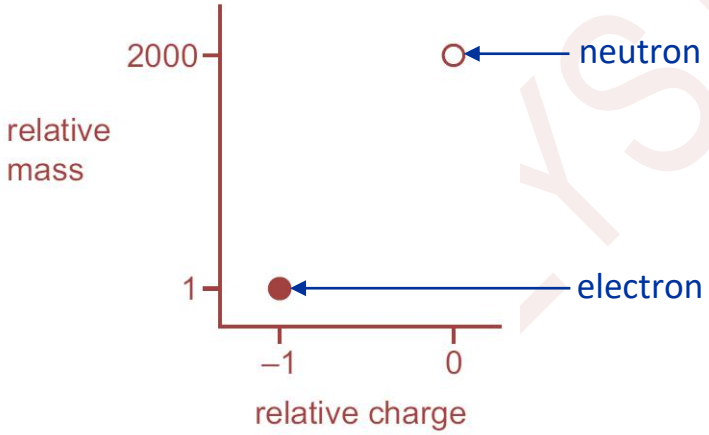
At a higher temperature, the gas molecules have a higher average kinetic energy and move faster.

The rate of diffusion of H_2S gas is therefore greater at –20°C than at –40°C.

BACK TO QUICK ACCESS GRID

S7

C



A ^{1}H atom has one proton and one electron. It does not possess a neutron.

A $^{1}H^{+}$ ion has is formed by the loss on an electron from ^{1}H atom. It has one proton only.

BACK TO QUICK ACCESS GRID

S8

D

Ion	Electronic configuration	Number of shells that contain electrons
Al^{3+}	2.8	2
Be^{2+}	2	1
N^{3-}	2.8	1
S^{2-}	**2.8.8**	**3**

BACK TO QUICK ACCESS GRID

S9

A

A metal conducts electricity both when solid and when molten.
An alloy is a homogeneous mixture of a metal with other elements.
The properties of the constituents are largely retained in a mixture. An alloy can therefore conduct electricity.

BACK TO QUICK ACCESS GRID

S10

C

Lithium is a metal. Oxygen is a non-metal.

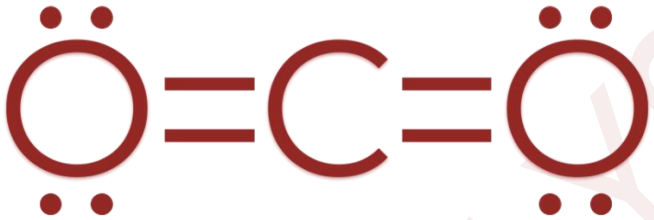
A metal and a non-metal react to form an ionic compound.

Lithium and Oxygen form an ionic compound.

BACK TO QUICK ACCESS GRID

S11

C



Number of shared electrons in one carbon dioxide molecule = 8

One — = 2 electrons

BACK TO QUICK ACCESS GRID

S12

B

Element X has a lattice of positive ions and a 'sea of electrons' → metallic bonding.

Element X is a metal. It has a high melting point.

It conducts electricity by the movement of delocalised electrons and is malleable.

BACK TO QUICK ACCESS GRID

S13

D

$CaCO_3\,(g) + 2HCl\,(aq) \rightarrow CaCl_2\,(aq) + H_2O\,(l) + CO_2\,(g)$

BACK TO QUICK ACCESS GRID

S14

B

The relative atomic mass of an element is the average mass of one atom of that element in relation to the $^1/_{12}$ of the mass of one atom of C–12.

$$A_r \text{ (fluorine)} = \frac{\text{average mass of one atom of fluorine}}{\frac{1}{12} \text{ of the mass of one atome of } {}^{12}_{6}C}$$

BACK TO QUICK ACCESS GRID

S15

B

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

For gases, mole ratio = volume ratio.

Volume of O_2 in 100 cm^3 of air = 20 cm^3

5 cm^3 of CH_4 gas reacts completely with 10 cm^3 of O_2 gas to form 5 cm^3 of CO_2 gas.

10 cm^3 of O_2 gas remains unreacted.

BACK TO QUICK ACCESS GRID

S16

A

Electroplating essentials:

Object to be plated: cathode

Pure metal of which plating is to be done: anode

Electrolyte: solution containing metal ions of metal of which plating is to be done

To electroplate Copper onto a steel key:

Object to be plated: steel key → cathode

Pure metal of which plating is to be done: piece of pure copper → anode

Electrolyte: solution containing Cu^{2+} ions → aqueous copper(II) sulfate

BACK TO QUICK ACCESS GRID

S17

B

X is above sodium in the reactivity series. It is therefore above Hydrogen as well.

H^+ ions are discharged at the cathode in preference to ions of metal X.

Hydrogen gas is formed at the cathode.

BACK TO QUICK ACCESS GRID

S18

A

Adding a catalyst lowers the activation energy of a reaction by providing an alternative reaction pathway.

BACK TO QUICK ACCESS GRID

S19

A

All three equations show redox reactions.

NOTE:

Reactions involving elements as reactants / products / both are generally redox reactions.

BACK TO QUICK ACCESS GRID

S20

C

Ethanoic acid is a weak acid whereas Hydrochloric acid is a strong acid.

Strong acids dissociate completely in aqueous solution to produce a high concentration of Hydrogen ions.
Weak acids dissociate partially in aqueous solution to produce a low concentration of Hydrogen ions.

Higher the concentration of Hydrogen ions, lower the pH.

Hydrochloric acid therefore has a lower pH than Ethanoic acid of the same concentration.

BACK TO QUICK ACCESS GRID

S21

B

Liberation of Ammonia from ammonium salts is a characteristic reaction of oxides and hydroxides.

Potassium hydroxide liberates ammonia from ammonium nitrate on warming.

BACK TO QUICK ACCESS GRID

S22

A

80 g of NH_4NO_3 contains 28 g of N.

Mass of N in 500 g of NH_4NO_3

$= \frac{500 \times 28}{80}$ = 175 g

132 g of $(NH_4)_2SO_4$ contains 28 g of N.

Mass of N in 500 g of $(NH_4)_2SO_4$

$= \frac{500 \times 28}{132}$ = 106 g (3 sf)

Total mass of N in 1 kg of fertilizer X
= 175 + 106 = 281 g

Mass of N in 700 g of $(NH_4)_2SO_4$

$= \frac{700 \times 28}{132}$ = 148 g (3 sf)

Total mass of N in 1 kg of fertilizer X
= 148 g

∴ Percentage of nitrogen by mass in X > Percentage of nitrogen by mass in Y

132 g of $(NH_4)_2SO_4$ contains 32 g of S.

Mass of S in 500 g of $(NH_4)_2SO_4$

$= \frac{500 \times 32}{132}$ = 121 g (3 sf)

136 g of $CaSO_4$ contains 32 g of S.

Total mass of S in 1 kg of fertilizer X
= 121 g

Mass of S in 300 g of $CaSO_4$

$= \frac{300 \times 32}{136}$ = 71 g (3 sf)

Total mass of S in 1 kg of fertilizer Y
= 71 g

∴ Percentage of Sulfur by mass in X > Percentage of Sulfur by mass in Y

BACK TO QUICK ACCESS GRID

S23

C

Processes that occur in the manufacture of Sulfuric acid:

- burning Sulfur in air to form Sulfur dioxide gas **(1)**
- reacting Sulfur dioxide with air to form Sulfur trioxide gas **(4)**
- dissolving Sulfur trioxide in concentrated Sulfuric acid to form oleum
- diluting oleum by addition to water to form Sulfuric acid

BACK TO QUICK ACCESS GRID

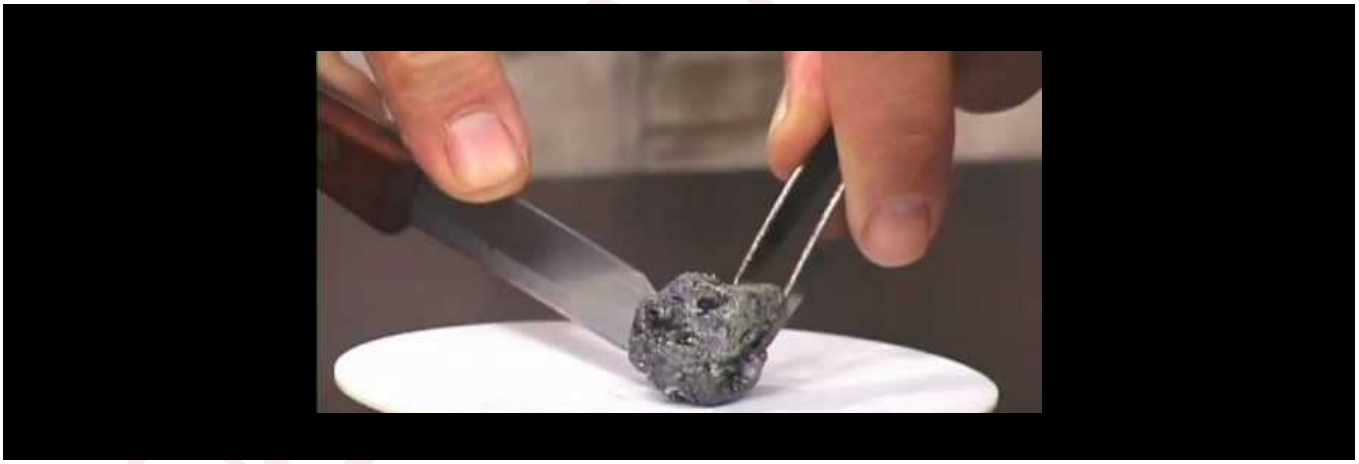
S24

D

The properties described in the question are typical of Alkali metals (Group I).

Element X is **Potassium**.

NOTE:
Alkali metals are soft; they can be cut easily with a knife.
They have low densities and react readily with water.
The density of Li, Na, and K is lower than water.
K therefore fizzes on the surface of water.



BACK TO QUICK ACCESS GRID

S25

A

	KI(aq)	KBr(aq)
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = yes

✗ = no

A more reactive halogen can displace a less reactive halogen from its halide solution.

The reactivity of group VII elements decreases down the group.

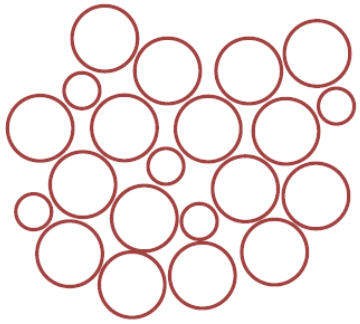
Chlorine is more reactive than both, Bromine and Iodine. It can therefore displace Iodine from KI (aq) as well as Br_2 from KBr (aq).

BACK TO QUICK ACCESS GRID

S26

A

Diagram A represents an alloy. An alloy is a homogeneous mixture of a metal with other elements.
Diagram A has differently sized particles.
All other diagrams represent elements as they have particles of the same type.



BACK TO QUICK ACCESS GRID

S27

A

Calcium can only be extracted from its ore using electrolysis as it is a reactive metal and is above Carbon on the reactivity series.

Copper, Lead, and Silver are below Carbon on the reactivity series and can be extracted from their ores by –

- electrolysis
- reduction of metal oxides with carbon

BACK TO QUICK ACCESS GRID

S28

C

$CaCO_3 \rightarrow CaO + CO_2$

$CaCO_3$ (limestone) decomposes in the blast furnace to produce CaO (lime) and CO_2 (carbon dioxide). The reaction is endothermic.

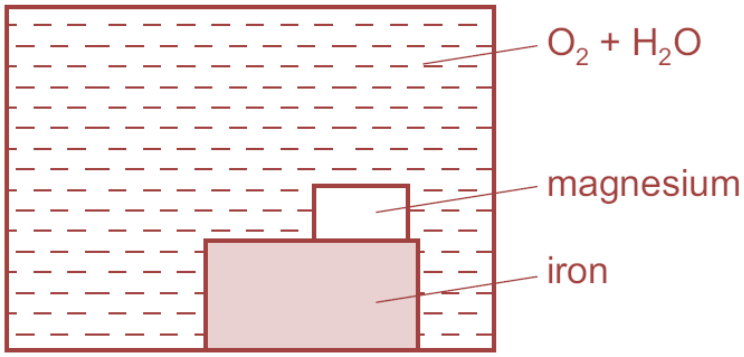
BACK TO QUICK ACCESS GRID

S29

D

Conditions necessary for the rusting of Iron: **Presence of Oxygen and water (O_2 + H_2O)**

Metal that can be used to prevent rusting by sacrificial protection:
metal that is more reactive than Iron and moderately reactive with Oxygen and water like **Magnesium**



BACK TO QUICK ACCESS GRID

S30

A

Overall reaction for the electrolysis of molten aluminium oxide:

$2Al_2O_3$ (l) → 4Al (l) + $3O_2$ (g)

The molar ratio of aluminium to oxygen gas formed is 4 : 3.

Oxygen gas is formed at the anode by the oxidation of O^{2-} ions.

Al is formed at the cathode by the reduction of Al^{3+} ions.

BACK TO QUICK ACCESS GRID

S31

B

Carbon dioxide → CO_2

Methane → CH_4

Both contain Carbon. Both are greenhouse gases.

Only Carbon dioxide lowers the pH of water when dissolved in it as it is an acidic oxide.

Methane is a neutral gas. It does not affect the pH of water when dissolved in it.

BACK TO QUICK ACCESS GRID

S32

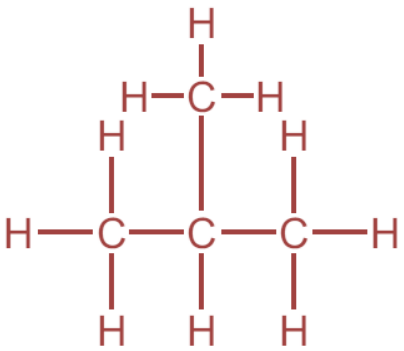
C

Desalination involves separating the water by **distillation**.

BACK TO QUICK ACCESS GRID

S33

C



Isomers are compounds with the same molecular formula but different structural formulae.

Structures A and B represent Butane. Structure C represents an isomer of Butane: 2-methyl propane. The molecular formula of A, B, and C is C_4H_{10}.

Structure D represents cyclobutane. The molecular formula of D is C_4H_8.

BACK TO QUICK ACCESS GRID

S34

D

All of the listed organic compounds are hydrocarbons – compounds containing C and H atoms only.

CH_4, C_2H_6, and C_3H_8 are saturated hydrocarbons (alkanes).

C_2H_4 is an unsaturated hydrocarbon (alkene) and can decolourise bromine water.

BACK TO QUICK ACCESS GRID

S35

C

An alkene molecule contains four fewer hydrogen atoms than an alkane molecule with the same number of carbon atoms. ✗

An alkene molecule contains **two** fewer hydrogen atoms than an alkane molecule with the same number of carbon atoms.

If a food is described as polyunsaturated it means that it contains polymers. ✗

If a food is described as polyunsaturated it means that it contains unsaturated compounds with several C=C bonds.

Propene reacts with steam to form propanol. ✓

$C_3H_6 + H_2O \rightarrow C_3H_7OH$

The general formula for the alkenes is C_nH_{2n+2}. ✗

The general formula for the alkenes is C_nH_{2n}.

BACK TO QUICK ACCESS GRID

S36

B

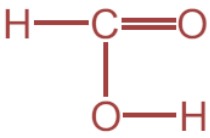
Ethanol

- used as a solvent
- used as a renewable fuel
- can be oxidised to produce ethanoic acid which is used to produce Vinegar

BACK TO QUICK ACCESS GRID

S37

A



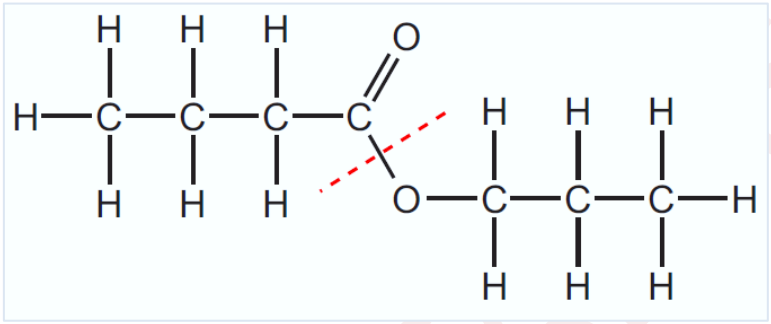
Structures A and B show carboxylic acids.

Structure A has a lower relative molecular mass than B as it has fewer Carbon and Hydrogen atoms than B.

BACK TO QUICK ACCESS GRID

S38

B



The ester shown is derived from Butanoic acid and Propanol.

First part of the ester name is derived from the alcohol.

Propanol → Propyl

Second part of the ester name is derived from the acid.

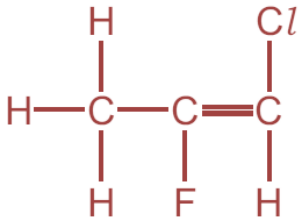
Butanoic acid → butanoate

Name of the ester shown: **Propyl butanoate**

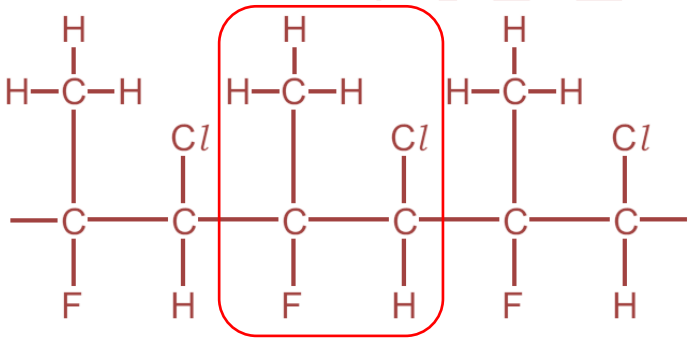
BACK TO QUICK ACCESS GRID

S39

D



addition polymerisation



repeat unit

NOTE:

structure of the repeat unit = structure of the monomer with a C–C instead of C=C

BACK TO QUICK ACCESS GRID

S40

D

Nylon and Terylene are produced by addition polymerisation. ✗

Nylon and Terylene are produced by **condensation** polymerisation.

Nylon and Terylene both contain the amide linkages. ✗

Nylon contains amide linkages while Terylene contains ester linkages.

Simple sugars are produced by hydrolysing proteins. ✗

Simple sugars are produced by hydrolysing carbohydrates.
Hydrolysis of proteins produces amino acids.

Starch contains the elements carbon, hydrogen and oxygen. ✓

Starch is a complex carbohydrate.
It is a natural condensation polymer formed from Glucose (simple sugar).

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