PHYSICAL SCIENCE **8780/01**

Paper 1 Multiple Choice **October/November 2017**

40 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
Electronic calculators may be used.

This document consists of **15** printed pages and **1** blank page.

International Examinations **[Turn over**

Relevant data, formulae and the Periodic Table are provided in the Data Booklet.

Section A

For each question there are four possible answers **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

1   A quantity is measured. What is the effect of taking repeated measurements and then averaging?

   A   It reduces the effect of both random and systematic errors.

   B   It reduces the effect of neither random nor systematic errors.

   C   It reduces the effect of random errors only.

   D   It reduces the effect of systematic errors only.

2   The variation with time t of the displacement s of an object travelling along a straight line is shown in the graph.
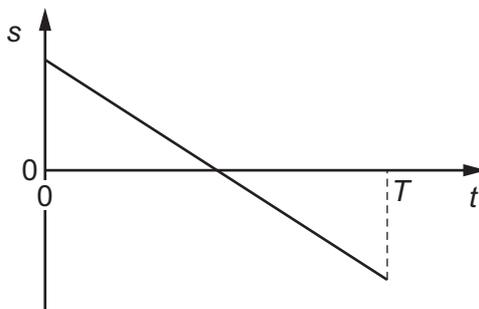
   Which statement describes the velocity of the object over the time interval from $t = 0$ to $t = T$?

   A   The velocity decreases and then increases in the opposite direction.

   B   The velocity decreases at a constant rate.

   C   The velocity has a constant magnitude and changes to the opposite direction.

   D   The velocity has a constant magnitude and is always in the same direction.

3 A sphere is suspended by a string from a fixed point. The sphere moves with constant speed around a horizontal, circular path.
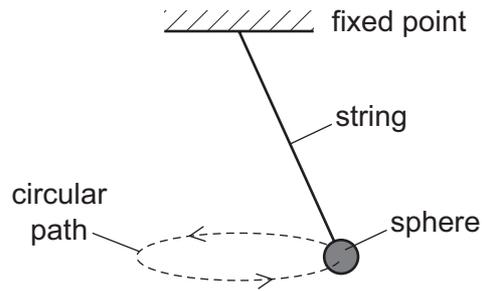
Which statement about the resultant force acting on the sphere is correct?

A It has zero magnitude.

B It is directed along the string towards the fixed point.

C It is directed towards the centre of the circular path.

D It is in the same direction as the velocity of the sphere.

4 The diagram shows a man using a key to open a valve to release water at a dam.
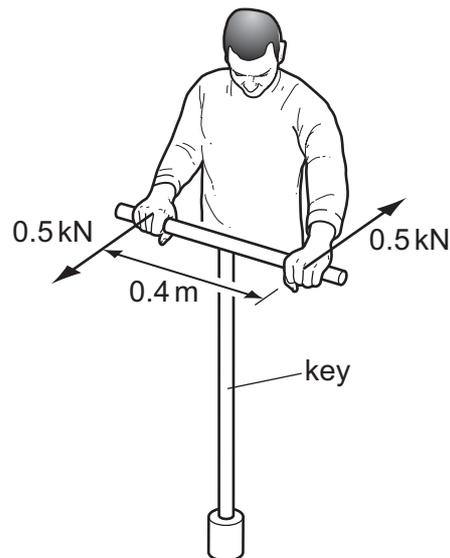
What is the torque produced by the couple on the key?

**A** 0.2 Nm   **B** 0.4 Nm   **C** 200 Nm   **D** 400 Nm

5 Car X is travelling along a straight, level road at speed *v*. It accelerates to speed *v* + Δ*v* in time Δ*t*.

An identical car Y travels along the same road at speed 2*v*. It accelerates to speed 2*v* + Δ*v* in the same time Δ*t*.

Which row correctly compares the kinetic energy gained and work done against air resistance by the two cars?

|	kinetic energy gained	work done against air resistance
A	is equal for both cars	is equal for both cars
B	is equal for both cars	is greater for car Y
C	is greater for car Y	is equal for both cars
D	is greater for car Y	is greater for car Y

6 The diagram shows the path of an α-particle travelling through a uniform electric field produced by charged parallel plates.
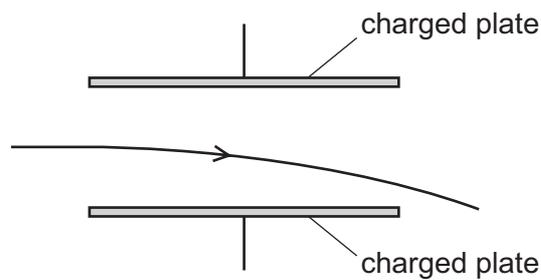
Which diagram shows the path of a proton that enters the same electric field with the same speed?
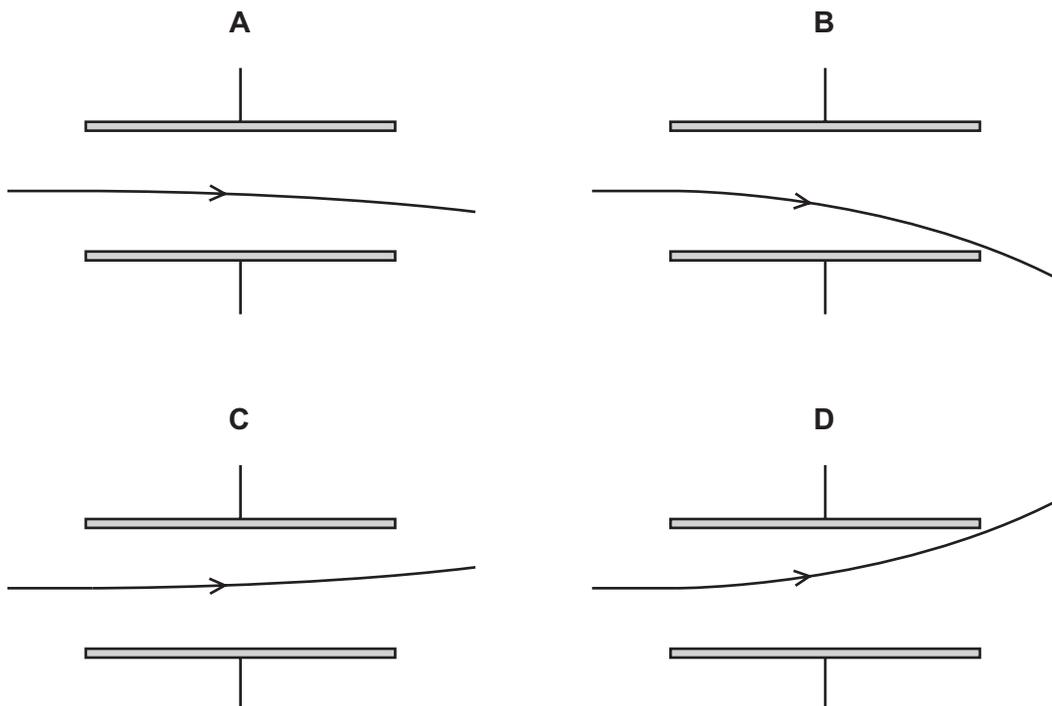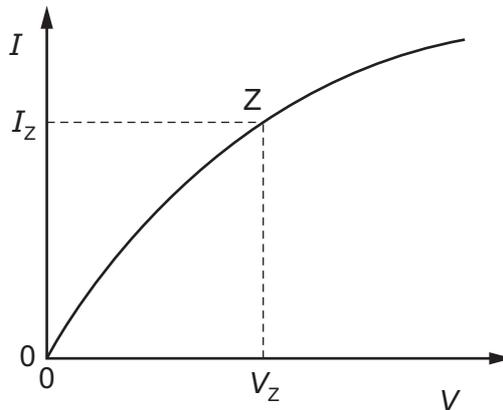
7 The diagram shows the trace on a cathode-ray oscilloscope (c.r.o.) from a signal of frequency 400 Hz.
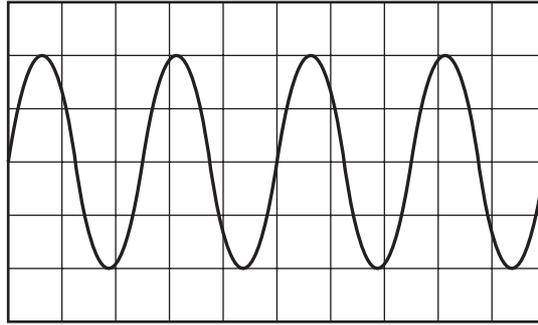
What is the time-base scale setting on the oscilloscope?

A $1.00\,\text{ms div}^{-1}$

B $1.25\,\text{ms div}^{-1}$

C $2.00\,\text{ms div}^{-1}$

D $2.50\,\text{ms div}^{-1}$

8 The graph shows how the current I in a filament lamp varies with the potential difference (p.d.) V across it.

At point Z on the graph, the p.d. is V_Z and the current is I_Z.

What is the resistance of the filament lamp at point Z?

A I_Z divided by V_Z

B the gradient of the graph at point Z

C the reciprocal of the gradient of the graph at point Z

D V_Z divided by I_Z

9   A sound wave travels through the air. The graph shows the variation of pressure against distance along the wave at a particular instant.

Below the graph are four representations of the positions of the air particles along the wave at the same instant.

Which representation of the position of the particles in the wave is correct?
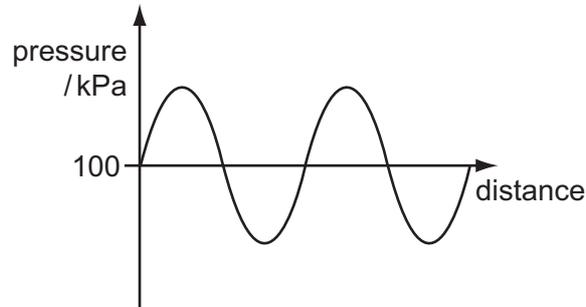
10 After a series of decays, the proton (atomic) number of a nucleus decreases by three and the nucleon (mass) number decreases by eight.

Which particles were emitted during the series of decays?

A   one α-particle and two β-particles

B   two α-particles and one β-particle

C   three α-particles

D   three β-particles

11 The equation shows the complete combustion of ethanol, CH_3CH_2OH.

$$CH_3CH_2OH(g) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$$
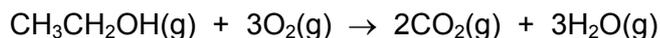
What is the enthalpy change of combustion, ΔH_c, for this reaction? Bond energy data can be found in the Data Booklet.

A $-1012\,kJ\,mol^{-1}$

B $-1362\,kJ\,mol^{-1}$

**C** $-1422\,kJ\,mol^{-1}$

D $-2004\,kJ\,mol^{-1}$

12 In which reaction will the position of equilibrium move to the right when the pressure is increased **and** when the temperature is increased?

A $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\hspace{2cm}$ $\Delta H = -97\,kJ\,mol^{-1}$

B $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ $\hspace{2.3cm}$ $\Delta H = -10\,kJ\,mol^{-1}$

C $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$ $\hspace{0.5cm}$ $\Delta H = +207\,kJ\,mol^{-1}$

D $3O_2(g) \rightleftharpoons 2O_3(g)$ $\hspace{3.2cm}$ $\Delta H = +286\,kJ\,mol^{-1}$

13 The distribution of molecular energies of a gas can be shown as a Boltzmann curve.

A fixed mass of gas is heated and its temperature increases from 298 K to 450 K.

Which curves show the distribution of molecular energies of the gas at 298 K and 450 K?
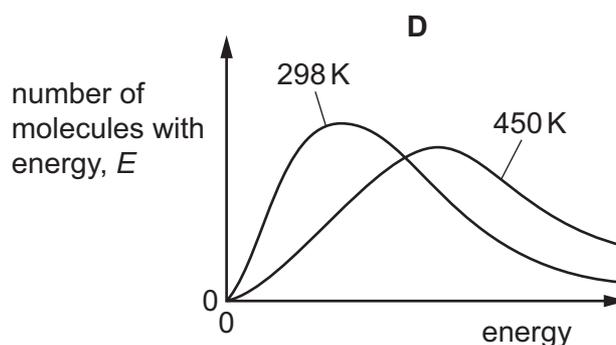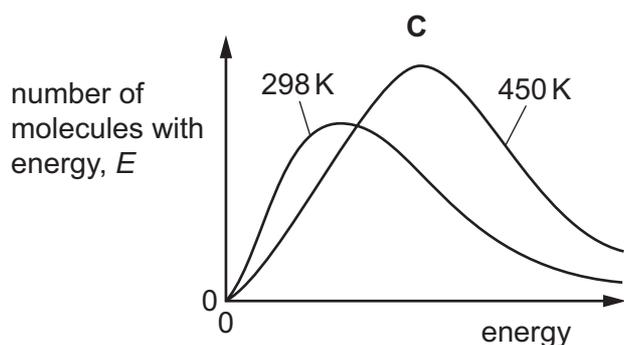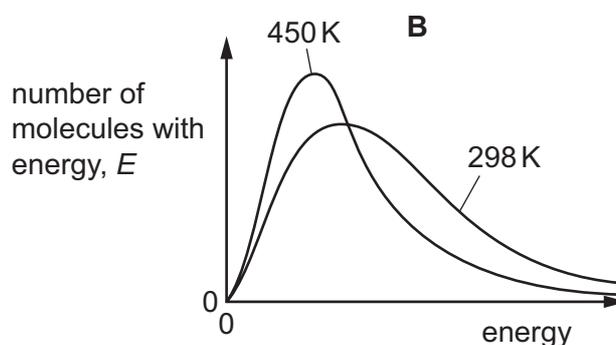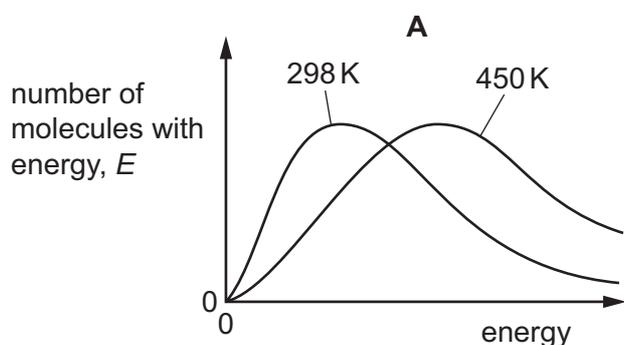
14 The melting points of four consecutive elements from Period 3 of the Periodic Table are

<div align="center">

922 K   933 K   1683 K   317 K

</div>

Which is the melting point of the element that forms an oxide which reacts with water to form a strong acid?

A 922 K   **B** 933 K   **C** 1683 K   **D** 317 K

15 Lead(II) oxide has a melting point of $887\,°C$. When molten, it conducts electricity. When a direct current is passed through molten lead(II) oxide it decomposes into liquid lead and oxygen gas.

What is the structure and bonding in lead(II) oxide?

A giant covalent

B giant ionic

C giant metallic

D simple covalent

16 Two species were separately added to water.

Both species readily dissolved to form two solutions that reacted together when mixed.

What were the two species?

A Cl_2 and SiO_2

B Na and SO_2

**C** Na_2O and Al_2O_3

D SO_3 and P_2O_3

17 Which statement about the properties of Group II metals or their compounds is correct?

A The acidity of the oxides increases down the group.

B The decomposition temperature of the carbonates decreases down the group.

C The reactivity of the metals decreases down the group.

D The thermal stability of the nitrates increases down the group.

18 Which statement about ammonium chloride is correct?

A Ammonium chloride contains an ion with an H–N–H bond angle of 107°.

B An alkaline gas is released when ammonium chloride is heated with NaOH(aq).

C The formula of the ammonium ion is NH_4^-.

D There are three bonding pairs and one lone pair around each nitrogen atom.

19 What is the name of the alkene monomer that forms the polymer shown?
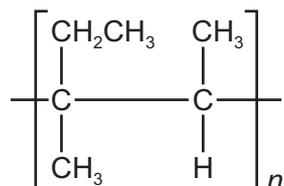
A 3-ethylbut-2-ene

B 3-ethyl-3-methylpropene

C 3-methylpent-2-ene

D 3-methylpent-3-ene

20 Which statement is correct?

A Both ethane and ethene molecules have H–C–H bond angles of 109.5°.

B The bond between the two carbon atoms in an ethane molecule has restricted rotation.

C The ethene molecule is planar.

D The two carbon atoms in an ethene molecule are joined by two π bonds.

Section B

For each of the questions in this section, one or more of the four numbered statements **1** to **4** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** only are correct	**1** and **3** only are correct	**2** and **4** only are correct	**4** only is correct

No other combination of statements is used as a correct response.

21 Which of the expressions are used to calculate a scalar quantity?

1 $\dfrac{\text{change in momentum}}{\text{time taken}}$

2 force $\times$ displacement

3 $\dfrac{\text{force}}{\text{mass}}$

4 $\dfrac{\text{force}}{\text{acceleration}}$

22 Two identical boxes, at the same height, are released from rest at the same time. One box falls directly to the ground and the other box slides down a slope to the ground, as shown.
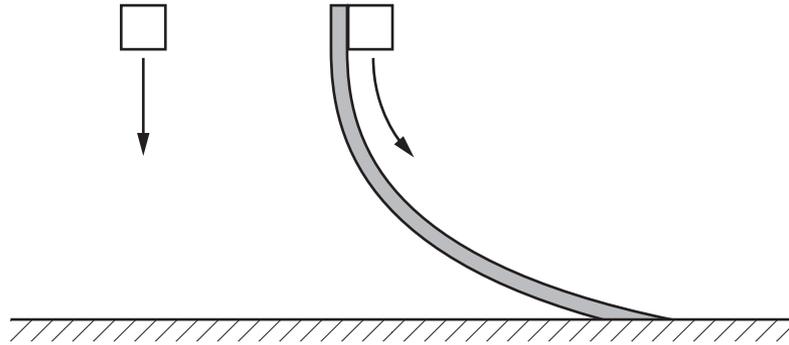
Friction between the box and the slope and air resistance are negligible.

Which statements are correct?

1 Both boxes arrive at the ground with the same speed.

2 Both boxes arrive at the ground with the same momentum.

3 Both boxes arrive at the ground with the same kinetic energy.

4 Both boxes arrive at the ground with the same velocity.

23 Three coplanar forces act at a point.

In which vector diagrams are the forces in equilibrium?
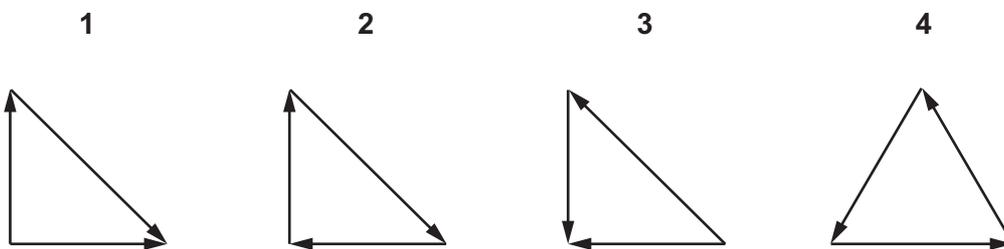
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** only are correct	**1** and **3** only are correct	**2** and **4** only are correct	**4** only is correct

No other combination of statements is used as a correct response.

24 Two resistors, X and Y, have resistances R_X and R_Y. The resistors are connected in parallel with a 6.0 V battery, as shown.
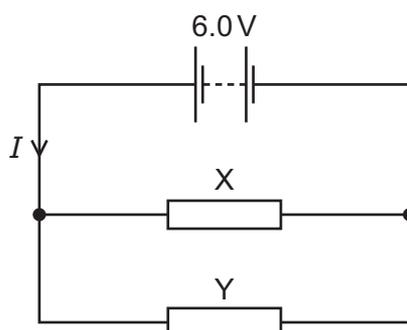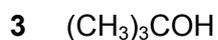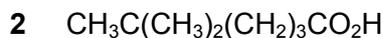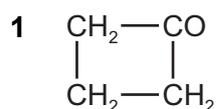

There is a current I in the battery.

What are possible values of I, R_X and R_Y?

	$I/$A	R_X/Ω	R_Y/Ω
1	3.0	4.0	4.0
2	3.0	6.0	3.0
3	6.0	3.0	1.5
4	6.0	8.0	8.0

25 Which statements about radiation are correct?

1 β-particles have a greater charge to mass ratio than α-particles.

2 β-particles have a greater ionising effect in air than α-particles or γ-radiation.

3 γ-radiation includes electromagnetic radiation of wavelength 1×10^{-14} m.

4 α-, β- and γ-radiation are all deflected by an electric field.

26 Which of these compounds represented by the following molecular formulae have the empirical formula C_4H_8O?

1   CH_2——CO
    | |
   CH_2——CH_2

2   $CH_3C(CH_3)_2(CH_2)_3CO_2H$

3   $(CH_3)_3COH$

4   $HOCH_2C(CH_3)_2C(CH_3)_2C(CH_3)_2CH_2CO_2H$

27 The formulae of two isotopes of nickel are shown.

$$^{58}_{28}Ni \qquad\qquad ^{60}_{28}Ni$$

Both isotopes form Ni^{2+} ions.

Which statements are correct?

1   The electron arrangement of both Ni^{2+} ions is $1s^22s^22p^63s^23p^63d^8$.

2   The $^{58}_{28}Ni$ isotope is more chemically reactive than the $^{60}_{28}Ni$ isotope.

3   The Ni^{2+} ions of both isotopes have the same number of electrons, but different numbers of neutrons.

4   The first ionisation energy of the $^{58}_{28}Ni$ atom is different from that of the $^{60}_{28}Ni$ atom.

28 The diagram shows the energy profile of a reaction.
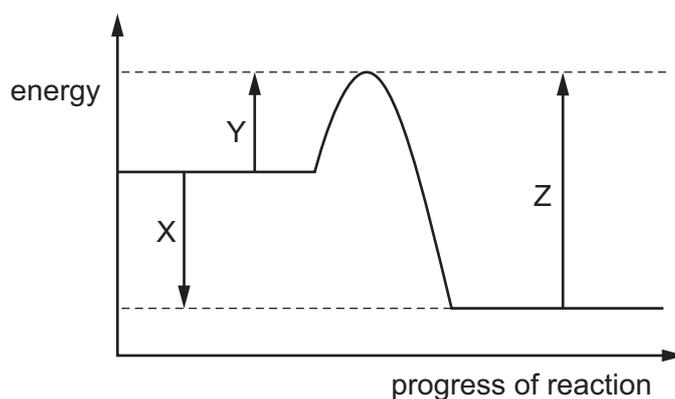
Which statements are correct?

1   The forward reaction is endothermic.

2   X is the enthalpy change of the forward reaction.

3   Z is the activation energy of the forward reaction.

4   Y is the activation energy of the forward reaction.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and **3** only are correct	**1** and **3** only are correct	**2** and **4** only are correct	**4** only is correct

No other combination of statements is used as a correct response.

29 Compound X has the structure shown.
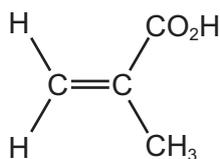
Which diagrams show structural isomers of compound X?

1

2

3   CH₃CH—CH—CHO with O bridge

$CH_3CH\!-\!CH\!-\!CHO$

4   $H_2C\!-\!CH\!-\!CH_2OH$ with O bridge
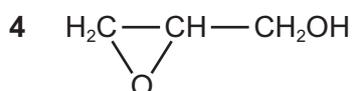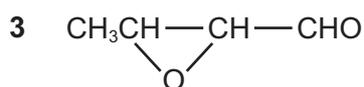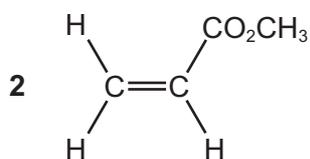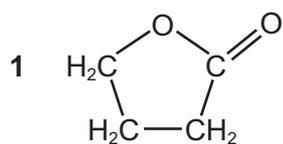
30 Compound Y has the formula shown.

$$H_3CCOCH_2CH_2OH$$

Which statements about compound Y are correct?

1 Elemental analysis of Y gives a composition by mass of C, 54.55%; O, 36.36%; H, 9.09%.

2 Reaction of Y with acidified potassium dichromate(VI) can produce two different organic products.

3 When reacted with 2,4-dinitrophenylhydrazine, 2,4-DNPH, Y forms an orange precipitate.

4 When heated with Fehling's reagent, Y forms a red precipitate.

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