National Qualifications 2014

X757/75/02

Physics
Section 1—Questions

THURSDAY, 22 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

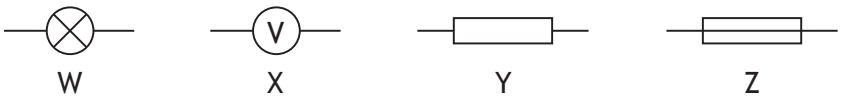
Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3
X-rays	1

SECTION 1

1. The voltage of an electrical supply is a measure of the

A resistance of the circuit
B speed of the charges in the circuit
C power developed in the circuit
D energy given to the charges in the circuit
E current in the circuit.

2. Four circuit symbols, W, X, Y and Z, are shown.



Which row identifies the components represented by these symbols?

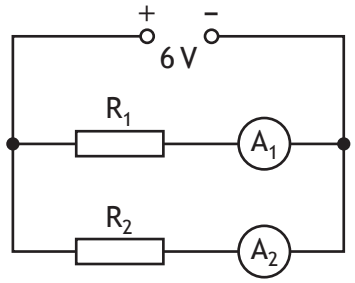
	W	*X*	*Y*	*Z*
A	battery	ammeter	resistor	variable resistor
B	battery	ammeter	fuse	resistor
C	lamp	ammeter	variable resistor	resistor
D	lamp	voltmeter	resistor	fuse
E	lamp	voltmeter	variable resistor	fuse

[Turn over

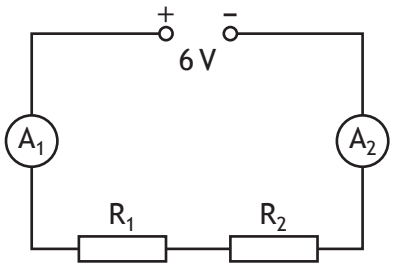
3. A student suspects that ammeter A_1 may be inaccurate. Ammeter A_2 is known to be accurate.

Which of the following circuits should be used to compare the reading on A_1 with A_2?

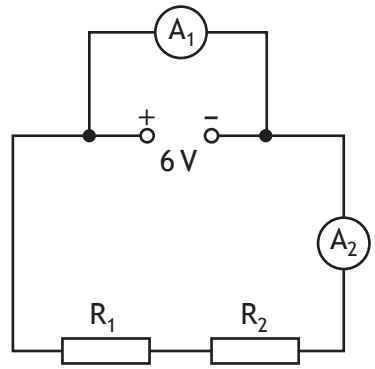
A



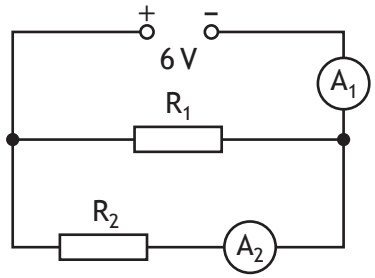
B



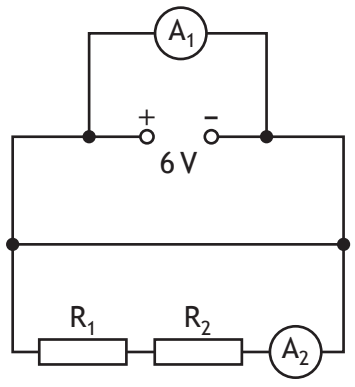
C



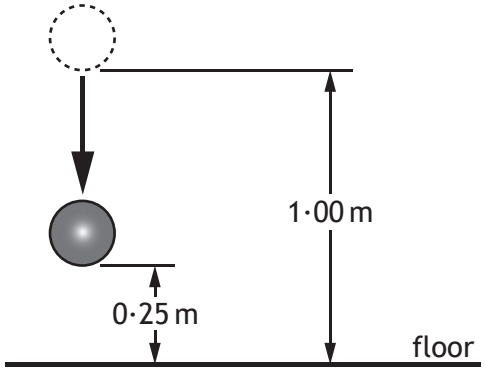
D



E



4. A ball of mass 0·50 kg is released from a height of 1·00 m and falls towards the floor.



Which row in the table shows the gravitational potential energy and the kinetic energy of the ball when it is at a height of 0·25 m from the floor?

	Gravitational potential energy (J)	*Kinetic energy* (J)
A	0·12	0·12
B	1·2	1·2
C	1·2	3·7
D	3·7	1·2
E	4·9	1·2

5. The pressure of a fixed mass of gas is $6{\cdot}0 \times 10^5$ Pa.

The temperature of the gas is 27 °C and the volume of the gas is $2{\cdot}5\ m^3$.

The temperature of the gas increases to 54 °C and the volume of the gas increases to $5{\cdot}0\ m^3$.

What is the new pressure of the gas?

A $2{\cdot}8 \times 10^5$ Pa

B $3{\cdot}3 \times 10^5$ Pa

C $6{\cdot}0 \times 10^5$ Pa

D $1{\cdot}1 \times 10^6$ Pa

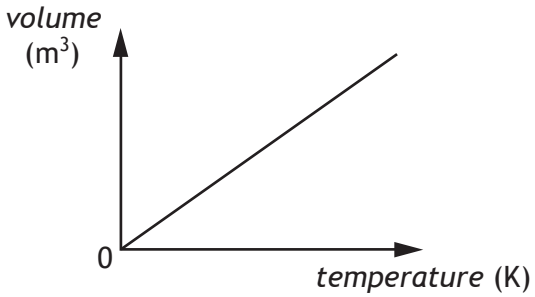
E $1{\cdot}3 \times 10^6$ Pa

[Turn over

6. A student is investigating the relationship between the volume and the kelvin temperature of a fixed mass of gas at constant pressure.

Which graph shows this relationship?

A



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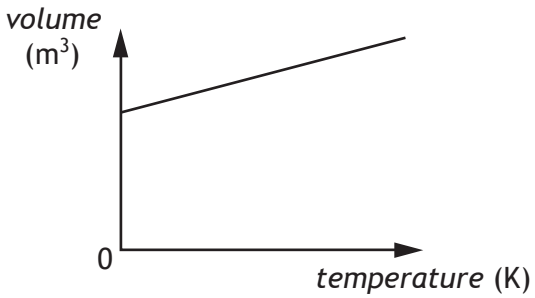

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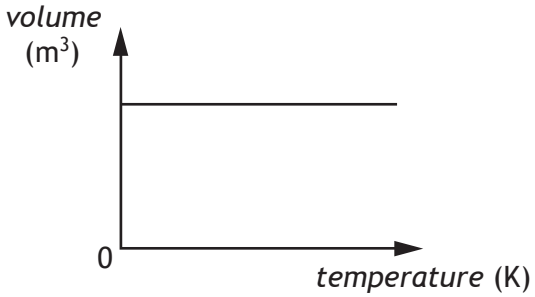

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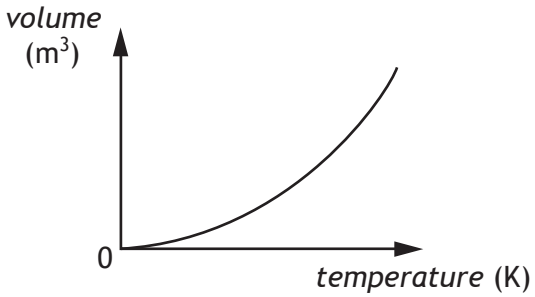
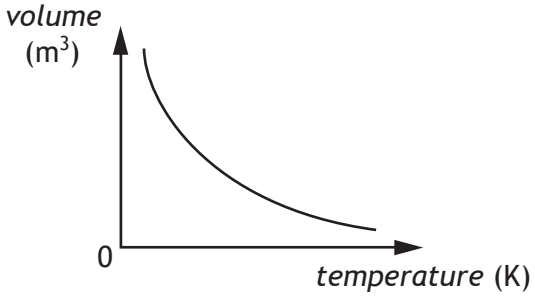


E



7. A liquid is heated from 17 °C to 50 °C. The temperature rise in kelvin is

A 33 K
B 67 K
C 306 K
D 340 K
E 579 K.

8. The period of vibration of a guitar string is 8 ms.
The frequency of the sound produced by the guitar string is

A 0·125 Hz
B 12·5 Hz
C 125 Hz
D 800 Hz
E 8000 Hz.

9. A student makes the following statements about microwaves and radio waves.

I In air, microwaves travel faster than radio waves.
II In air, microwaves have a longer wavelength than radio waves.
III Microwaves and radio waves are both members of the electromagnetic spectrum.

Which of these statements is/are correct?

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

10. Which row describes alpha (α), beta (β) and gamma (γ) radiations?

	α	β	γ
A	helium nucleus	electromagnetic radiation	electron from the nucleus
B	helium nucleus	electron from the nucleus	electromagnetic radiation
C	electron from the nucleus	helium nucleus	electromagnetic radiation
D	electromagnetic radiation	helium nucleus	electron from the nucleus
E	electromagnetic radiation	electron from the nucleus	helium nucleus

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

A student makes the following statements about the sample.

I The equivalent dose received by the sample is reduced by shielding the sample with a lead screen.

II The equivalent dose received by the sample is increased as the distance from the source to the sample is increased.

III The equivalent dose received by the sample is increased by increasing the time of exposure of the sample to the radiation.

Which of these 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

12. The half-life of a radioactive source is 64 years.

In 2 hours, $1{\cdot}44 \times 10^8$ radioactive nuclei in the source decay.

What is the activity of the source in Bq?

A 2×10^4

B 4×10^4

C $1{\cdot}2 \times 10^6$

D $2{\cdot}25 \times 10^6$

E $7{\cdot}2 \times 10^7$

13. A student makes the following statements about the fission process in a nuclear power station.

I Electrons are used to bombard a uranium nucleus.

II Heat is produced.

III The neutrons released can cause other nuclei to undergo fission.

Which of these statements is/are correct?

A I only

B II only

C III only

D I and II only

E II and III only

14. Which of the following contains two vectors and one scalar quantity?

A Acceleration, mass, displacement

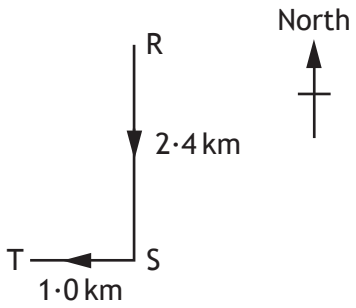
B Displacement, force, velocity

C Time, distance, force

D Displacement, velocity, acceleration

E Speed, velocity, distance

15. A vehicle follows a course from R to T as shown.



The total journey takes 1 hour.

Which row in the table gives the average speed and the average velocity of the vehicle for the whole journey?

	Average speed	*Average velocity*
A	2·6 km h^{-1} (023)	3·4 km h^{-1}
B	2·6 km h^{-1}	3·4 km h^{-1} (203)
C	3·4 km h^{-1} (203)	2·6 km h^{-1}
D	3·4 km h^{-1}	2·6 km h^{-1} (023)
E	3·4 km h^{-1}	2·6 km h^{-1} (203)

16. A force of 10 N acts on an object for 2 s.

During this time the object moves a distance of 3 m.

The work done on the object is

A 6·7 J

B 15 J

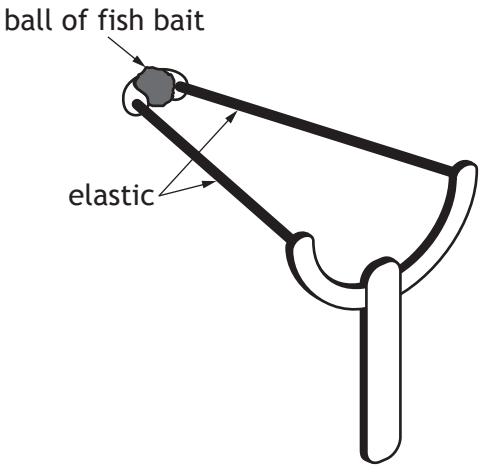
C 20 J

D 30 J

E 60 J.

17. Catapults are used by anglers to project fish bait into water.

A technician designs a catapult for this use.



Pieces of elastic of different thickness are used to provide a force on the ball.

Each piece of elastic is the same length.

The amount of stretch given to each elastic is the same each time.

The force exerted on the ball increases as the thickness of the elastic increases.

Which row in the table shows the combination of the thickness of elastic and mass of ball that produces the greatest acceleration?

	Thickness of elastic (mm)	*Mass of ball* (kg)
A	5	0·01
B	10	0·01
C	10	0·02
D	15	0·01
E	15	0·02

18. A spacecraft completes the last stage of its journey back to Earth by parachute, falling with constant speed into the sea.

The spacecraft falls with constant speed because

A the gravitational field strength of the Earth is constant near the Earth's surface

B it has come from space where the gravitational field strength is almost zero

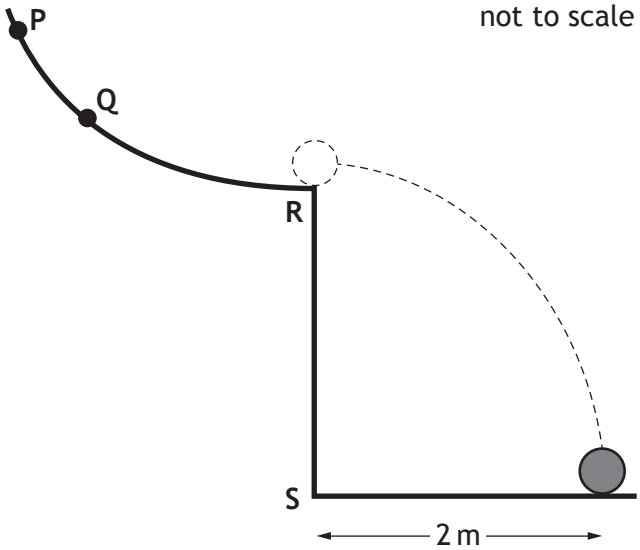
C the air resistance is greater than the weight of the spacecraft

D the weight of the spacecraft is greater than the air resistance

E the air resistance is equal to the weight of the spacecraft.

19. A ball is released from point **Q** on a curved rail, leaves the rail horizontally at R and lands 1 s later.

The ball is now released from point **P**.

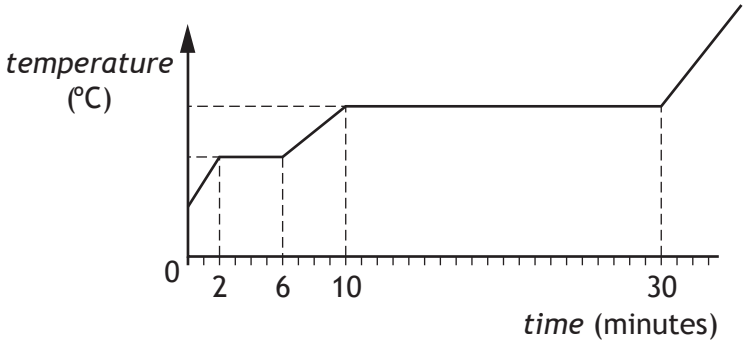


Which row describes the motion of the ball after leaving the rail?

	Time to land after leaving rail	*Distance from S to landing point*
A	1 s	less than 2 m
B	less than 1 s	more than 2 m
C	1 s	more than 2 m
D	less than 1 s	2 m
E	more than 1 s	more than 2 m

20. A solid substance is placed in an insulated flask and heated continuously with an immersion heater.

The graph shows how the temperature of the substance in the flask changes in time.



After 5 minutes the substance is a

A solid

B liquid

C gas

D mixture of solid and liquid

E mixture of liquid and gas.

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