National Qualifications 2015

X757/75/02

Physics
Section 1—Questions

TUESDAY, 5 MAY

9:00 AM – 11:00 AM

Instructions for the completion of Section 1 are given on *Page two* of your question and answer booklet X757/75/01.

Record your answers on the answer grid on *Page three* of your question and answer booklet.

Reference may be made to the Data Sheet on *Page two* of this booklet and to the Relationship Sheet X757/75/11.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

DATA SHEET

Speed of light in materials

Material	*Speed* in $m\,s^{-1}$
Air	$3{\cdot}0 \times 10^8$
Carbon dioxide	$3{\cdot}0 \times 10^8$
Diamond	$1{\cdot}2 \times 10^8$
Glass	$2{\cdot}0 \times 10^8$
Glycerol	$2{\cdot}1 \times 10^8$
Water	$2{\cdot}3 \times 10^8$

Gravitational field strengths

	Gravitational field strength on the surface in $N\,kg^{-1}$
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Specific latent heat of fusion of materials

Material	*Specific latent heat of fusion* in $J\,kg^{-1}$
Alcohol	$0{\cdot}99 \times 10^5$
Aluminium	$3{\cdot}95 \times 10^5$
Carbon Dioxide	$1{\cdot}80 \times 10^5$
Copper	$2{\cdot}05 \times 10^5$
Iron	$2{\cdot}67 \times 10^5$
Lead	$0{\cdot}25 \times 10^5$
Water	$3{\cdot}34 \times 10^5$

Specific latent heat of vaporisation of materials

Material	*Specific latent heat of vaporisation* in $J\,kg^{-1}$
Alcohol	$11{\cdot}2 \times 10^5$
Carbon Dioxide	$3{\cdot}77 \times 10^5$
Glycerol	$8{\cdot}30 \times 10^5$
Turpentine	$2{\cdot}90 \times 10^5$
Water	$22{\cdot}6 \times 10^5$

Speed of sound in materials

Material	*Speed* in $m\,s^{-1}$
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	*Specific heat capacity* in $J\,kg^{-1}\,°C^{-1}$
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	*Melting point* in °C	*Boiling point* in °C
Alcohol	−98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Iron	1537	2737

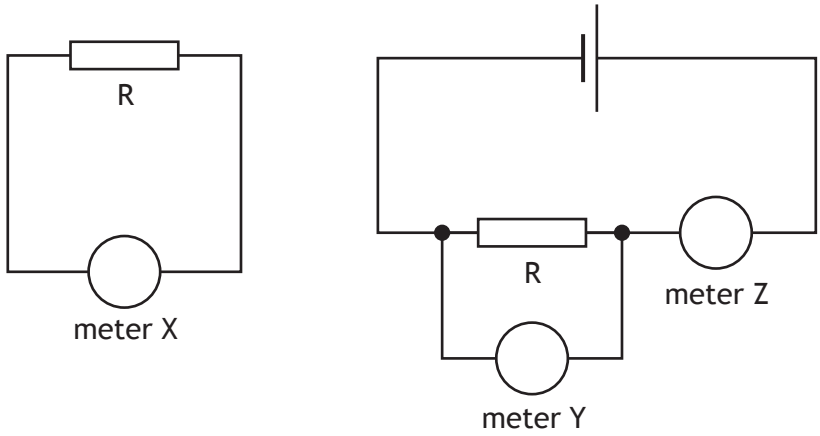
Radiation weighting factors

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3
X-rays	1

SECTION 1

Attempt ALL questions

1. Two circuits are set up as shown.



Both circuits are used to determine the resistance of resistor R.

Which row in the table identifies meter X, meter Y and meter Z?

	meter X	*meter Y*	*meter Z*
A	ohmmeter	voltmeter	ammeter
B	ohmmeter	ammeter	voltmeter
C	voltmeter	ammeter	ohmmeter
D	ammeter	voltmeter	ohmmeter
E	voltmeter	ohmmeter	ammeter

2. Which of the following statements is/are correct?

I The voltage of a battery is the number of joules of energy it gives to each coulomb of charge.

II A battery only has a voltage when it is connected in a complete circuit.

III Electrons are free to move within an insulator.

A I only

B II only

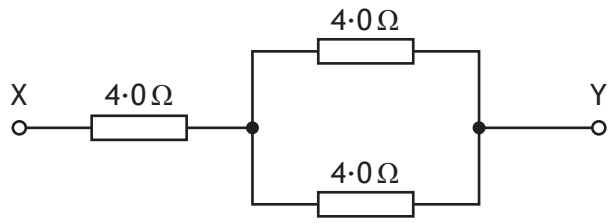
C III only

D II and III only

E I, II and III

[Turn over

3. A circuit is set up as shown.



The resistance between X and Y is

A 1·3 Ω
B 4·5 Ω
C 6·0 Ω
D 8·0 Ω
E 12 Ω.

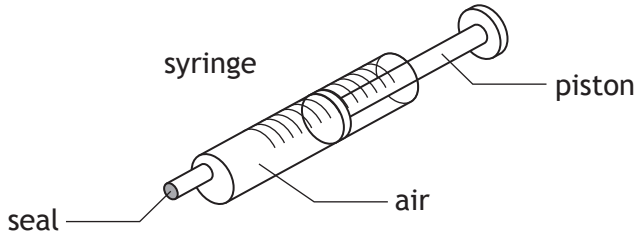
4. The rating plate on an electrical appliance is shown.

230 V~
50 Hz
920 W
model: HD 1055

The resistance of this appliance is

A 0·017 Ω
B 0·25 Ω
C 4·0 Ω
D 18·4 Ω
E 57·5 Ω.

5. A syringe containing air is sealed at one end as shown.



The piston is pushed in slowly.

There is no change in temperature of the air inside the syringe.

Which of the following statements describes and explains the change in pressure of the air in the syringe?

A The pressure increases because the air particles have more kinetic energy.

B The pressure increases because the air particles hit the sides of the syringe more frequently.

C The pressure increases because the air particles hit the sides of the syringe less frequently.

D The pressure decreases because the air particles hit the sides of the syringe with less force.

E The pressure decreases because the air particles have less kinetic energy.

6. The pressure of a fixed mass of gas is 150 kPa at a temperature of 27 °C.

The temperature of the gas is now increased to 47 °C.

The volume of the gas remains constant.

The pressure of the gas is now

A 86 kPa

B 141 kPa

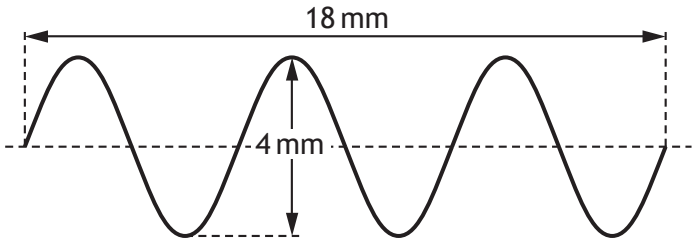
C 150 kPa

D 160 kPa

E 261 kPa.

[Turn over

7. The diagram represents a water wave.



The wavelength of the water wave is

A 2 mm
B 3 mm
C 4 mm
D 6 mm
E 18 mm.

8. A student makes the following statements about different types of electromagnetic waves.

I Light waves are transverse waves.
II Radio waves travel at 340 m s^{-1} through air.
III Ultraviolet waves have a longer wavelength than infrared waves.

Which of these statements is/are correct?

A I only
B I and II only
C I and III only
D II and III only
E I, II and III

9. Alpha radiation ionises an atom.

Which statement describes what happens to the atom?

A The atom splits in half.
B The atom releases a neutron.
C The atom becomes positively charged.
D The atom gives out gamma radiation.
E The atom releases heat.

10. A sample of tissue is irradiated using a radioactive source.

A student makes the following statements.

The equivalent dose received by the tissue is

I reduced by shielding the tissue with a lead screen

II increased as the distance from the source to the tissue is increased

III increased by increasing the time of exposure of the tissue to the radiation.

Which of the statements is/are correct?

A I only

B II only

C I and II only

D II and III only

E I and III only

11. A sample of tissue receives an absorbed dose of 16 μGy from alpha particles.

The radiation weighting factor for alpha particles is 20.

The equivalent dose received by the sample is

A 0·80 μSv

B 1·25 μSv

C 4 μSv

D 36 μSv

E 320 μSv.

12. For a particular radioactive source, 240 atoms decay in 1 minute.

The activity of this source is

A 4 Bq

B 180 Bq

C 240 Bq

D 300 Bq

E 14 400 Bq.

[Turn over

13. The letters **X, Y** and **Z** represent missing words from the following passage.

During a nuclear ..... **X** ..... *reaction two nuclei of smaller mass number combine to produce a nucleus of larger mass number. During a nuclear* ..... **Y** ..... *reaction a nucleus of larger mass number splits into two nuclei of smaller mass number. Both of these reactions are important because these processes can release* ..... **Z** ..... .

Which row in the table shows the missing words?

	X	*Y*	*Z*
A	fusion	fission	electrons
B	fission	fusion	energy
C	fusion	fission	protons
D	fission	fusion	protons
E	fusion	fission	energy

14. Which of the following quantities is fully described by its magnitude?

A Force

B Displacement

C Energy

D Velocity

E Acceleration

15. The table shows the velocities of three objects X, Y and Z over a period of 3 seconds. Each object is moving in a straight line.

Time (s)	0	1	2	3
Velocity of X ($m\,s^{-1}$)	2	4	6	8
Velocity of Y ($m\,s^{-1}$)	0	1	2	3
Velocity of Z ($m\,s^{-1}$)	0	2	5	9

Which of the following statements is/are correct?

I X moves with constant velocity.

II Y moves with constant acceleration.

III Z moves with constant acceleration.

A I only

B II only

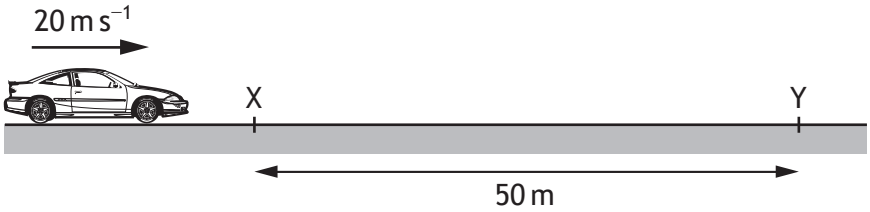
C I and II only

D I and III only

E II and III only

16. A car of mass 1200 kg is travelling along a straight level road at a constant speed of $20\,m\,s^{-1}$.

The driving force on the car is 2500 N. The frictional force on the car is 2500 N.



The work done moving the car between point X and point Y is

A 0 J

B 11 800 J

C 125 000 J

D 240 000 J

E 250 000 J.

[Turn over

17. A person sits on a chair which rests on the Earth. The person exerts a downward force on the chair.

Which of the following is the reaction to this force?

A The force of the chair on the person

B The force of the person on the chair

C The force of the Earth on the person

D The force of the chair on the Earth

E The force of the person on the Earth

18. A package falls vertically from a helicopter. After some time the package reaches its terminal velocity.

A group of students make the following statements about the package when it reaches its terminal velocity.

I The weight of the package is less than the air resistance acting on the package.

II The forces acting on the package are balanced.

III The package is accelerating towards the ground at $9{\cdot}8\,\text{m}\,\text{s}^{-2}$.

Which of these statements is/are correct?

A I only

B II only

C III only

D I and III only

E II and III only

19. The distance from the Sun to Proxima Centauri is 4·3 light years.

This distance is equivalent to

A $1{\cdot}4 \times 10^{8}$ m

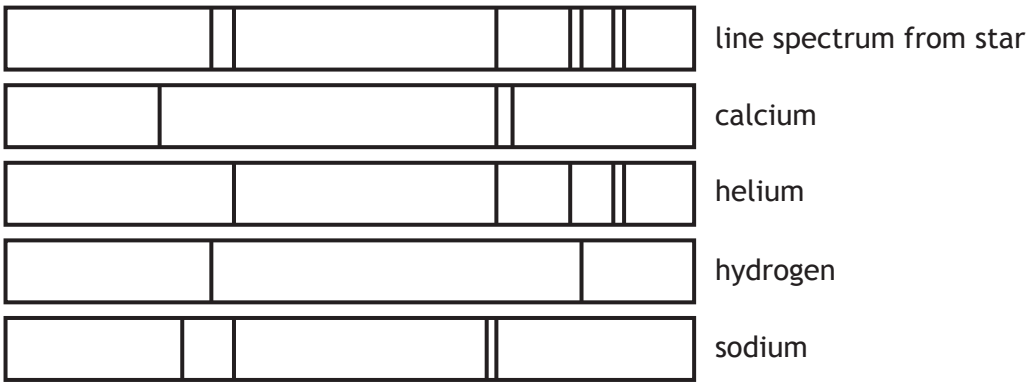
B $1{\cdot}6 \times 10^{14}$ m

C $6{\cdot}8 \times 10^{14}$ m

D $9{\cdot}5 \times 10^{15}$ m

E $4{\cdot}1 \times 10^{16}$ m.

20. Light from a star is split into a line spectrum of different colours. The line spectrum from the star is shown, along with the line spectra of the elements calcium, helium, hydrogen and sodium.



The elements present in this star are

A sodium and calcium

B calcium and helium

C hydrogen and sodium

D helium and hydrogen

E calcium, sodium and hydrogen.

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET]

ACKNOWLEDGEMENTS

Question 17 – Rob Byron/shutterstock.com