Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/11**

Paper 1 Multiple Choice **October/November 2015**

1 hour

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

8125084631

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 **forty** 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 working should be done in this booklet.
Electronic calculators may be used.

This document consists of **19** printed pages and **1** blank page.

IB15 11_9702_11/6RP

CAMBRIDGE International Examinations

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\,\mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\,\mathrm{H\,m^{-1}}$
permittivity of free space,	$\varepsilon_0 = 8.85 \times 10^{-12}\,\mathrm{F\,m^{-1}}$
	$(\frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^{9}\,\mathrm{m\,F^{-1}})$
elementary charge,	$e = 1.60 \times 10^{-19}\,\mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\,\mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\,\mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\,\mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\,\mathrm{kg}$
molar gas constant,	$R = 8.31\,\mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\,\mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\,\mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\,\mathrm{N\,m^{2}\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\,\mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
hydrostatic pressure,	$p = \rho gh$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
simple harmonic motion,	$a = -\omega^2 x$
velocity of particle in s.h.m.,	$v = v_0 \cos \omega t$
	$v = \pm \omega \sqrt{(x_0^2 - x^2)}$
electric potential,	$V = \frac{Q}{4\pi\varepsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
alternating current/voltage,	$x = x_0 \sin \omega t$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

1 What is the unit of weight in terms of SI base unit(s)?

A kg m s^{-1} **B** kg m s^{-2} **C** N **D** J m^{-1}

2 At temperatures close to 0 K, the specific heat capacity c of a particular solid is given by $c = bT^3$, where T is the thermodynamic temperature and b is a constant characteristic of the solid.
The SI unit of specific heat capacity is J kg^{-1} K^{-1}.

What is the unit of constant b, expressed in SI base units?

A m^2 s^{-2} K^{-3}

B m^2 s^{-2} K^{-4}

C kg m^2 s^{-2} K^{-3}

D kg m^2 s^{-2} K^{-4}

3 In making reasonable estimates of physical quantities, which statement is **not** correct?

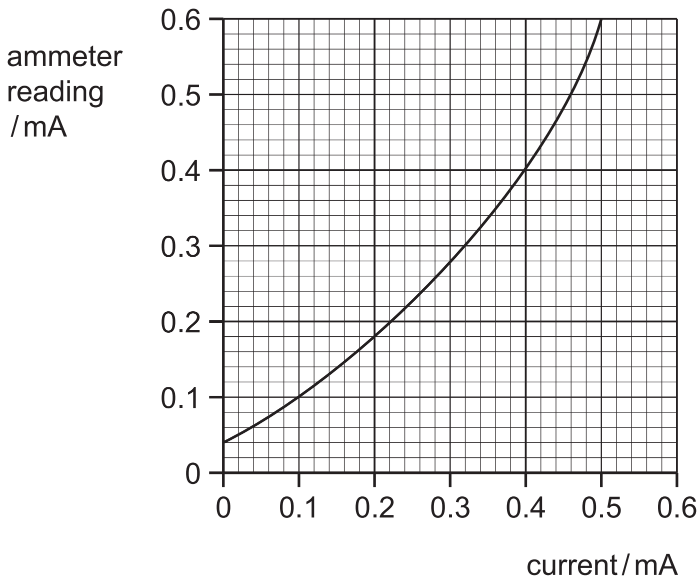
A The frequency of sound can be of the order of GHz.

B The wavelength of light can be of the order of 600 nm.

C The Young modulus of a metal can be of the order of 10^{11} Pa.

D Beta particles are associated with one unit of negative charge.

4 A calibration graph is shown for an ammeter whose scale is inaccurate.

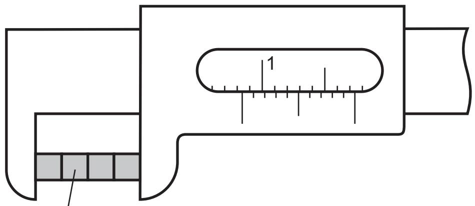


Two readings taken on the meter at different times during an experiment are 0.13 mA and 0.47 mA.

By how much did the current really increase between taking the two readings?

A 0.30 mA **B** 0.35 mA **C** 0.40 mA **D** 0.44 mA

5 Four identical rods have a square cross-section. The rods are placed side by side and their total width is measured with vernier calipers, as shown.



The measurement is (8.4 ± 0.1) mm and the zero reading on the calipers is (0.0 ± 0.1) mm.

What is the width of one rod?

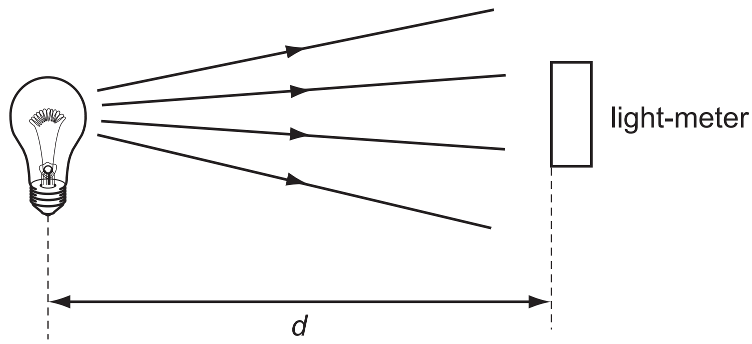
A (2.10 ± 0.025) mm

B (2.10 ± 0.05) mm

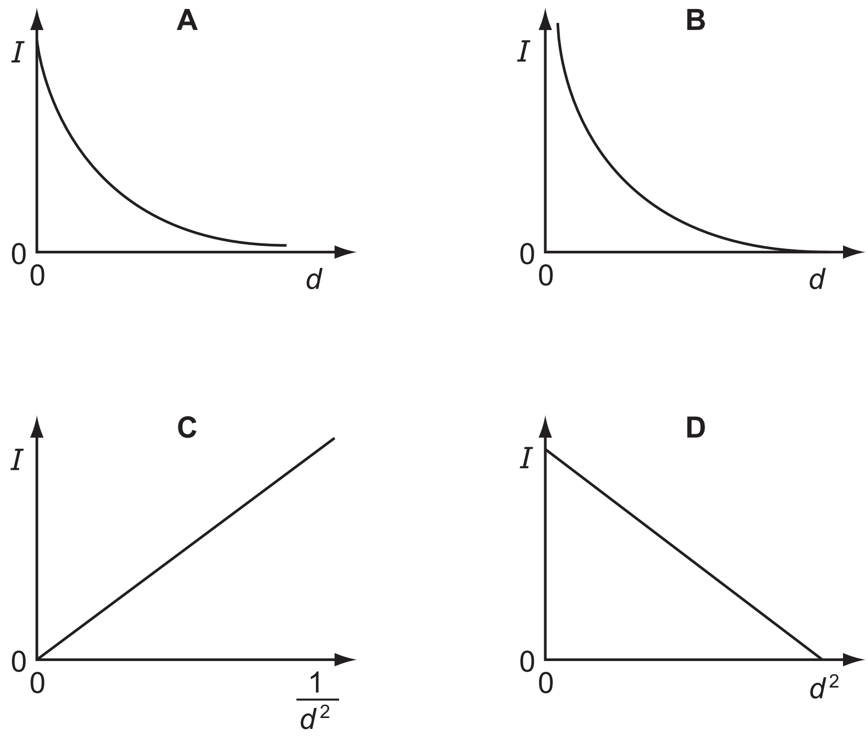
C (2.1 ± 0.1) mm

D (2.1 ± 0.2) mm

6 A light-meter measures the intensity I of the light incident on it. Theory suggests that I varies inversely as the square of the distance d.



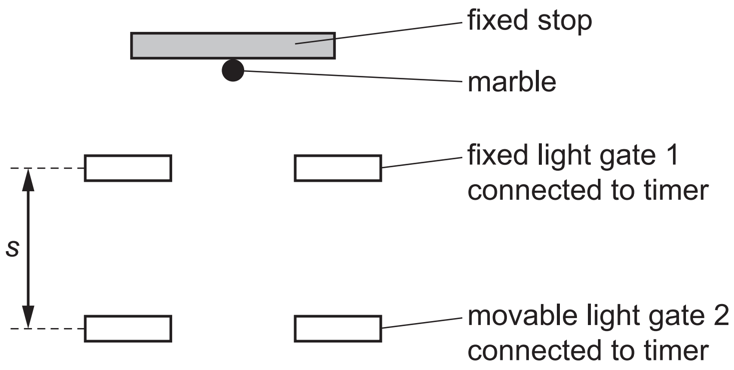
Which graph of the results supports this theory?



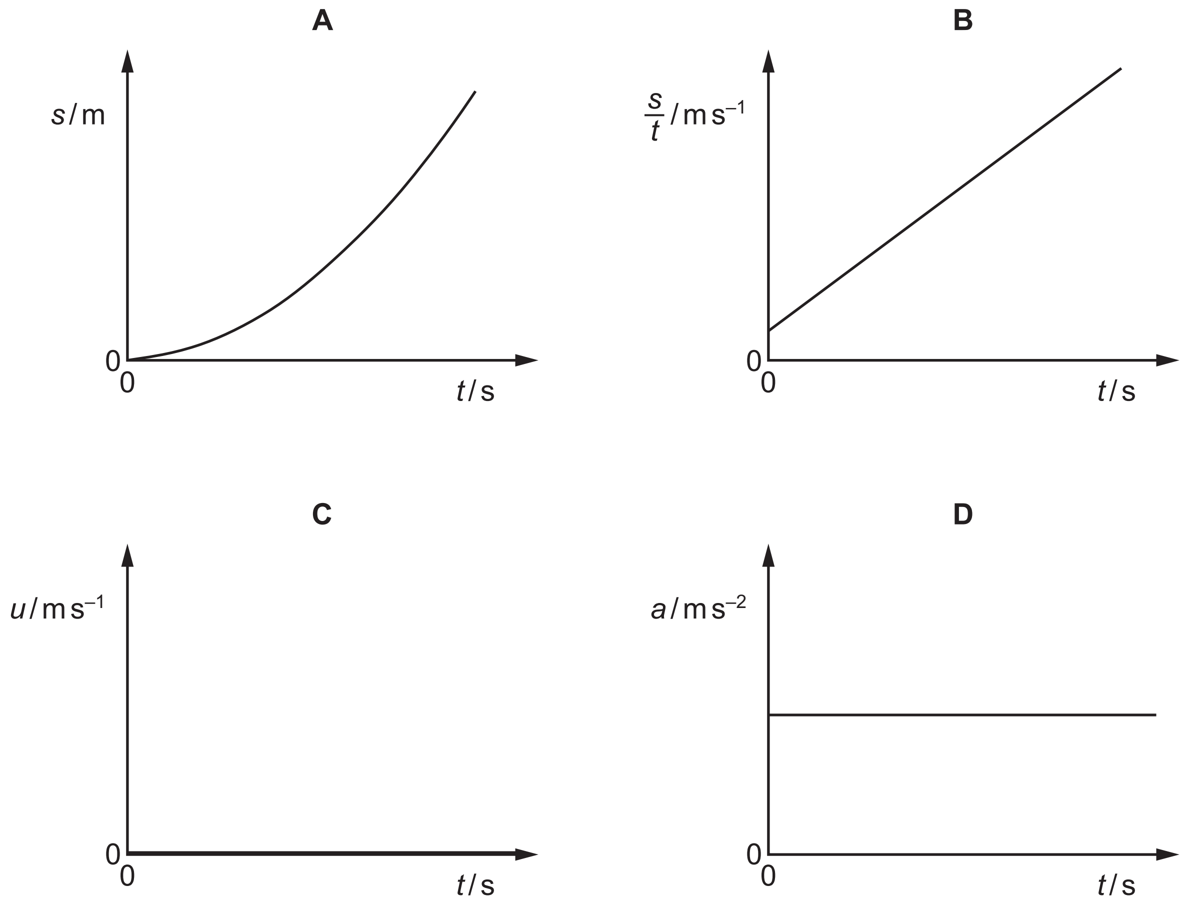
7 One of the equations of uniformly accelerated motion is shown.

$$s = ut + \tfrac{1}{2}at^2$$

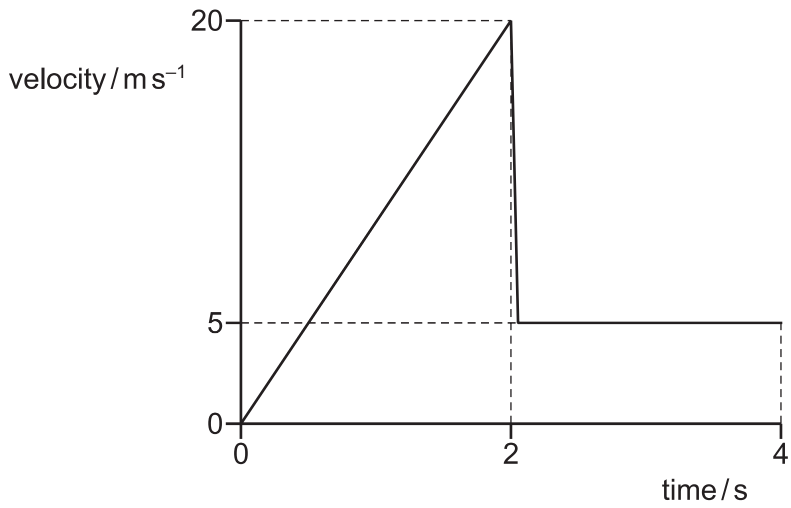
Apparatus is arranged to record the time t taken for a marble to fall between two light gates connected to timers. The marble touches the stop before it is released. The vertical distance s between the light gates is measured.



Which graph does **not** show a correct relationship when light gate 2 moves up to light gate 1 which is fixed?



8 A stone is dropped from a height of 20 m above water. The graph shows the variation with time of the velocity of the stone.



Which statement describes the approximate position of the stone four seconds after it is dropped?

A It is at a distance of 10 m above the surface of the water.

B It is at a distance of 10 m below the surface of the water.

C It is at a distance of 20 m below the surface of the water.

D It is at a distance of 30 m below the surface of the water.

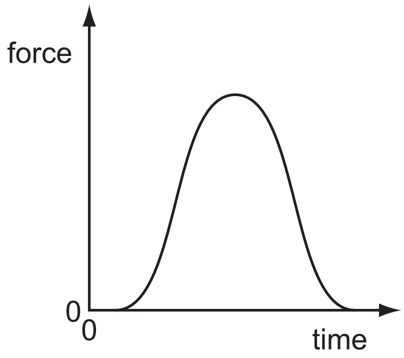
9 The water surface in a deep well is 78.0 m below the top of the well. A person at the top of the well drops a heavy stone down the well.

Air resistance is negligible. The speed of sound in the air is 330 m s^{-1}.

What is the time interval between the person dropping the stone and hearing it hitting the water?

A 3.75 s **B** 3.99 s **C** 4.19 s **D** 4.22 s

10 A golf ball is hit by a club. The graph shows the variation with time of the force exerted on the ball by the club.



Which quantity, for the time of contact, **cannot** be found from the graph?

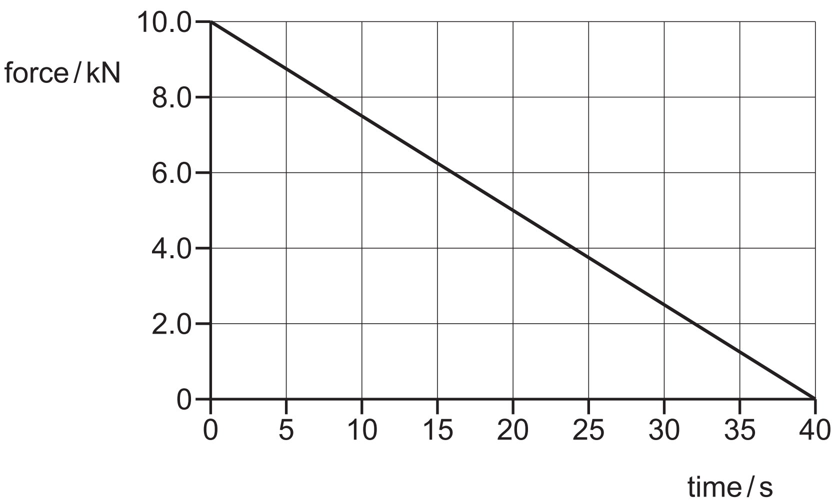
A the average force on the ball

B the change in momentum of the ball

C the contact time between the ball and the club

D the maximum acceleration of the ball

11 A glider of mass 1500 kg is launched from rest on a straight and level track using a catapult. The graph shows the variation with time of the resultant force.



What is the speed of the glider when the resultant force acting on it reaches zero?

A $133\,\text{m}\,\text{s}^{-1}$ **B** $200\,\text{m}\,\text{s}^{-1}$ **C** $250\,\text{m}\,\text{s}^{-1}$ **D** $267\,\text{m}\,\text{s}^{-1}$

12 Which statement about a ball that strikes a tennis racket and rebounds is **always** correct?

A The total kinetic energy of the ball is conserved.

B The total kinetic energy of the system is conserved.

C The total momentum of the ball is conserved.

D The total momentum of the system is conserved.

13 In which example is it **not** possible for the underlined body to be in equilibrium?

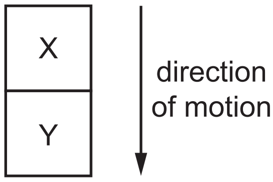
A an aeroplane climbs at a steady rate

B an aeroplane tows a glider at a constant altitude

C a speedboat changes direction at a constant speed

D two tug boats tow a ship into harbour

14 Two blocks X and Y are falling through a vacuum in a uniform gravitational field, as shown.



Block X has weight $2w$.

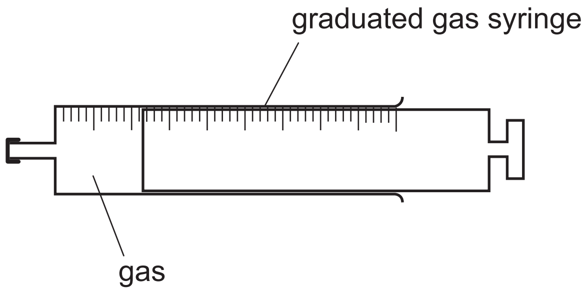
Block Y has weight w.

The blocks do not move apart.

Which value best represents the force exerted by block X on block Y?

A 0 **B** w **C** $1.5w$ **D** $2w$

15 A gas is contained inside a sealed syringe, as shown.



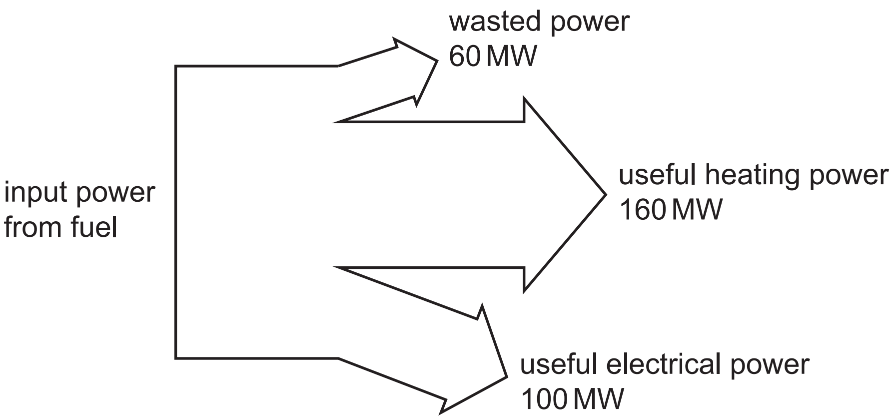
The volume of gas at room temperature is $2.0\,cm^3$.

Atmospheric pressure is 101 kPa.

What is the work done by the gas when it is heated and expands to a volume of $6.0\,cm^3$?

A 404 μJ **B** 404 mJ **C** 404 J **D** 404 kJ

16 A combined heat and power (CHP) station generates electrical power and useful heat. The diagram shows the input and output for a CHP station.



What is the efficiency of the CHP station for producing useful power?

A 31% **B** 38% **C** 50% **D** 81%

17 In 'normal driving conditions', an electric car has a range of 150 km. This uses all of the 200 MJ energy stored in its batteries.

With the batteries initially fully charged, the car is driven 100 km in 'normal driving conditions'. The batteries are then recharged from a household electrical supply delivering a constant current of 13.0 A at a potential difference (p.d.) of 230 V.

What is the minimum time required to recharge the batteries?

A 0.95 hours

B 12.4 hours

C 18.6 hours

D 27.9 hours

18 A fixed amount of gas is reduced in volume at a constant temperature.

What is the reason for the increase in pressure of the gas?

A The average distance travelled between collisions by the gas molecules is increased.

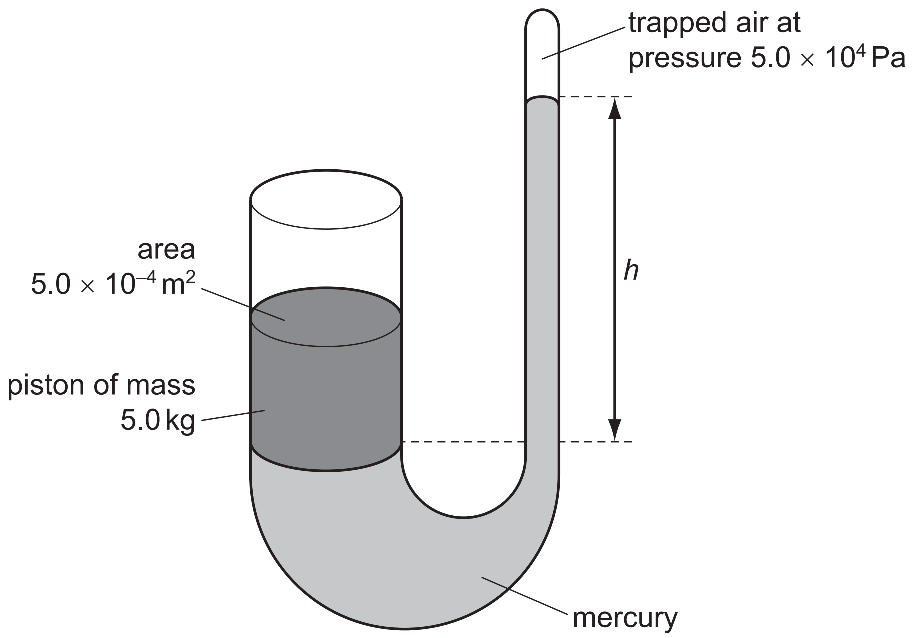
B The average intermolecular attractive force between the gas molecules is decreased.

C The average speed of the gas molecules is increased.

D The frequency of the collisions of the gas molecules with the walls of the container is increased.

19 A U-tube closed at one end contains mercury. Air at a pressure of 5.0×10^4 Pa is trapped at the closed end. The other end is open to the atmosphere and is fitted with a piston of mass 5.0 kg and cross-sectional area 5.0×10^{-4} m^2.

The density of mercury is 13 600 kg m^{-3} and atmospheric pressure is 1.01×10^5 Pa.



What is the height *h* of the mercury column?

A 37 cm **B** 44 cm **C** 74 cm **D** 110 cm

20 A known tensile force acts on a wire. The wire does not exceed its elastic limit.

Which two measurements enable the strain of the wire to be calculated?

A the unstretched length of the wire and the cross-sectional area of the wire

B the unstretched length of the wire and the extension of the wire

C the Young modulus of the wire's material and the extension of the wire

D the Young modulus of the wire's material and the unstretched length of the wire

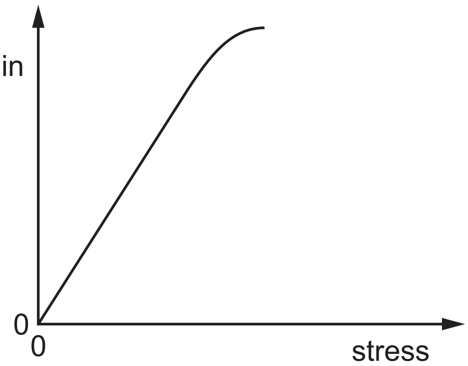
21 The Young modulus of steel is determined using a length of steel wire and is found to have the value *E*.

Another experiment is carried out using a wire of the same steel, but of half the length and half the diameter.

Which value is obtained for the Young modulus in the second experiment?

A $\frac{1}{2}E$ **B** E **C** $2E$ **D** $4E$

22 The graph shows the variation with stress of the strain of a material as it is extended elastically.



Why is the strain energy per unit volume of the material **not** the area under the graph?

A The axes are the wrong way round.

B The graph is not a straight line.

C The graph is strain-stress instead of extension-force.

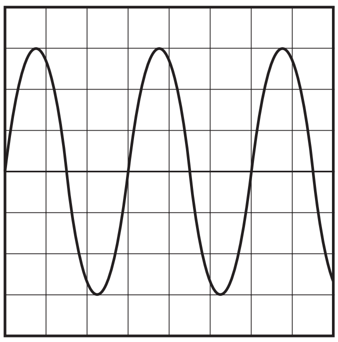
D The material is polymeric.

23 A wire has a final length of 6.0 m after undergoing a strain of 200%.

What is the original length of the wire?

A 1.5 m **B** 2.0 m **C** 3.0 m **D** 4.0 m

24 A sound wave is displayed on the screen of a cathode-ray oscilloscope, as shown.



The time-base setting is 0.50 ms per division.

What is the frequency of the sound wave?

A 250 Hz **B** 500 Hz **C** 670 Hz **D** 1300 Hz

25 Part of a car was damaged by heating when, on a sunny day, the car was left in front of a curved mirrored building which focussed reflected sunlight onto the car.

Which statement about sunlight correctly explains this observation?

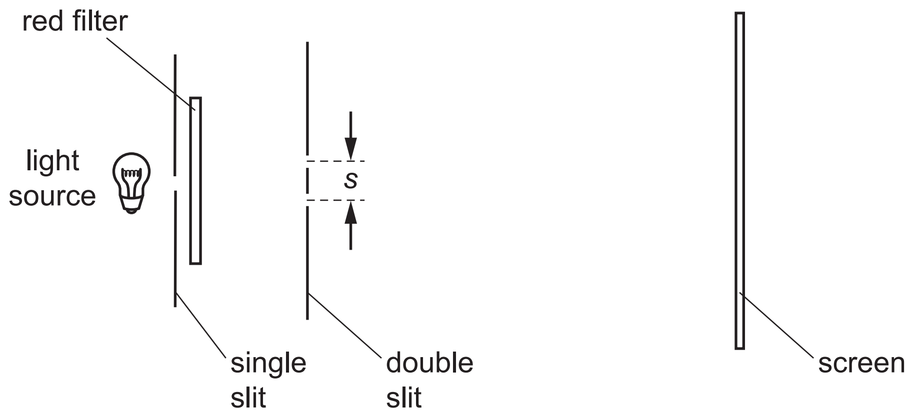
A Sunlight contains infra-red radiation.

B Sunlight contains ultraviolet radiation.

C Sunlight is a longitudinal progressive wave which carries energy.

D Sunlight is a transverse standing wave which carries energy.

26 A student sets up an experiment to investigate double-slit interference of light but finds that the interference fringes observed on the screen are too close to each other to be distinguished.



Which change would help the student to distinguish the fringes?

A decrease the distance *s* between the two slits

B increase the width of each slit

C move the screen closer to the light source

D use a blue filter instead of a red filter

27 Ships have been damaged by water waves with large amplitudes. These waves could have been formed by adding the displacements of smaller waves.

Which term describes this phenomenon?

A diffraction

B polarisation

C refraction

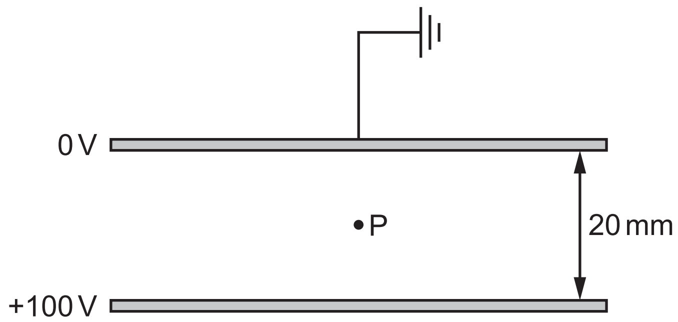
D superposition

28 Water waves of wavelength λ are diffracted as they pass through a gap of width d in a barrier.

Which combination of wavelength and gap width would produce the greatest angle of diffraction?

	gap width	wavelength
A	$\frac{1}{2}d$	2λ
B	$\frac{1}{2}d$	$\frac{1}{2}\lambda$
C	$2d$	2λ
D	$2d$	$\frac{1}{2}\lambda$

29 Two horizontal parallel plate conductors are separated by a distance of 20 mm in air. The upper plate is earthed and the potential of the lower plate is +100 V.



What is the electric field strength at point P midway between the plates?

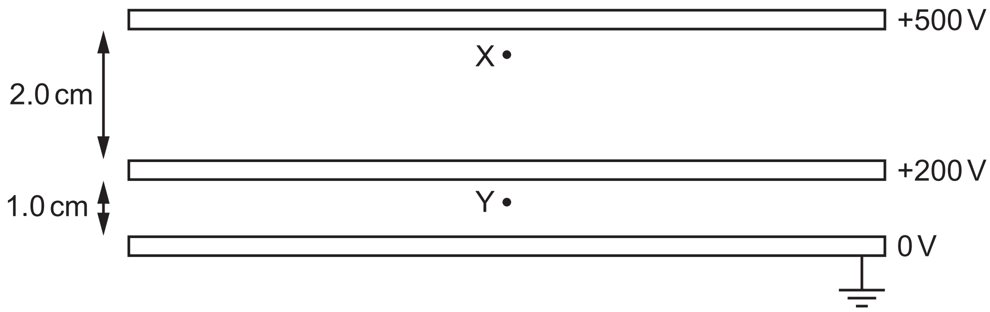
A 5000 V m^{-1} downwards

B 5000 V m^{-1} upwards

C 10 000 V m^{-1} downwards

D 10 000 V m^{-1} upwards

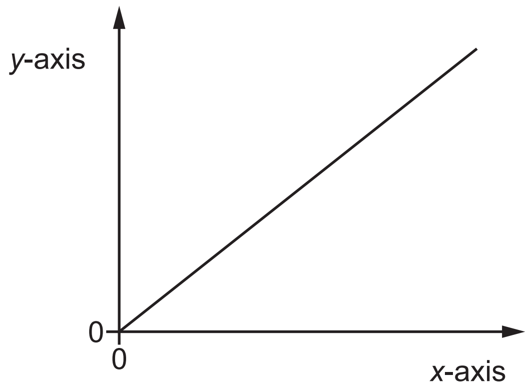
30 Three parallel metal plates of the same area are fixed with a separation of 2.0 cm between the top plate and the centre plate, and 1.0 cm between the centre plate and the bottom plate. The top plate is held at a potential of +500 V, the middle plate at +200 V and the bottom plate is earthed, as shown.



What is the value of the ratio $\dfrac{\text{magnitude of force on an electron at X}}{\text{magnitude of force on an electron at Y}}$?

A 0.75 **B** 1.00 **C** 1.25 **D** 1.50

31 The diagram shows a graph.



For a uniform metallic wire, what could the graph **not** represent?

	y-axis	*x*-axis
A	current	potential difference
B	resistance	length
C	resistance	temperature in °C
D	potential difference	current

32 An iron wire has length 8.0 m and diameter 0.50 mm. The wire has resistance R.

A second iron wire has length 2.0 m and diameter 1.0 mm.

What is the resistance of the second wire?

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

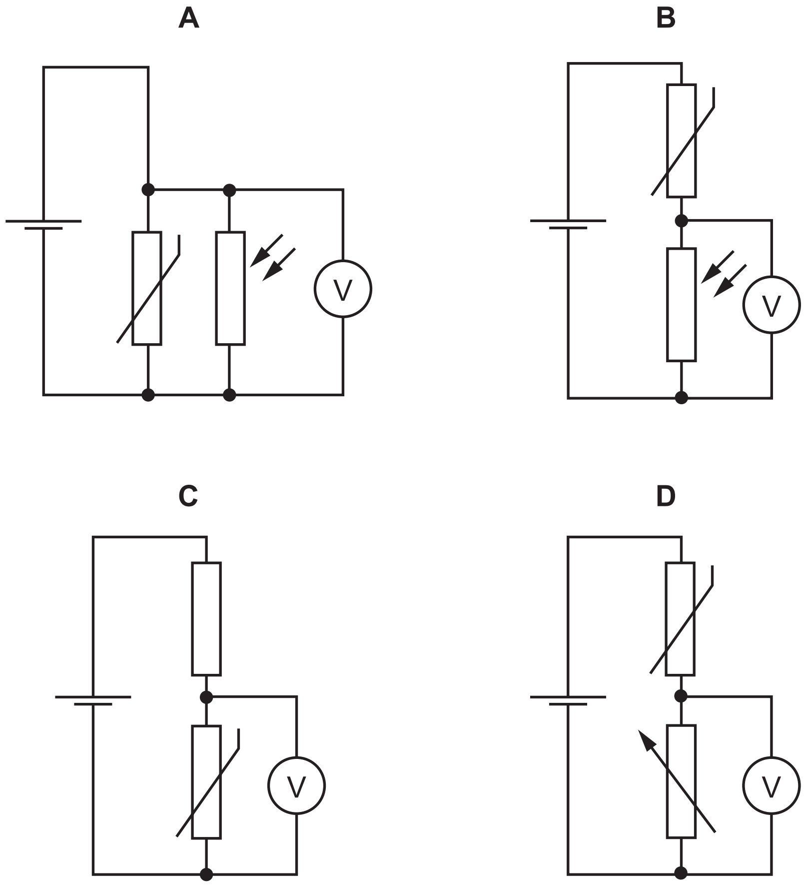
33 The Atlantic torpedo is a large electric fish capable of generating a voltage of 220 V between its tail and its head. This drives a pulse of current of 15 A lasting for a time of 2.0 ms. The fish produces 200 pulses per second.

What is the average power output of the fish?

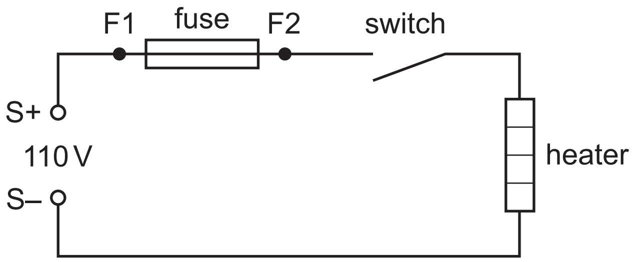
A 33 W **B** 1.3 kW **C** 3.3 kW **D** 6.6 kW

34 A thermistor and another component are connected to a constant voltage supply. A voltmeter is connected across one of the components. The temperature of the thermistor is then reduced but no other changes are made.

In which circuit will the voltmeter reading increase?



35 A 110 V d.c. supply is connected to a heater, a fuse and a switch, as shown.



Owing to a fault in the system, power is not supplied to the heater. A technician diagnoses the fault using a voltmeter.

He closes the switch and connects his meter between the positive supply terminal S+ and the fuse terminal F2. The voltmeter reads 110 V.

Which diagnosis is correct?

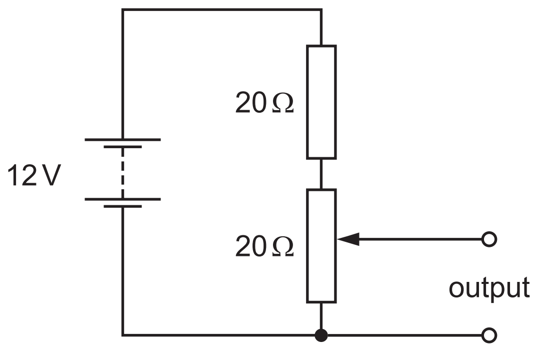
A The fuse has melted.

B The fuse has not melted and there is a short circuit in the heater.

C The fuse has not melted and there is no path for current through the heater.

D The fuse has not melted and the switch has operated correctly.

36 The diagram shows a potentiometer and a fixed resistor connected across a 12 V battery of negligible internal resistance.



The fixed resistor and the potentiometer each have resistance 20 Ω. The circuit is designed to provide a variable output voltage.

What is the range of output voltages?

A 0 – 6 V **B** 0 – 12 V **C** 6 – 12 V **D** 12 – 20 V

37 Radioactive decay is random.

What is meant by the term *random*?

A The decay of a nucleus can be predicted.

B The decay of a nucleus is unaffected by pressure.

C The decay of a nucleus is unaffected by temperature.

D The nucleus has a constant probability of decay per unit time.

38 The nuclei of the isotopes of an element all contain the same number of a certain particle.

What is this particle?

A electron

B neutron

C nucleon

D proton

39 Which statement about nuclei is correct?

A Different isotopic nuclei have different proton numbers.

B For some nuclei, the nucleon number can be less than the proton number.

C In some nuclear processes, mass-energy is not conserved.

D Nucleon numbers of nuclei are unchanged by the emission of β-particles.

40 The diagram shows part of a radioactive decay chain in which the nuclide thorium-232 decays by α-emission into radium-228. This nuclide is also unstable and decays by β-emission into a nuclide of actinium. This process continues.

$$^{232}_{90}\mathrm{Th} \xrightarrow{\alpha} {}^{228}_{88}\mathrm{Ra} \xrightarrow{\beta} {}^{X}_{89}\mathrm{Ac} \xrightarrow{Y} {}^{228}_{90}\mathrm{Th} \xrightarrow{\alpha} {}^{224}\mathrm{Z} \longrightarrow$$

What are X, Y and Z?

	X	Y	Z
A	228	α	Th
B	228	β	Ra
C	232	α	Th
D	232	β	Ra

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