Edexcel

AS Chemistry

Practice Unit Test 1

philip allan UPDATES
www.philipallan.co.uk

Practice Unit Test 1

Time allowed: 1 hour 15 minutes
Use the periodic table printed at the back of the textbook (page 340).

Section A

Answer *all* questions in this section. You are advised not to spend more than 25 minutes on this section. For each question, select the one answer from **A**, **B**, **C** or **D** that you think is correct and put a cross in the box alongside the answer.

1 The relative isotopic mass is

- ☐ **A** the average mass of the atoms of that element relative to the mass of a ^{12}C atom
- ☐ **B** the average mass of the atoms of that element relative to $\frac{1}{12}$ the mass of a ^{12}C atom
- ☐ **C** the mass of one atom of that isotope relative to the mass of a ^{12}C atom
- ☐ **D** the mass of one atom of that isotope relative to $\frac{1}{12}$ the mass of a ^{12}C atom

2 Effluent water from a factory contains 5.4 ppm Al^{3+} ions. The mass of Al^{3+} ions in 1.0 dm^3 of water is

- ☐ **A** 5.4 mg
- ☐ **B** 0.146 mg
- ☐ **C** 0.2 mg
- ☐ **D** 2×10^{-4} g

3 10 g of a substance of molar mass 100 g mol^{-1} was dissolved in 250 cm^3 of water. The concentration in mol dm^{-3} of this solution is

- ☐ **A** 0.40
- ☐ **B** 0.00040
- ☐ **C** 0.0250
- ☐ **D** 25.0

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

4 Butane burns according to the equation:

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$$

Calculate the mass of carbon dioxide (the carbon footprint) produced when 1.0 dm^3 of butane gas is burnt. (The molar volume of gas at this temperature is 24 $dm^3\ mol^{-1}$.)

- ☐ **A** 1.8 g
- ☐ **B** 7.3 g
- ☐ **C** 14.7 g
- ☐ **D** 352 g

5 Chloroethane can be made by the reaction of phosphorus pentachloride with ethanol according to the equation:

$$PCl_5 + C_2H_5OH \rightarrow C_2H_5Cl + HCl + POCl_3$$

The atom economy is

- ☐ **A** 53.3%
- ☐ **B** 25.3%
- ☐ **C** 20%
- ☐ **D** it depends on the yield of the experiment

6 When 23 g of ethanol was oxidised by H^+ and $Cr_2O_7^{2-}$ ions, 16 g of ethanoic acid was produced. The percentage yield of this reaction is

- ☐ **A** 0.53%
- ☐ **B** 30.4%
- ☐ **C** 53.3%
- ☐ **D** 69.6%

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

The following information is needed for questions 7 and 8.

Avogadro constant = 6.02×10^{23} mol^{-1}

7 The number of ions in 111.1 g of calcium chloride, $CaCl_2$, is

- ☐ **A** 6.02×10^{23}
- ☐ **B** 1.81×10^{24}
- ☐ **C** 1
- ☐ **D** 3

8 An athlete's urine sample contained 20 nmol of a steroid per dm^3 of a steroid. Calculate the number of molecules of the steroid in 100 cm^3 of solution.

- ☐ **A** 1.204×10^{14}
- ☐ **B** 1.204×10^{15}
- ☐ **C** 1.204×10^{16}
- ☐ **D** 1.204×10^{18}

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

Use the following data to answer questions 9–11:

Standard enthalpy of formation/ kJ mol^{-1}	
Sulfur dioxide, $SO_2(g)$	−297
Sulfur trioxide, $SO_3(g)$	−395
Sulfur trioxide, $SO_3(s)$	−461

Standard enthalpy of combustion/ kJ mol^{-1}	
Ethane, $C_2H_6(g)$	−1560
Carbon, C(s)	−395
Hydrogen, $H_2(g)$	−286

Bond enthalpy/kJ mol^{-1}	
N≡N	+946
N–H in NH_3	+391
H–H	+436

9 Sulfur dioxide and oxygen react together according to the equation:

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

The standard enthalpy change/kJ mol^{-1} of this reaction is

- ☐ **A** −328
- ☐ **B** −196
- ☐ **C** −164
- ☐ **D** −98

10 The standard enthalpy change/kJ mol^{-1} of formation of ethane, $C_2H_6(g)$, is

- ☐ **A** +88
- ☐ **B** −88
- ☐ **C** +879
- ☐ **D** −879

11 Nitrogen and hydrogen react according to the equation

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

The standard enthalpy change/kJ mol^{-1} of formation of ammonia, $NH_3(g)$, is

- ☐ **A** −46
- ☐ **B** +46
- ☐ **C** −92
- ☐ **D** +92

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

12 The thermodynamic equations for the reactions of dilute hydrochloric acid with sodium hydrogen-carbonate and with sodium carbonate are:

(i) $NaHCO_3(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$

$\Delta H = -y\ kJ\ mol^{-1}$

(ii) $Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$

$\Delta H = -z\ kJ\ mol^{-1}$

What is the enthalpy change ($kJ\ mol^{-1}$) for the reaction $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(l) + CO_2(g)$?

- ☐ **A** $z - y$
- ☐ **B** $y - z$
- ☐ **C** $2y - z$
- ☐ **D** $z - 2y$

13 A sample of a solid X of mass 1.0 g was dissolved in 100 cm^3 of water. The temperature of the water fell from 22.4°C to 18.7°C. Assume that the specific heat capacity of water is 4.18 $J\ g^{-1}\ °C^{-1}$. The heat change (J), to three significant figures, is

- ☐ **A** 15.5
- ☐ **B** 93.6
- ☐ **C** 1550
- ☐ **D** 9360

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

14 The enthalpy of neutralisation of hydrochloric acid was measured by placing 50 cm^3 of a solution of the acid into a beaker and adding 50 cm^3 of sodium hydroxide solution. The temperature before and after mixing was measured using the same thermometer.

Which would **not** cause an error in the value of the enthalpy of neutralisation of the acid?

- ☐ **A** using a thermometer that always reads 2°C too high
- ☐ **B** heat losses from the beaker
- ☐ **C** heat being absorbed by the thermometer
- ☐ **D** the sodium hydroxide solution being slightly more dilute than the acid

15 When 25 cm^3 of a 0.500 mol dm^{-3} solution of sulfuric acid, H_2SO_4, was neutralised by a sodium hydroxide solution, 1.46 kJ of heat energy was released.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

The enthalpy of neutralisation/kJ mol^{-1} of sulfuric acid is

- ☐ **A** +116.8
- ☐ **B** –116.8
- ☐ **C** +58.4
- ☐ **D** –58.4

16 The number 0.0210 is written to

- ☐ **A** five significant figures
- ☐ **B** four significant figures
- ☐ **C** three significant figures
- ☐ **D** two significant figures

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

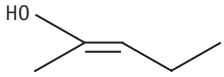
17 The equation that represents the first ionisation energy of bromine is

- ☐ **A** $Br(g) \rightarrow Br^+(g) + e^-$
- ☐ **B** $Br(g) + e^- \rightarrow Br^-(g)$
- ☐ **C** $\frac{1}{2}Br_2(g) \rightarrow Br^+(g) + e^-$
- ☐ **D** $\frac{1}{2}Br_2(l) \rightarrow Br^+(g) + e^-$

18 The electronic configuration of an O^+ ion is

- ☐ **A** $1s^2\ 2s^2\ 2p_x^{\ 1}\ 2p_y^{\ 1}\ 2p_z^{\ 1}$
- ☐ **B** $1s^2\ 2s^1\ 2p_x^{\ 1}\ 2p_y^{\ 1}\ 2p_z^{\ 1}$
- ☐ **C** $1s^2\ 2s^2\ 2p_x^{\ 1}\ 2p_y^{\ 1}$
- ☐ **D** $1s^2\ 2s^2\ 2p_x^{\ 2}\ 2p_y^{\ 1}\ 2p_z^{\ 1}$

19 What is the name of the following compound?

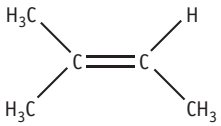


- ☐ **A** (*Z*)-2-hydroxypent-2-ene
- ☐ **B** (*E*)-2-hydroxypent-2-ene
- ☐ **C** (*Z*)-2-hydroxybut-2-ene
- ☐ **D** (*E*)-2-hydroxybut-2-ene

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

20 The formula of 2-methylbut-2-ene is:



Which is a correct statement about 2-methylbut-2-ene?

- ☐ **A** It does not exist as geometric isomers as the molecule can rotate about the C=C.
- ☐ **B** It does not exist as geometric isomers as there are two identical groups on one of the carbon atoms of the C=C group.
- ☐ **C** It is a *Z*-isomer.
- ☐ **D** It is an *E*-isomer.

21 A diatomic element X has three molecular ion peaks in its mass spectrum at *m/e* values 158, 160 and 162. The peak at 160 is twice as high as the other two peaks, which are the same height. Which is a true statement about X?

- ☐ **A** X consists of three isotopes, ^{79}X, ^{80}X and ^{81}X, in equal amounts.
- ☐ **B** X consists of three isotopes, ^{79}X, ^{80}X and ^{81}X, with twice as much of the ^{80}X isotope.
- ☐ **C** X consists of two isotopes, ^{79}X and ^{81}X, in equal amounts.
- ☐ **D** X consists of two isotopes, ^{79}X and ^{80}X, with more ^{80}X than ^{79}X.

22 An organic compound has the molecular formula C_7H_{14}. It does not decolorise bromine water. Which is **not** true?

- ☐ **A** Its empirical and molecular formulae are different.
- ☐ **B** It is an alkene.
- ☐ **C** It is a cycloalkane.
- ☐ **D** It is a hydrocarbon.

Use this space for any rough working. Anything you write in this space will gain no credit.

© Philip Allan Updates

23 Question 23 is about the following consecutive ionisation energies/kJ mol^{-1}.

A	900	736	590	548	502
B	799	2420	3660	25 000	328 000
C	494	736	577	786	1 060
D	418	590	632	661	648

Which is the most likely to:

(i) be the successive ionisation energies of an element in group 3 of the periodic table

☐ **A**
☐ **B**
☐ **C**
☐ **D**

(ii) be the first ionisation energies of elements going down a group of the periodic table

☐ **A**
☐ **B**
☐ **C**
☐ **D**

(iii) be the first ionisation energies of the first five elements in period 3 of the periodic table

☐ **A**
☐ **B**
☐ **C**
☐ **D**

Use this space for any rough working. Anything you write in this space will gain no credit.

Section A total: 25 marks

© Philip Allan Updates

Section B

Answer *all* questions in this section.

24 This question is about mass spectrometry.

(a) A mass spectrometer can be used to find the percentage composition of the isotopes of an element. Explain how the following are achieved in a mass spectrometer:

(i) ionisation **(1)**

.....

.....

(ii) acceleration **(1)**

.....

.....

(iii) deflection **(1)**

.....

.....

(b) Analysis of a sample of iron in a mass spectrometer gave the following results:

Isotope	Relative isotopic mass	%
^{54}Fe	53.94	5.94
^{56}Fe	55.93	91.78
^{57}Fe	56.94	2.28

Calculate the relative atomic mass of iron to two decimal places. **(2)**

(c) State and outline one modern use of mass spectrometry. **(3)**

.....

.....

.....

.....

.....

Total: 8 marks

© Philip Allan Updates

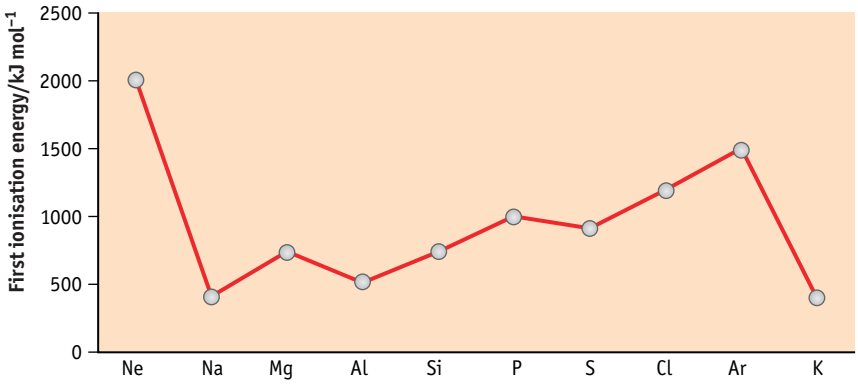
25 (a) Define the term 'first ionisation energy'. **(3)**

.....

.....

.....

(b) The variation of the first ionisation energy of the elements neon to potassium is shown in the graph below.



Explain why:

(i) the first ionisation energy of sodium is less than that of magnesium **(3)**

.....

.....

.....

.....

(ii) the first ionisation energy of aluminium is less than that of magnesium **(2)**

.....

.....

.....

.....

(c) A compound containing sodium, sulfur and oxygen was analysed and the following percentages by mass were found.

Element % by mass: sodium 36.5; sulfur 25.4; oxygen 38.1

Calculate the empirical formula of this compound. **(2)**

Total: 10 marks

© Philip Allan Updates

26 (a) Chlorine reacts with ethane, CH_3CH_3, and with ethene, $CH_2{=}CH_2$.

(i) Classify the reaction with ethane. **(1)**

.....

(ii) Classify the reaction with ethene. **(1)**

.....

(b) Ethene and but-1-ene are members of the same homologous series.

(i) Explain what is meant by the term 'homologous series'. **(3)**

.....

.....

.....

(ii) Write the equation for the reaction of but-1-ene with bromine. **(1)**

.....

(iii) Write the mechanism for the reaction between but-1-ene and bromine. **(3)**

(iv) Identify the major product of the reaction of but-1-ene with bromine water, $Br_2(aq)$. **(1)**

.....

(v) But-1-ene reacts with an aqueous solution of potassium manganate(VII). Describe what you would see and identify the organic compound produced. **(3)**

.....

.....

© Philip Allan Updates

(vi) But-2-ene can be polymerised to poly(but-1-ene). Draw a section of the structure of the polymer that shows one repeating unit. **(2)**

Total: 15 marks

© Philip Allan Updates

27 (a) Define the term 'standard enthalpy of formation' and write an equation that represents the enthalpy of formation of chloroethane, CH_3CH_2Cl. **(4)**

.....

.....

.....

.....

.....

(b) Enthalpies of formation of organic compounds cannot usually be measured directly, but they can be calculated from enthalpy of combustion data. The thermochemical equation for the combustion of chloroethane, C_2H_5Cl, is:

$$C_2H_5Cl(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l) + HCl(g) \quad \Delta H_c^\circ = -1325 \text{ kJ mol}^{-1}$$

(i) Draw a labelled Hess's law diagram connecting the enthalpy of combustion of chloroethane with the enthalpies of formation of carbon dioxide, water and hydrogen chloride. **(2)**

(ii) Use your diagram, the value of $\Delta H_c^\ominus$ of chloroethane and the enthalpy of formation data in the table to calculate the enthalpy of formation of chloroethane. **(2)**

Substance	ΔH_f /kJ mol^{-1}
Carbon dioxide, $CO_2(g)$	−394
Water, $H_2O(l)$	−286
Hydrogen chloride, HCl(g)	−92.3

© Philip Allan Updates

(c) Chloroethane can be produced by the reaction of ethene with hydrogen chloride:

$H_2C{=}CH_2(g) + H{-}Cl(g) \rightarrow H_3C{-}CH_2Cl(g)$

(i) Calculate the standard enthalpy change for this reaction given the following average bond enthalpies.

Bond	Average bond enthalpy/kJ mol^{-1}
C=C	+612
C–H	+467
C–C	+347
H–Cl	+432
C–Cl	+346

(3)

(ii) Draw a labelled reaction profile diagram for this reaction. **(2)**

(iii) The standard enthalpy of this reaction, calculated from enthalpy of formation data, is –97 kJ mol^{-1}. Explain why this is different from the value obtained in **(c)(i)**. **(1)**

.....

.....

Total: 14 marks

© Philip Allan Updates

28 (a) Draw a dot-and-cross diagram for the ions in magnesium iodide, showing outer electrons only:

(i) the magnesium ion

(ii) the iodide ion **(3)**

(b) Lattice energy values obtained from Born–Haber experimental data and those calculated from the ionic model are shown in the table below:

	Values from Born–Haber/kJ mol^{-1}	Values calculated from ionic model/kJ mol^{-1}
Magnesium iodide, $MgI_2(s)$	–2327	–1944
Magnesium fluoride, $MgF_2(s)$	–2957	–2913

(i) Explain why the difference between the two values for magnesium iodide is greater than the difference between the two values for magnesium fluoride. **(3)**

.....

.....

.....

.....

.....

(ii) Why is the lattice energy of calcium fluoride much less exothermic than that of magnesium fluoride? **(2)**

.....

.....

.....

Total: 8 marks

Section B total: 55 marks

Paper total: 80 marks

© Philip Allan Updates