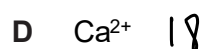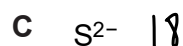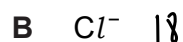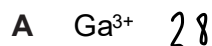# AS Level Chemistry A

**H032/01** Breadth in chemistry

# MCQ Question Set 1
# 2.1 Atoms and reactions

Multiple Choice Questions

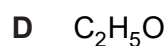1. Which ion has a different number of electrons from the other three ions?

   A   $Ga^{3+}$   28

   B   $Cl^-$   18

   C   $S^{2-}$   18
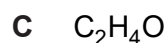
   D   $Ca^{2+}$   18

   Your answer   A
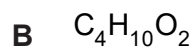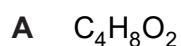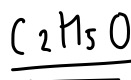
   [1]

2. An organic compound has the composition by mass:

   C, 53.33 %; H, 11.11%; O, 35.56%.

   What is the empirical formula of the organic compound?

   A   $C_4H_8O_2$

   B   $C_4H_{10}O_2$

   C   $C_2H_4O$

   D   $C_2H_5O$

   C: $53.33 \div 12 = 4.44 \div 2.223 = 2$
   H: $11.11 \div 1 = 11.11 \div 2.223 = 4.99 \approx 5$
   O: $35.56 \div 16 = 2.223 \div 2.223 = 1$

   $C_2H_5O$

   Your answer   D

   [1]

3. Samples of four hydrocarbons are completely burnt under the same conditions of temperature and pressure.

   Which sample produces the greatest volume of $CO_2$?

   A   0.4 mol $C_2H_6$   $\rightarrow$ $2CO_2$ $\Rightarrow$ $0.4 \times 2 = 0.8$

   B   0.3 mol $C_3H_8$   $\rightarrow$ $3CO_2$ $\Rightarrow$ $0.3 \times 3 \boxed{0.9}$

   C   0.2 mol $C_4H_{10}$   $\rightarrow$ $4CO_2$ $\Rightarrow$ $0.2 \times 4 = 0.8$

   D   0.1 mol $C_5H_{12}$   $\rightarrow$ $5CO_2$ $\Rightarrow$ $0.1 \times 5 = 0.5$
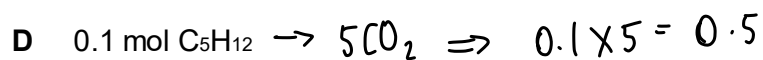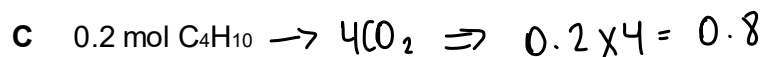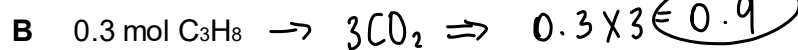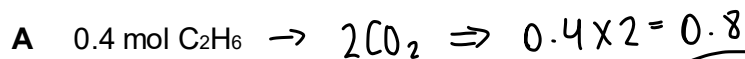
   Your answer   B

   [1]

**4.** Which reaction produces the smallest atom economy of $BaCl_2$? → Mr = 208.3

↳ largest number of products

85.2%    **A**    $BaCl_2 \cdot 2H_2O \rightarrow BaCl_2 + 2H_2O$

92.0%    **B**    $BaO + 2HCl \rightarrow BaCl_2 + H_2O$

77.1%    **C**    $BaCO_3 + 2HCl \rightarrow BaCl_2 + CO_2 + H_2O$

99.0%    **D**    $Ba + 2HCl \rightarrow BaCl_2 + H_2$

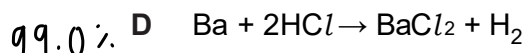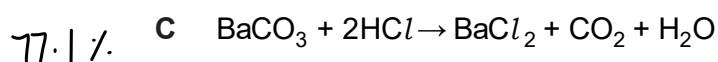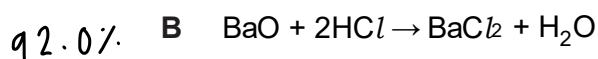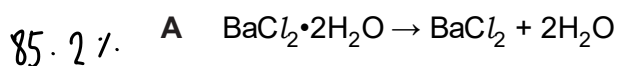atom economy = $\dfrac{Mr \text{ of product}}{\text{total Mr of all reactants}}$

Your answer    | C |

[1]

**5.** The burette readings from a titration are shown below.

| Final reading / cm³ | 24.95 |
|---|---|
| Initial reading / cm³ | 5.00 |

The burette used has an uncertainty of ±0.05 cm³ in each reading.

What is the percentage uncertainty of the resulting titre?

**A**    0.20%

**B**    0.25%

**C**    0.45%

**D**    0.50%

$$\frac{0.05 \times 2}{19.95} \times 100 = 0.501\%$$

Your answer    | D |

[1]

**6.** The electron configuration of element **X** is: $1s^2 2s^2 2p^6 3s^2 3p^4$ → needs 2 more electrons for full outer shell

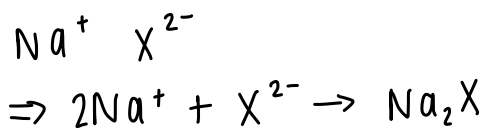What is the formula of a compound formed when sodium reacts with element **X**?

**A**    Na**X**

**B**    Na**X**$_2$

**C**    Na$_2$**X**

**D**    Na$_2$**X**$_3$

$Na^+ \quad X^{2-}$

$\Rightarrow 2Na^+ + X^{2-} \rightarrow Na_2X$

Your answer    | C |

[1]

**7.** What is the number of oxygen atoms in 88.0 g of $CO_2$?

A  $3.01 \times 10^{23}$

B  $1.20 \times 10^{24}$

C  $2.41 \times 10^{24}$

D  $4.82 \times 10^{24}$

$moles = \dfrac{Mass}{Mr} = \dfrac{88.0}{44} = 2 \; moles$

$atoms = \\ in \; total = moles \times 6.022 \times 10^{23}$
$= 2 \times 6.02 \times 10^{23} = 1.20 \times 10^{24}$

Your answer  **C**

$oxygen \; atoms = \underline{2 \times 1.20 \times 10^{24}}$

[1]

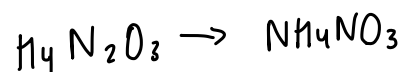**8.** A compound has the composition by mass: H, 5.00%; N, 35.00%; O, 60.00%.

Which compound has this composition?

A  $HNO_3$

B  $NH_4NO_3$

C  $HNO_2$

D  $NH_2OH$

H: $5 \div 1 = 5 \div 2.5 = 2 \times 2 = 4$

N: $35 \div 14 = 2.5 \div 2.5 = 1 \times 2 = 2$

O: $60 \div 16 = 3.75 \div 2.5 = 1.5 \times 2 = 3$

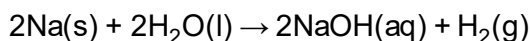$H_4 N_2 O_3 \longrightarrow NH_4NO_3$

Your answer  **B**

[1]

**9.** Sodium reacts with water as shown below.

$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

Which mass of sodium reacts with water to produce 960 cm³ of hydrogen gas at RTP?

A  0.46 g

B  0.92 g

C  1.84 g

D  3.68 g

o  1 mole of any gas at RTP occupies 24 dm³

$960 \div 1000 = 0.96 \; dm^3$

1 mole = 24 dm³

$\dfrac{1}{24}$ moles = 1 dm³

$\dfrac{1}{24} \times 0.96 = 0.96 \; dm^3$

0.04 moles $H_2$

moles of Na = $0.04 \times 2 = 0.08$

mass = moles × Mr
$= 0.08 \times 23$
$= 1.84 g$

Your answer  **C**

[1]

**10.** Which equation does **not** represent a neutralisation reaction?

metal    acid
**A**    $Zn + 2HCl \rightarrow ZnCl_2 + H_2$   → Zn not a base

base    acid
**B**    $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

base    acid
**C**    $Na_2CO_3 + 2CH_3COOH \rightarrow 2CH_3COONa + CO_2 + H_2O$

**D**    $CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$
   base         acid

Your answer    **A**

**[1]**

**11.** What is the oxidation number of Fe in $K_2FeO_4$?

**A**    +4               $2 + x + (-2 \times 4) = 0$

**B**    +5                   $2 + x - 8 = 0$

**C**    +6                      $x = +6$

**D**    +7

Your answer    **C**

**[1]**

**12.** Which reaction shows oxidation of sulfur?

                 +6     +4
**A**    $2HBr + H_2SO_4 \rightarrow SO_2 + 2H_2O + Br_2$

     +4              +4
**B**    $SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

**C**    $8HI + H_2SO_4 \rightarrow 4I_2 + H_2S + 4H_2O$

       -2             +1
**D**    $H_2S + Cl_2 \rightarrow 2HCl + S$

Your answer    **D**

**[1]**

**13.** What is the percentage composition by mass of nitrogen in $(NH_4)_2CO_3$?

**A**    14.58%

**B**    17.95%      $\dfrac{14 \times 2}{[(14+4) \times 2] + 12 + (16 \times 3)} = 0.291 = 29.17\%$

**C**    29.17%

**D**    37.50%

Your answer    **C**

**[1]**

**14.** Which chemical process is the most sustainable in terms of the atom economy of the organic product?

    **A**   $CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$

    **B**   $CH_3CH_2OH + NaCl + H_2SO_4 \rightarrow CH_3CH_2Cl + NaHSO_4 + H_2O$

    **C**   $CH_3CH_2Br + NaOH \rightarrow CH_3CH_2OH + NaBr$

    **D**   $CH_3CH_2CH_2CH_2OH \rightarrow CH_3CH_2CH=CH_2 + H_2O$
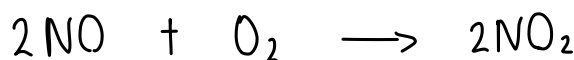
Your answer    D

[1]

**15.** $8.0\,dm^3$ of NO is mixed with $6.0\,dm^3$ of $O_2$ at room temperature and pressure (RTP). The reaction below takes place until one of the reactants is used up.

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$
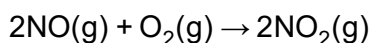
What is the volume of the mixture at RTP after the reaction has taken place?

    **A**   $8.0\,dm^3$

    **B**   $10.0\,dm^3$

    **C**   $12.0\,dm^3$

    **D**   $14.0\,dm^3$

Your answer    B

*(handwritten working)*

$2NO \quad + \quad O_2 \quad \longrightarrow \quad 2NO_2$

$8dm^3 \longrightarrow 4dm^3 \longrightarrow 10dm^3$

- so $O_2$ is in excess as there are $6dm^3$.
- all NO reacts making $8dm^3$, and 2 $dm^3$ of $O_2$ left ($6dm^3$ originally).

$8 + 2 = 10dm^3$

[1]

**16.** What is the volume of $0.0100\,mol$ of $N_2$ at $350\,°C$ and $200\,kPa$?

    **A**   $145\,cm^3$

    **B**   $259\,cm^3$

    **C**   $145\,dm^3$

    **D**   $259\,dm^3$

Your answer    B

*(handwritten working)*

$pV = nRT$

$$V = \frac{0.01 \times 8.31 \times (350 + 273)}{200000}$$

$V = 2.5885 \times 10^{-4}\,m^3$

$V = 258.8 = 259\,cm^3$

[1]

$m^3 \xrightarrow{\times 10^3} dm^3 \xrightarrow{\times 10^3} cm^3$

**17.** 0.24 g of an element, **X**, is reacted with 0.0100 mol $Cl_2$ to form a chloride with the formula $XCl_2$.

What is element **X**?
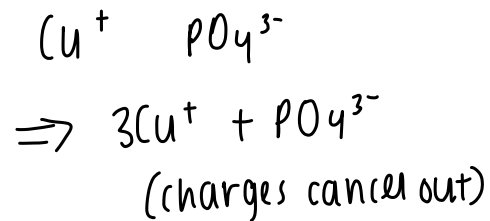
A  carbon

B  magnesium

C  molybdenum

D  titanium

$X + Cl_2 \rightarrow XCl_2 \rightarrow X^{2+} \ Cl^-$

$0.24g \qquad 0.71g$

$0.01 \ moles$

$Mr = \dfrac{0.24}{0.01} = 24 = magnesium$
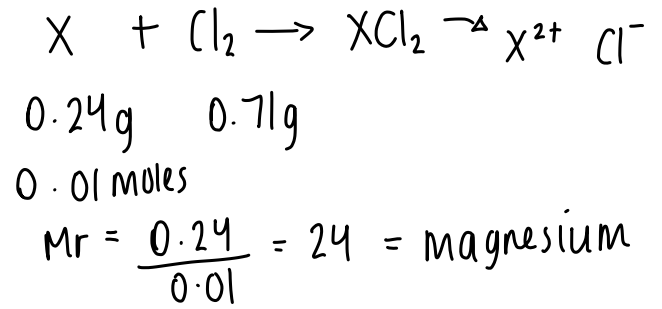
Your answer  $\boxed{B}$

[1]

**18.** A phosphate(V) ion has the formula $PO_4^{3-}$.

What is the formula for copper(I) phosphate(V)?

A  $Cu(PO_4)_5$

B  $Cu_5PO_4$

C  $Cu(PO_4)_3$

D  $Cu_3PO_4$

$Cu^+ \qquad PO_4^{3-}$

$\Rightarrow 3Cu^+ + PO_4^{3-}$

(charges cancel out)

Your answer  $\boxed{D}$

[1]

**19.** Which reaction shows chlorine only being oxidised?

A  $\overset{0}{Cl_2} + H_2O \rightarrow H\overset{-1}{Cl} + H\overset{+1}{Cl}O$

B  $2\overset{+4}{Cl}O_2 + 2NaOH \rightarrow Na\overset{+3}{Cl}O_2 + Na\overset{+5}{Cl}O_3 + H_2O$

C  $4K\overset{+5}{Cl}O_3 \rightarrow 3K\overset{+7}{Cl}O_4 + K\overset{-1}{Cl}$

D  $MnO_2 + 4H\overset{-1}{Cl} \rightarrow Mn\overset{-1}{Cl_2} + \overset{0}{Cl_2} + 2H_2O$

Your answer  $\boxed{D}$

[1]

# Total Marks for Question Set 1: 19

**OCR**

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