PHYSICAL SCIENCE **8780/01**

Paper 1 Multiple Choice **October/November 2016**

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.

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 The vector diagram shows three coplanar forces acting at a point **P**.
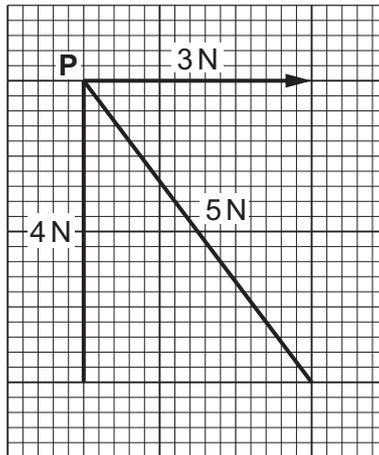
The three forces are in equilibrium. The direction of the 3 N force is shown.

What are the directions of the 4 N and 5 N forces?

	4 N force	5 N force
A	away from **P**	away from **P**
B	away from **P**	towards **P**
C	towards **P**	away from **P**
D	towards **P**	towards **P**

2 Two students **R** and **S** investigated how the potential difference (p.d.) V across a fixed resistor varied with the current I through it. The graphs show the students' results.
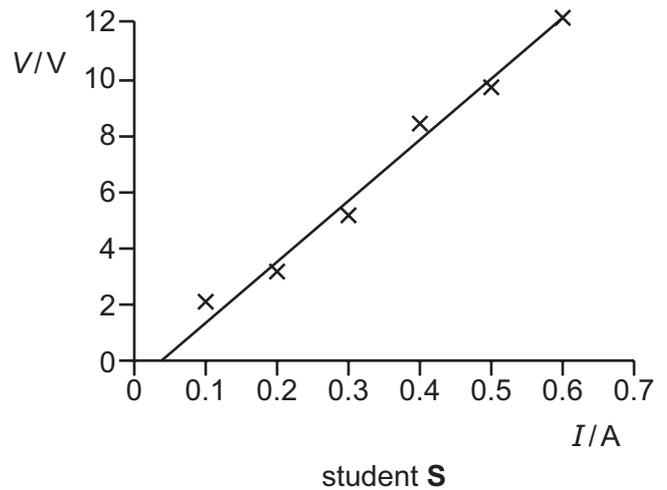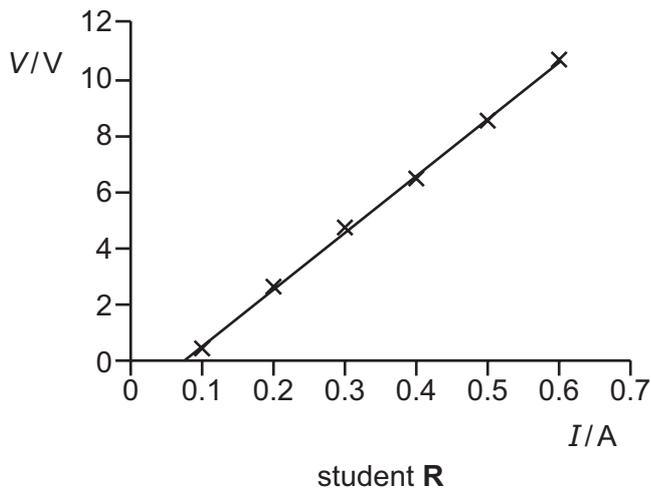
student **R**   student **S**

Which statement correctly compares the measurements made by the students?

A The measurements of student **R** show a bigger systematic error and bigger random errors.

B The measurements of student **R** show a bigger systematic error and smaller random errors.

C The measurements of student **R** show a smaller systematic error and bigger random errors.

D The measurements of student **R** show a smaller systematic error and smaller random errors.

3 An electric motor lifts a mass of 50 kg vertically upwards at a steady speed of $2.5\,\mathrm{m\,s^{-1}}$. The motor is connected to a 625 V supply and the current in the motor is 7.5 A.

What is the efficiency of the motor?

A 2.7%   **B** 10%   **C** 26%   **D** 78%

4 A parallel beam of X-rays has amplitude A and intensity I.

The beam passes through a block of aluminium.

The intensity of the beam after passing through the block is $\dfrac{I}{4}$.

What is the amplitude of the beam after passing through the block?

A $\dfrac{A}{16}$ **B** $\dfrac{A}{8}$ **C** $\dfrac{A}{4}$ **D** $\dfrac{A}{2}$

5 The diagram shows the diffraction of water waves in a ripple tank when they pass through a gap.
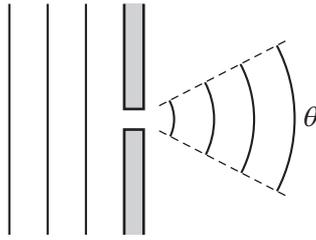
Which pair of changes would always cause the angle θ to increase?

A Decrease the frequency of the waves and make the gap narrower.

B Decrease the frequency of the waves and make the gap wider.

C Increase the frequency of the waves and make the gap narrower.

D Increase the frequency of the waves and make the gap wider.

6 Two horizontal metal plates are in a vacuum. The plates are 4.0 cm apart and connected to a 5000 V supply as shown.
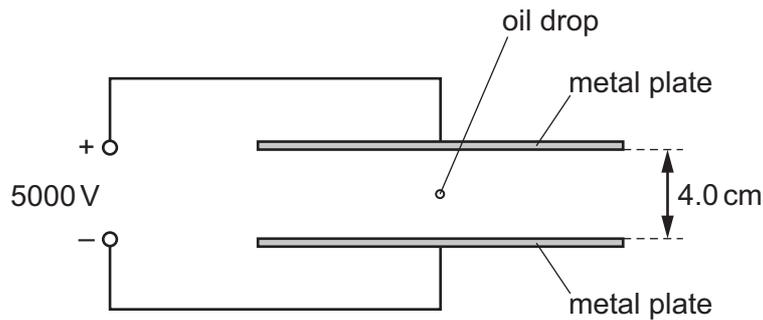
A charged oil drop of mass 8.2×10^{-15} kg is placed between the plates. The gravitational and electrical forces on the oil drop hold it in equilibrium.

What is the charge on the oil drop?

A -1.0×10^{-8} C

B -1.0×10^{-10} C

C -6.4×10^{-19} C

D -6.4×10^{-21} C

7 The power of a lamp is 36 W when there is a potential difference of 12 V across its terminals.

What is the charge that passes through this lamp in one minute when it is operating normally?

A 0.05 C   **B** 3.0 C   **C** 20 C   **D** 180 C

8   Kirchhoff's laws can be derived from two laws of conservation.

On which laws of conservation do Kirchhoff's laws depend?

	Kirchhoff's first law	Kirchhoff's second law
A	charge	current
B	charge	energy
C	current	charge
D	energy	charge

9   In Rutherford's α-particle scattering experiment one of the observations was that most of the α-particles passed through the gold foil undeviated.

What was inferred from **this** observation?

A   Atoms contain a positively charged nucleus.

B   Electrons orbit around the nucleus.

C   Most of the atom is empty space.

D   The nucleus is at the centre of the atom.

10 The air pressure in a car tyre is reduced on cold days.

Which statement helps to explains this observation?

A   The air particles lose potential energy and move closer together.

B   The air particles lose kinetic energy and hit the inside surface of the tyre less frequently.

C   The air particles have less space and hit the inside surface of the tyre more frequently.

D   The air particles have less space and hit the inside surface of the tyre with more force.

11 Which sample contains one mole of the named particle?

	sample	named particle
A	16.0 g of methane gas	hydrogen atoms
B	16.0 g of oxygen gas	oxygen molecules
C	28.0 g of nitrogen gas	nitrogen molecules
D	44.0 g of carbon dioxide gas	oxygen atoms

12 Equal masses of four gases, CH_4, C_2H_2, C_2H_4 and C_2H_6, are burnt separately to completion in excess oxygen.

Which one produces the greatest mass of carbon dioxide?

A CH_4 **B** C_2H_2 **C** C_2H_4 **D** C_2H_6

13 There is a trend in the first ionisation energy values of aluminium, silicon and phosphorus.

Which factor does **not** contribute to this trend?

A atomic radius

B attractive force exerted by the nucleus

C proton number

D shielding by inner shells

14 Four experiments are carried out in which equal small amounts of potassium dichromate are added to $10\,cm^3$ of a mixture of acidified ethanol and water.

The time t for the reaction to be completed can be measured.

For which row is the value of t the largest?

	acidified ethanol volume /cm^3	water volume /cm^3	temperature /°C
A	5	5	25
B	5	5	35
C	9	1	25
D	9	1	35

15 Molecules of ozone, O_3, and atoms of oxygen, O, exist in the upper atmosphere. They react together slowly to form oxygen, O_2, as shown in reaction **1**.

reaction **1** $O_3 + O \rightarrow 2O_2$

Chlorine atoms, Cl, increase the rate at which ozone is removed from the atmosphere.
Chlorine atoms do this by causing a new reaction route to occur. This route involves reactions **2** and **3**.

reaction **2** $Cl + O_3 \rightarrow ClO + O_2$
reaction **3** $ClO + O \rightarrow Cl + O_2$

Which statement explains why Cl atoms increase the rate of removal of ozone?

A Cl atoms act as a catalyst and the O_3 and O particles are given more energy.

B Cl atoms get used up by providing a new route.

C More O_3 and O particles have energy greater than the activation energy for the reactions in which chlorine atoms are involved.

D There are more collisions between O_3 and O particles when Cl atoms are present.

16 Which statement is true for both the manufacture of ammonia by the Haber process and the manufacture of sulfuric acid by the Contact process?

A A catalyst containing an s-block element is used.

B A gas obtained from the air is involved in one of the stages.

C The final product is collected by cooling a gas in order to liquefy it.

D The process involves the use of a pressure greater than $3 \times 10^7\,Pa$ (300 atmospheres).

17 Bromoethane, CH_3CH_2Br, can be converted to propanoic acid, $CH_3CH_2CO_2H$ by the reaction scheme shown.

$$CH_3CH_2Br \xrightarrow{\text{reaction } \mathbf{1}} \mathbf{X} \xrightarrow{\text{reaction } \mathbf{2}} CH_3CH_2CO_2H$$
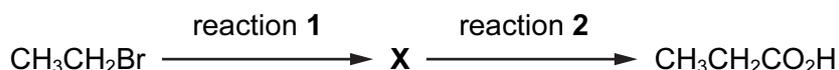
Which row gives the correct reagents and conditions for reaction **1** and reaction **2** in this reaction scheme?

	reaction **1**	reaction **2**
A	heat with ethanolic KCN	heat with aqueous acid
B	heat with ethanolic KCN	heat with acidified potassium dichromate
C	heat with ethanolic KOH	heat with aqueous acid
D	heat with aqueous KOH	heat with acidified potassium dichromate

18 Many alcohols are oxidised by heating with acidified potassium dichromate.

Which alcohol is not oxidised by these conditions?

A   **B**   **C**   **D**
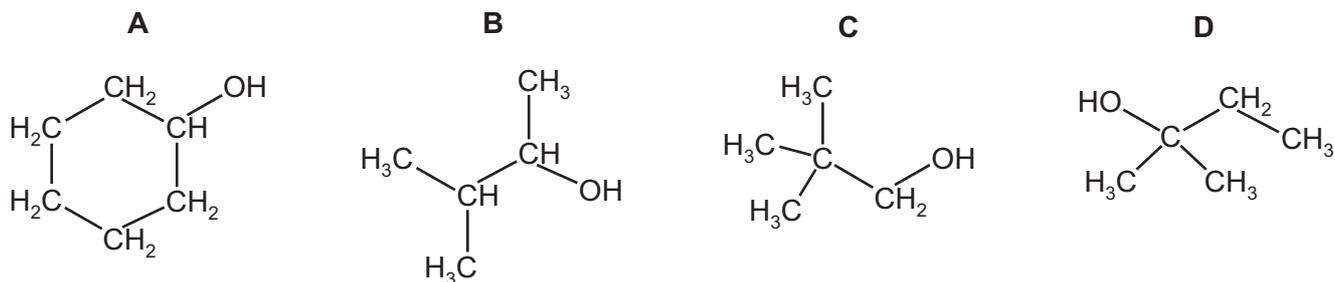
19 The diagram shows the structure of propanone.

$$H_3C-C-CH_3$$
$$\parallel$$
$$O$$
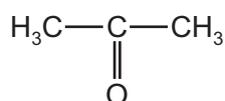
Which row gives the correct observations when propanone has reacted separately with each of the reagents?

	warm $K_2Cr_2O_7/H^+$	2,4-DNPH
A	green solution	an orange precipitate
B	green solution	a silver mirror
C	orange solution	an orange precipitate
D	orange solution	a silver mirror

20 But-2-ene can be polymerised to form an addition polymer.

The structural formula of but-2-ene is $CH_3CH=CHCH_3$.

What is a correct equation for the addition polymerisation of but-2-ene?

A $2CH_3CH=CHCH_3 \rightarrow CH_3CH_2C(CH_3)=C(CH_3)CH_2CH_3$

B $nCH_3CH=CHCH_3 \rightarrow -(CH_2CH_2CH_2CH_2)_n-$

C $nCH_3CH=CHCH_3 \rightarrow -(CH_3CH=CHCH_3)_n-$

D $nCH_3CH=CHCH_3 \rightarrow -(CH(CH_3)CH(CH_3))_n-$
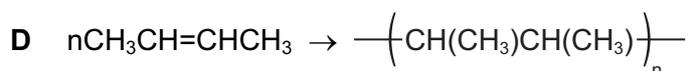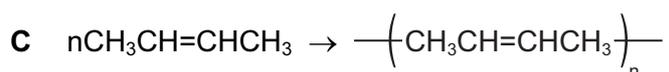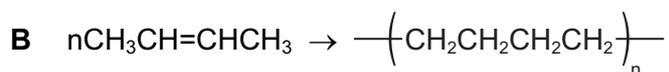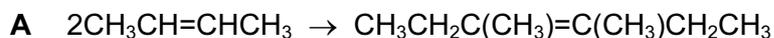
Section B

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 Four statements using prefixes to change the size of units are listed.

Which statements are correct?

1   1 ps is equal to $1 \times 10^{-6}\,\mu s$

2   1 ms is equal to $1 \times 10^{-3}\,\mu s$

3   1 Ms is equal to $1 \times 10^{12}\,\mu s$

4   1 Gs is equal to $1 \times 10^{9}\,\mu s$

22 A raindrop is formed in a cloud in the upper atmosphere.

The raindrop falls vertically through the air from rest.

Which statements are correct?

1   The acceleration of the raindrop is always $9.81\,m\,s^{-2}$.

2   The speed of the raindrop increases and then becomes constant.

3   The resultant force on the raindrop increases and then becomes constant.

4   The force on the raindrop due to air resistance increases and then becomes constant.

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.

23 Two identical spheres move towards each other along a horizontal, frictionless surface in a vacuum.
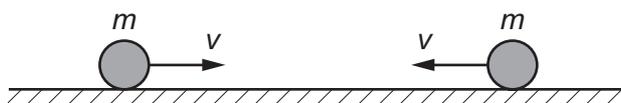
Each sphere has mass *m* and speed *v*. The spheres undergo a head-on elastic collision.

Which statements are correct?

1 The total momentum of the spheres before the collision is 2*mv*.

2 The total momentum of the spheres after the collision is zero.

3 The total kinetic energy of the spheres after the collision is zero.

4 The total kinetic energy of the spheres before the collision is mv^2.

24 A student makes four comments regarding energy changes for changes of state.

Which statements are correct?

1 When ice at $0\,°C$ changes to water at $0\,°C$ the molecules gain kinetic energy.

2 When water boils it transfers more energy to the surroundings than it absorbs from its surroundings.

3 When liquid water at $0\,°C$ changes to ice at $0\,°C$ the molecules gain potential energy.

4 When water vapour condenses the molecules lose potential energy.

25 Which statements about a positively charged particle moving in a uniform electric field are correct?

1 The force on the particle due to the field is always opposite to the direction of its velocity.

2 The force on the particle is always opposite to the direction of the field.

3 The force on the particle is always in the direction of the velocity.

4 The force on the particle due to the field is always in the direction of the field.

26 Which statements are correct?

1 Nitrogen is an unreactive gas due to the high strength of the triple covalent bond in a nitrogen molecule.

2 The ammonium ion, NH_4^+, is tetrahedral with a bond angle of 109.5°.

3 Excessive use of nitrate fertilisers can result in eutrophication.

4 Ammonia is released when solid ammonium sulfate is heated with hydrochloric acid.

27 Rain is polluted by acidic gases released from an old power station. This old power station burns coal which has a sulfur content of 1.5% by weight.

The old power station is to be replaced by a new power station.

Which design feature of a new power station would lead to the rain being less acidic?

1 It burns 100% pure methane instead of coal.

2 It passes its exhaust gases through calcium hydroxide.

3 It burns coal with a sulfur content of 0.2% by weight.

4 It burns coal with a sulfur content of 3.0% by weight.

28 Blister copper is an impure form of copper obtained from the ore *chalcopyrite*, $CuFeS_2$.

Blister copper is converted into pure copper by electrolysis.

Which statements about the purification of blister copper are correct?

1 Valuable metals such as gold may be recovered from anode sludge.

2 Blister copper is used as the cathode of the electrolysis cell.

3 Aqueous $CuSO_4$ can be used as the electrolyte in the electrolysis cell.

4 The mass of the anode increases as copper metal is deposited.

29 The structural formula of a compound is shown.

$$CH_3CH_2CHO$$

Which statements about the compound are correct?

1 It can be reduced to propan-1-ol by $NaBH_4$.

2 It can be oxidised to propanoic acid.

3 It reacts with Tollens' reagent to form a silver mirror.

4 It can be formed from propan-2-ol by oxidation.

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.

30 Which statements are correct?

1 Poly(ethene) is formed when many C_2H_4 molecules link together into a chain.

2 Used PVC may be safely disposed of by burning on a domestic fire.

3 Polymerisation of the monomer $CH_2=CHCl$ produces PVC.

4 The polymer of propene, $CH_3CH=CH_2$, is biodegradable.