CHEMISTRY MULTIPLE CHOICE QUESTIONS

A. Atoms, molecules and stoichiometry

2002 -2014
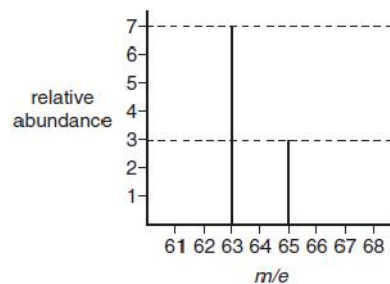
As a simplification, an adult human can be considered to have a daily diet of 1.80 kg of carbohydrate (empirical formula CH_2O).

Which mass of carbon dioxide does a person produce each day if all the carbohydrate eaten is digested and oxidised?

A 0.267 kg   B 0.800 kg   C 1.32 kg   D 2.64 kg

<div align="right">[2002 M/J (2)]</div>

The diagram shows the mass spectrum of a sample of naturally-occurring copper.

What is the relative atomic mass of this copper?

A 63.3   B 63.5   C 63.6   D 64.0

<div align="right">[2002 M/J (3)]</div>

Which pairs of compounds have the same empirical formula?

1 ethane and ethene

2 ethene and cyclohexane

3 cyclohexane and oct-1-ene

<div align="right">[2002 M/J (31)]</div>

A mixture of $10 \, cm^3$ of methane and $10 \, cm^3$ of ethane was sparked with an excess of oxygen. After cooling to room temperature, the residual gas was passed through aqueous potassium hydroxide.

What volume of gas was absorbed by the alkali?

A $15 \, cm^3$

B $20 \, cm^3$

C $30 \, cm^3$

D $40 \, cm^3$

<div align="right">[2002 O/N (1)]</div>

Which compounds have the empirical formula CH_2O?

1 methanal

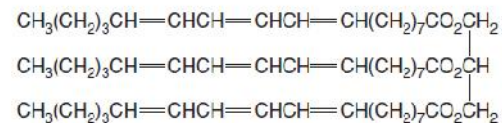2 ethanoic acid

3 methyl methanoate

<div align="right">[2002 O/N (31)]</div>

What is the number of molecules in $500 \, cm^3$ of oxygen under room conditions?

A 1.25×10^{22}

B 1.34×10^{22}

C 3.0×10^{22}

D 3.0×10^{26}

<div align="right">[2003 M/J (1)]</div>

In the preparation of soft margarine, glyceryl trieleostearate

$$CH_3(CH_2)_3CH={}CHCH={}CHCH={}CH(CH_2)_7CO_2CH_2$$
$$CH_3(CH_2)_3CH={}CHCH={}CHCH={}CH(CH_2)_7CO_2CH$$
$$CH_3(CH_2)_3CH={}CHCH={}CHCH={}CH(CH_2)_7CO_2CH_2$$

is suitably hydrogenated so that, on average, one of its side-chains is converted into the $CH_3(CH_2)_4CH=CHCH_2CH=CH(CH_2)_7CO_2$ residue and two side-chains are converted into the $CH_3(CH_2)_7CH=CH(CH_2)_7CO_2$ residue.

How many moles of hydrogen are required to convert one mole of glyceryl trieleostearate into the soft margarine?

A 4   B 5   C 6   D 9

<div align="right">[2003 M/J (2)]</div>

Use of the Data Booklet is relevant to this question.

Analytical chemists can detect very small amounts of amino acids, down to $3 \times 10^{-21} \, mol$. How many molecules of an amino acid ($M_r = 200$) would this be?

A 9   B 200   C 1800   D 360 000

<div align="right">[2003 O/N (1)]</div>

2

Use of the Data Booklet is relevant to this question.

A garden fertiliser is said to have a phosphorus content of 30.0% 'P_2O_5 soluble in water'.

What is the percentage by mass of phosphorus in the fertiliser?

A   6.55%   B   13.1%   C   26.2%   D   30.0%

One mole of each of the following compounds is strongly heated and any gas produced is collected at room temperature and pressure.

From which compound is 24 dm^3 of gas likely to be collected?
[One mole of any gas occupies 24 dm^3 at room temperature and pressure.]

A $MgCl_2$ B $MgCO_3$ C $Mg(NO_3)_2$ D $Mg(OH)_2$

Which of these samples of gas contains the same number of atoms as 1g of hydrogen (M_r : H_2, 2)?

A   22g of carbon dioxide (M_r : CO_2, 44)

B   8g of methane (M_r : CH_4, 16)

C   20g of neon (M_r : Ne, 20)

D   8g of ozone (M_r : O_3, 48)

Use of the Data Booklet is relevant to this question.

Most modern cars are fitted with airbags. These work by decomposing sodium azide to liberate nitrogen gas, which inflates the bag.

$$2NaN_3 \rightarrow 3N_2 + 2Na$$
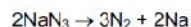
A typical driver's airbag contains 50 g of sodium azide.

Calculate the volume of nitrogen this will produce at room temperature.

A   9.2 dm^3 B   13.9 dm^3 C   27.7 dm^3 D   72.0 dm^3

Which substance, in 1 mol dm^{-3} aqueous solution, would have the same hydrogen ion concentration as 1 mol dm^{-3} of hydrochloric acid?

A   ethanoic acid

B   nitric acid

C   sodium hydroxide

D   sulphuric acid

Granular urea, CON_2H_4, can be used to remove NO_2 from the flue gases of power stations, converting it into harmless nitrogen.
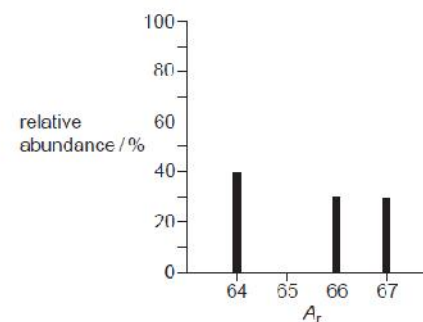
$$2CON_2H_4 + xNO_2 \rightarrow 2CO_2 + yH_2O + zN_2$$
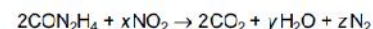
What are the values of x, y and z in a balanced equation?

	x	y	z
A	1½	2	1¼
B	2	4	3
C	3	4	3½
D	3	4	3

The diagram shows the mass spectrum of a sample of zinc. Use the data to calculate the relative atomic mass of the sample.
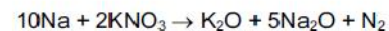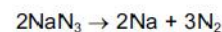

A   65   B   65.25   C   65.5   D   65.66

On collision, airbags in cars inflate rapidly due to the production of nitrogen.

The nitrogen is formed according to the following equations.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

$$10Na + 2KNO_3 \rightarrow K_2O + 5Na_2O + N_2$$

How many moles of nitrogen gas are produced from 1 mol of sodium azide, NaN_3?

A   1.5   B   1.6   C   3.2   D   4.0

The petrol additive tetraethyl-lead(IV), $Pb(C_2H_5)_4$, is now banned in many countries. When it is completely burned in air, lead(II) oxide, CO_2 and H_2O are formed.

How many moles of oxygen are required to burn one mole of $Pb(C_2H_5)_4$?

A 9.5   B 11   C 13.5   D 27

[2005 O/N (1)]

Chlorine dioxide is produced on a large scale as it is used for bleaching paper pulp. It is made by the following reaction.

$$2ClO_3(aq) + SO_2(g) \rightarrow 2ClO_2(g) + SO_4^{2-} (aq)$$
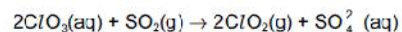
How do the oxidation numbers of chlorine and sulphur change in this reaction?

	chlorine	sulphur
A	decreases by 1	increases by 1
B	decreases by 1	increases by 2
C	decreases by 3	increases by 1
D	decreases by 3	increases by 2

[2005 O/N (9)]

Use of the Data Booklet is relevant to this question.

What volume of oxygen, measured under room conditions, can be obtained from the thermal decomposition of 8.2g of calcium nitrate ($M_r = 164$)?

A $150\,cm^3$ B $300\,cm^3$ C $600\,cm^3$ D $1200\,cm^3$

[2005 O/N (15)]
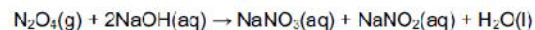
The relative molecular mass of a molecule of chlorine is 72.

Which properties of the atoms in this molecule are the same?

1 radius

2 nucleon number

3 relative isotopic mass

[2005 O/N (31)]

N_2O_4 is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide.

$$N_2O_4(g) + 2NaOH(aq) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$$

What is the minimum volume of $0.5\,mol\,dm^{-3}$ NaOH(aq) needed to dispose of 0.02 mol of N_2O_4?

A $8\,cm^3$ B $12.5\,cm^3$ C $40\,cm^3$ D $80\,cm^3$

[2006 M/J (1)]

A sample of chlorine containing isotopes of mass numbers 35 and 37 was analysed in a mass-spectrometer.

How many peaks corresponding to Cl_2^+ were recorded?

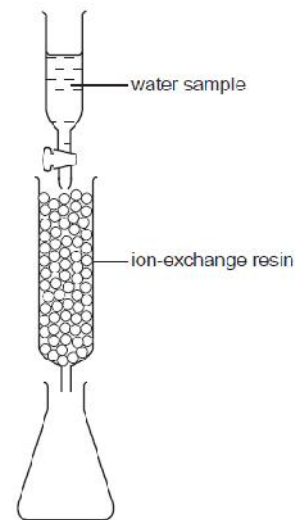A 2   B 3   C 4   D 5

[2006 M/J (2)]

Use of the Data Booklet is relevant to this question.

What mass of solid residue can be obtained from the thermal decomposition of 4.10 g of anhydrous calcium nitrate?

A 0.70g   B 1.00g   C 1.40g   D 2.25g

[2006 M/J (16)]

The amount of calcium ions in a sample of natural water can be determined by using an ion-exchange column as shown in the diagram.


A $50\,cm^3$ sample of water containing dissolved calcium sulphate was passed through the ion-exchange resin. Each calcium ion in the sample was exchanged for two hydrogen ions. The resulting acidic solution collected in the flask required $25\,cm^3$ of $1.0 \times 10^{-2}\,mol\,dm^{-3}$ potassium hydroxide for complete neutralisation.

What was the concentration of the calcium sulphate in the original sample?

A $2.5 \times 10^{-3}\,mol\,dm^{-3}$

B $1.0 \times 10^{-2}\,mol\,dm^{-3}$

C $2.0 \times 10^{-2}\,mol\,dm^{-3}$

D $4.0 \times 10^{-2}\,mol\,dm^{-3}$

[2006 O/N (1)]

4

The isotopic composition of an element is indicated below.
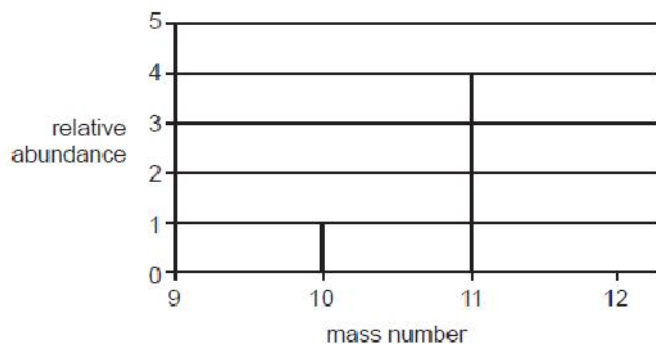
What is the relative atomic mass of the element?

A   10.2   B   10.5   C   10.8   D   11.0

Use of the Data Booklet is relevant to this question.

Oxides of nitrogen are pollutant gases which are emitted from car exhausts.

In urban traffic, when a car travels one kilometre, it releases 0.23 g of an oxide of nitrogen N_xO_y, which occupies 120 cm^3.
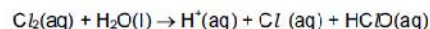
What are the values of x and y?
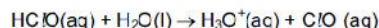(Assume 1 mol of gas molecules occupies 24.0 dm^3.)

A $x = 1, y = 1$

B $x = 1, y = 2$

C $x = 2, y = 1$

D $x = 2, y = 4$

In the treatment of domestic water supplies, chlorine is added to the water to form chloric(I) acid, $HClO$.

$$Cl_2(aq) + H_2O(l) \rightarrow H^+(aq) + Cl^-(aq) + HClO(aq)$$

This reacts further to give the chlorate(I) ion.

$$HClO(aq) + H_2O(l) \rightarrow H_3O^+(aq) + ClO^-(aq)$$

Both $HClO$ and ClO^- kill bacteria by oxidation.

What is the change in oxidation number of chlorine in forming the chlorate(I) ion from the aqueous chlorine?

A   −1   B   0   C   +1   D   +2

*Use of the Data Booklet is relevant to this question.*

When a sports medal with a total surface area of 150 cm^2 was evenly coated with silver, using electrolysis, its mass increased by 0.216 g.

How many atoms of silver were deposited per cm^2 on the surface of the medal?

A 8.0×10^{18}

B 1.8×10^{19}

C 1.2×10^{21}

D 4.1×10^{22}

The first stage in the manufacture of nitric acid is the oxidation of ammonia by oxygen.

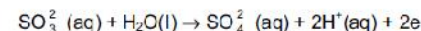$$wNH_3(g) + xO_2(g) \rightarrow yNO(g) + zH_2O(g)$$
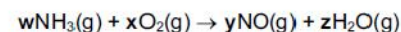
Which values for **w**, **x**, **y** and **z** are needed to balance the equation?

	w	x	y	z
A	4	5	4	6
B	4	6	4	5
C	5	6	5	4
D	6	5	6	4

In an experiment, 50.0 cm^3 of a 0.10 mol dm^{-3} solution of a metallic salt reacted exactly with 25.0 cm^3 of 0.10 mol dm^{-3} aqueous sodium sulphite.

The half-equation for oxidation of sulphite ion is shown below.

$$SO_3^{2-}(aq) + H_2O(l) \rightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2e$$

If the original oxidation number of the metal in the salt was +3, what would be the new oxidation number of the metal?

A   +1   B   +2   C   +4   D   +5

In the Basic Oxygen steel-making process the P_4O_{10} impurity is removed by reacting it with calcium oxide. The only product of this reaction is the salt calcium phosphate, $Ca_3(PO_4)_2$.

In this reaction, how many moles of calcium oxide react with one mole of P_4O_{10}?

A   1   B   1.5   C   3   D   6

Use of the Data Booklet is relevant to this question.

A typical solid fertiliser for use with household plants and shrubs contains the elements N, P, and K in the ratio of 15g :30g :15g per 100g of fertiliser. The recommended usage of fertiliser is 14g of fertiliser per 5 dm^3 of water.

What is the concentration of nitrogen atoms in this solution?

A   0.03 mol dm^{-3}

B   0.05 mol dm^{-3}

C   0.42 mol dm^{-3}

D   0.75 mol dm^{-3}

[2008 M/J (2)]

*Use of the Date Booklet is relevant to this question.*

Titanium(IV) oxide, TiO_2, is brilliantly white and much of the oxide produced is used in the manufacture of paint.

What is the maximum amount of TiO_2 obtainable from 19.0 tonnes of the ore ilmenite, $FeTiO_3$?

A   10.0 tonnes   B   12.7 tonnes   C   14.0 tonnes   D   17.7 tonnes

[2008 O/N (1)]

Carbon disulphide vapour burns in oxygen according to the following equation.

$$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$$
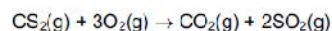
A sample of 10 cm^3 of carbon disulphide was burned in 50 cm^3 of oxygen. After measuring the volume of gas remaining, the product was treated with an excess of aqueous sodium hydroxide and the volume of gas measured again. All measurements were made at the same temperature and pressure, under such conditions that carbon disulphide was gaseous.

What were the measured volumes?

	volume of gas after burning / cm^3	volume of gas after adding NaOH(aq)/cm^3
A	30	0
B	30	20
C	50	20
D	50	40

[2008 O/N (2)]

*Use of the Data Booklet is relevant to this question.*

In leaded petrol there is an additive composed of lead, carbon and hydrogen only. This compound contains 29.7% carbon and 6.19% hydrogen by mass.

What is the value of x in the empirical formula PbC_8H_x?

A   5   B   6   C   16   D   20

[2009 M/J (1)]

A household bleach contains sodium chlorate(I), NaClO, as its active ingredient. The concentration of NaClO in the bleach can be determined by reacting a known amount with aqueous hydrogen peroxide, H_2O_2.
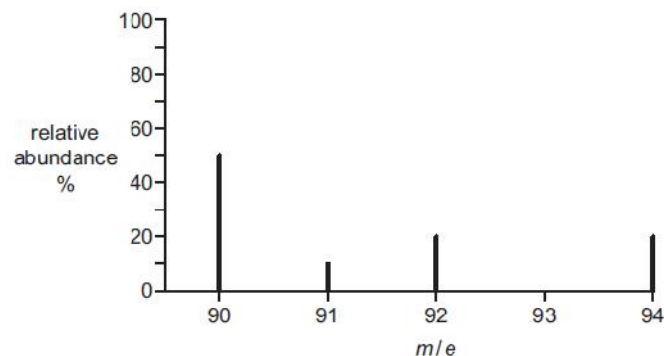
$$NaClO(aq) + H_2O_2(aq) \rightarrow NaCl(aq) + O_2(g) + H_2O(l)$$
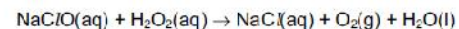
When 25.0 cm^3 of bleach is treated with an excess of aqueous H_2O_2, 0.0350 mol of oxygen gas is given off.

What is the concentration of NaClO in the bleach?

A 8.75×10^{-4} mol dm^{-3}

B   0.700 mol dm^{-3}

C   0.875 mol dm^{-3}

D   1.40 mol dm^{-3}

[2009 M/J (2)]

An element X consists of four isotopes. The mass spectrum of X is shown in the diagram.

What is the relative atomic mass of X?

A   91.00   B   91.30   C   91.75   D   92.00
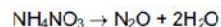
[2009 O/N – 11 (1)]

0.200 mol of a hydrocarbon undergo complete combustion to give 35.2 g of carbon dioxide and 14.4 g of water as the only products.

What is the molecular formula of the hydrocarbon?

A C_2H_4 B C_2H_6 C C_4H_4 D C_4H_8

[2009 O/N – 11 (2)]

6

Ammonium nitrate, NH_4NO_3, can decompose explosively when heated.

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

What are the changes in the oxidation numbers of the two nitrogen atoms in NH_4NO_3 when this reaction proceeds?

A −2, −4   **B** +2, +6   **C** +4, −6   **D** +4, −4

[2010 M/J – 11 (6)]

Use of the Data Booklet is relevant to this question.

2.920 g of a Group II metal, **X**, reacts with an excess of chlorine to form 5.287 g of a compound with formula XCl_2.

What is metal **X**?

A barium

B calcium

C magnesium

D strontium

[2010 M/J – 11 (8)]

Which reactions are redox reactions?

1 $CaBr_2 + 2H_2SO_4 \rightarrow CaSO_4 + Br_2 + SO_2 + 2H_2O$

2 $CaBr_2 + 2H_3PO_4 \rightarrow Ca(H_2PO_4)_2 + 2HBr$

3 $CaBr_2 + 2AgNO_3 \rightarrow Ca(NO_3)_2 + 2AgBr$

[2010 M/J – 11 (32)]

Sulfur dioxide, SO_2, is added to wines to prevent oxidation of ethanol by air. To determine the amount of SO_2, a sample of wine is titrated with iodine, I_2. In this reaction, **one** mole of SO_2 is oxidised by **one** mole of I_2.

What is the change in oxidation number of sulfur in this reaction?

A +2 to +4   **B** +2 to +6   **C** +4 to +5   **D** +4 to +6

[2010 O/N -13 (4)]

Sulfur dioxide, SO_2, is added to wines to prevent oxidation of ethanol by air. To determine the amount of SO_2, a sample of wine is titrated with iodine, I_2. In this reaction, **one** mole of SO_2 is oxidised by **one** mole of I_2.

What is the change in oxidation number of sulfur in this reaction?

A +2 to +4   **B** +2 to +6   **C** +4 to +5   **D** +4 to +6

[2010 O/N -13 (5)]

Ammonium sulfate in nitrogenous fertilisers in the soil can be slowly oxidised by air producing sulfuric acid, nitric acid and water.

How many moles of oxygen gas are needed to oxidise completely one mole of ammonium sulfate?

A 1   **B** 2   **C** 3   **D** 4

[2010 O/N -13 (15)]

Disproportionation is the term used to describe a reaction in which a reactant is simultaneously both oxidised and reduced.

To which incomplete equations does the term disproportionation apply?

1 $Cl_2(g) + 2OH^-(aq) \rightarrow H_2O(l) + Cl^-(aq) + \ldots$

2 $3Cl_2(g) + 6OH^-(aq) \rightarrow 3H_2O(l) + ClO_3^-(aq) + \ldots$

3 $2NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + \ldots$

[2010 O/N -13 (34)]

In flooded soils, like those used for rice cultivation, the oxygen content is low. In such soils, anaerobic bacteria cause the loss of nitrogen from the soil as shown in the following sequence.

In which step is the change in oxidation number (oxidation state) of nitrogen different to the changes in the other steps?

$$NO_3^-(aq) \xrightarrow{\text{A}} NO_2^-(aq) \xrightarrow{\text{B}} NO(g) \xrightarrow{\text{C}} N_2O(g) \xrightarrow{\text{D}} N_2(g)$$
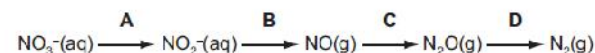
[2011 M/J – 11 (2)]

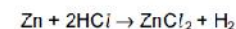0.02 mol of aluminium is burned in oxygen and the product is reacted with $2.00\ mol\ dm^{-3}$ hydrochloric acid.

What minimum volume of acid will be required for complete reaction?

A $15\ cm^3$ **B** $20\ cm^3$ **C** $30\ cm^3$ **D** $60\ cm^3$

[2011 M/J – 11 (13)]

Use of the Data Booklet is relevant to this question.

Zinc reacts with hydrochloric acid according to the following equation.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Which statements are correct?

[All volumes are measured at room conditions.]

1   A 3.27 g sample of zinc reacts with an excess of hydrochloric acid to give 0.050 mol of zinc chloride.

2   A 6.54 g sample of zinc reacts completely with exactly $100\ cm^3$ of $1.00\ mol\ dm^{-3}$ hydrochloric acid.

3   A 13.08 g sample of zinc reacts with an excess of hydrochloric acid to give $9.60\ dm^3$ of hydrogen.

[2011 M/J – 11 (33)]

7

Lead(IV) chloride will oxidise bromide ions to bromine. The Pb^{4+} ions are reduced to Pb^{2+} ions in this reaction.

If 6.980 g of lead(IV) chloride is added to an excess of sodium bromide solution, what mass of bromine would be produced?

A   0.799 g   B   1.598 g   C   3.196 g   D   6.392 g

When chlorine and aqueous sodium hydroxide are heated together the following overall reaction occurs.

$$3Cl_2(aq) + 6NaOH(aq) \rightarrow 5NaCl(aq) + NaClO_3(aq) + 3H_2O(l)$$

What are the oxidation numbers for chlorine in each of the following species?

	Cl_2	$NaCl$	$NaClO_3$
A	0	+1	–5
B	+2	–1	+3
C	0	–1	+5
D	–2	+1	–3

The oxide of titanium, TiO_2, is used as a 'whitener' in toothpaste. It is obtained from the ore iron(II) titanate, $FeTiO_3$.

What is the change, if any, in the oxidation number (oxidation state) of titanium in the reaction $FeTiO_3 \rightarrow TiO_2$?

A   It is oxidised from +3 to +4.

B   It is reduced from +3 to +2.

C   It is reduced from +6 to +4.

D   There is no change in the oxidation number.

The reaction between aluminium powder and anhydrous barium nitrate is used as the propellant in some fireworks. The metal oxides and nitrogen are the only products.

Which volume of nitrogen, measured under room conditions, is produced when 0.783 g of anhydrous barium nitrate reacts with an excess of aluminium?

A   46.8 cm^3 B   72.0 cm^3 C   93.6 cm^3 D   144 cm^3

In the treatment of domestic water supplies, chlorine is added to the water to form $HClO$.

$$Cl_2(aq) + H_2O(l) \rightarrow H^+(aq) + Cl^-(aq) + HClO(aq)$$
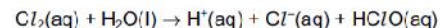
The $HClO$ reacts further to give ClO^- ions.

$$HClO(aq) + H_2O(l) \rightarrow H_3O^+(aq) + ClO^-(aq)$$

Both $HClO$ and ClO^- kill bacteria by oxidation.

What is the overall change in oxidation number of chlorine when forming the ClO^- ion from the aqueous chlorine?

A   –1   B   0   C   +1   D   +2

Ammonia and chlorine react in the gas phase.

$$8NH_3 + 3Cl_2 \rightarrow N_2 + 6NH_4Cl$$

Which statements are correct?

1   Ammonia behaves as a reducing agent.

2   Ammonia behaves as a base.

3   The oxidation number of the hydrogen changes

In which reaction does an element undergo the largest change in oxidation state?

A $Cl_2 + 2OH^- \rightarrow OCl^- + Cl^- + H_2O$

B $3Cl_2 + 6OH^- \rightarrow ClO_3^- + 5Cl^- + 3H_2O$

C $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

D $3MnO_4^{2-} + 4H^+ \rightarrow MnO_2 + 2MnO_4^- + 2H_2O$

The nitrates of beryllium, calcium, magnesium, and strontium all decompose in the same way when heated. When 2.00 g of one of these anhydrous nitrates is decomposed, 1.32 g of gas is produced.
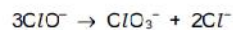
What is the nitrate?

A   beryllium nitrate

B   calcium nitrate

C   magnesium nitrate

D   strontium nitrate

Solutions containing chlorate(I) ions are used as household bleaches and disinfectants. These solutions decompose on heating as shown.

$$3ClO^- \rightarrow ClO_3^- + 2Cl^-$$

Which oxidation state is shown by chlorine in each of these three ions?

	ClO^-	ClO_3^-	Cl^-
A	+1	+3	−1
B	−1	+3	+1
C	+1	+5	−1
D	−1	+5	+1

[2013 M/J – 11 (1)]

A mixture of $10\,cm^3$ of methane and $10\,cm^3$ of ethane was sparked with an excess of oxygen. After cooling to room temperature, the residual gas was passed through aqueous potassium hydroxide.

All gas volumes were measured at the same temperature and pressure.

What volume of gas was absorbed by the alkali?

A $15\,cm^3$ 　　B $20\,cm^3$ 　　C $30\,cm^3$ 　　D $40\,cm^3$

[2013 M/J – 11 (2)]

A solution of Sn^{2+} ions will reduce an acidified solution of MnO_4^- ions to Mn^{2+} ions. The Sn^{2+} ions are oxidised to Sn^{4+} ions in this reaction.

How many moles of Mn^{2+} ions are formed when a solution containing $9.5\,g$ of $SnCl_2$ (M_r: 190) is added to an excess of acidified $KMnO_4$ solution?

A 0.010 　　B 0.020 　　C 0.050 　　D 0.125

[2013 M/J – 11 (11)]

Use of the Data Booklet is relevant to this question.

Magnesium nitrate, $Mg(NO_3)_2$, will decompose when heated to give a white solid and a mixture of gases. One of the gases released is an oxide of nitrogen, X.

$7.4\,g$ of anhydrous magnesium nitrate is heated until no further reaction takes place.

What mass of X is produced?

A 1.5 g 　　B 2.3 g 　　C 3.0 g 　　D 4.6 g

[2013 M/J – 11 (16)]

In which reaction does a single nitrogen atom have the greatest change in oxidation number?

A $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

B $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$

C $2NO + O_2 \rightarrow 2NO_2$

D $4NH_3 + 6NO \rightarrow 5N_2 + 6H_2O$

[2013 O/N – 11 (2)]

The following half reactions occur when potassium iodate(V), KIO_3, in hydrochloric acid solution oxidises iodine to ICl_2^-.

$$IO_3^- + 2Cl^- + 6H^+ + 4e^- \rightarrow ICl_2^- + 3H_2O$$

$$I_2 + 4Cl^- \rightarrow 2ICl_2^- + 2e^-$$

What is the ratio of IO_3^- to I_2 in the balanced chemical equation for the overall reaction?

A 1:1 　　　B 1:2 　　　C 1:4 　　　D 2:1

[2013 O/N – 11 (3)]

Use of the Data Booklet is relevant to this question.

A chemist took $2.00\,dm^3$ of nitrogen gas, measured under room conditions, and reacted it with a large volume of hydrogen gas, in order to produce ammonia. Only 15.0% of the nitrogen gas reacted to produce ammonia.

What mass of ammonia was formed?

A 0.213 g 　　B 0.425 g 　　C 1.42 g 　　D 2.83 g

[2014 M/J – 11 (18)]

In which reaction is the species in **bold** acting as an oxidising agent?

A **2Ca** + $O_2 \rightarrow 2CaO$

B $Cr_2O_7^{2-} + 8H^+ + \mathbf{3SO_3^{2-}} \rightarrow 2Cr^{3+} + 4H_2O + 3SO_4^{2-}$

C Mg + **Fe^{2+}** $\rightarrow Mg^{2+} + Fe$

D $\mathbf{SO_2} + 2H_2O + 2Cu^{2+} + 2Cl^- \rightarrow H_2SO_4 + 2H^+ + 2CuCl$

[2014 M/J – 12 (6)]

Ammonium sulfate in the soil is slowly oxidised by air, producing sulfuric acid, nitric acid and water as the only products.

How many moles of oxygen gas are needed for the complete oxidation of one mole of ammonium sulfate?

A 1 　　　B 2 　　　C 3 　　　D 4

[2014 M/J – 12 (14)]

9

When solid sodium iodide reacts with concentrated sulfuric acid, the products include $NaHSO_4$, H_2S, SO_2 and S.

In the formation of which product has the oxidation state of sulfur changed by a value of 8?

A H_2S **B** $NaHSO_4$ **C** S   **D** SO_2

[2014 M/J – 12 (17)]

Use of the Data Booklet is relevent to this question.

In an experiment, 0.125 mol of chlorine gas, Cl_2, is reacted with an excess of cold aqueous sodium hydroxide. One of the products is a compound of sodium, oxygen, and chlorine.

Which mass of this product is formed?

A 9.31 g   **B** 13.3 g   **C** 18.6 g   **D** 26.6 g

[2014 M/J – 12 (19)]