



PHYSICS (PRINCIPAL)

9792/01

Paper 1 Part A Multiple Choice

May/June 2015

1 hour 15 minutes

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



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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **16** printed pages.

Data

gravitational field strength close to Earth's surface	$g = 9.81 \text{ N kg}^{-1}$
elementary charge	$e = 1.60 \times 10^{-19} \text{ C}$
speed of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$
permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$
proton mass	$m_p = 1.67 \times 10^{-27} \text{ kg}$
unified atomic mass constant	$u = 1.66 \times 10^{-27} \text{ kg}$
molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
Avogadro constant	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$

Formulae

uniformly accelerated motion

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

$$v^2 = u^2 + 2as$$

$$s = \left(\frac{u+v}{2} \right) t$$

heating

$$\Delta E = mc\Delta\theta$$

change of state

$$\Delta E = mL$$

refraction

$$n = \frac{\sin\theta_1}{\sin\theta_2}$$

$$n = \frac{v_1}{v_2}$$

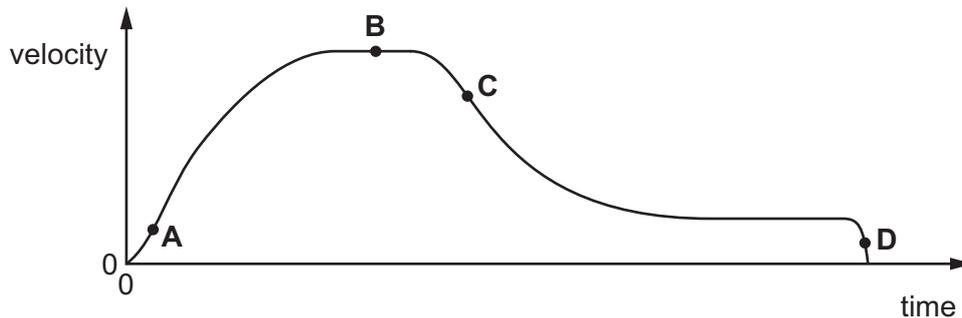
diffraction		electromagnetic induction	$E = -\frac{d(N\Phi)}{dt}$
single slit, minima	$n\lambda = b \sin \theta$	Hall effect	$V = Bvd$
grating, maxima	$n\lambda = d \sin \theta$	time dilation	$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$
double slit interference	$\lambda = \frac{ax}{D}$	kinetic theory	$\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$
Rayleigh criterion	$\theta \approx \frac{\lambda}{b}$	work done on/by a gas	$W = p\Delta V$
photon energy	$E = hf$	radioactive decay	$\frac{dN}{dt} = -\lambda N$ $N = N_0 e^{-\lambda t}$ $t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$
de Broglie wavelength	$\lambda = \frac{h}{p}$	attenuation losses	$I = I_0 e^{-\mu x}$
simple harmonic motion	$x = A \cos \omega t$ $v = -A\omega \sin \omega t$ $a = -A\omega^2 \cos \omega t$ $F = -m\omega^2 x$ $E = \frac{1}{2}mA^2\omega^2$	mass-energy equivalence	$\Delta E = c^2 \Delta m$
energy stored in a capacitor	$W = \frac{1}{2}QV$	hydrogen energy levels	$E_n = \frac{-13.6 \text{ eV}}{n^2}$
electric force	$F = \frac{Q_1 Q_2}{4\pi\epsilon_0 r^2}$	Heisenberg uncertainty principle	$\Delta p \Delta x \geq \frac{h}{2\pi}$ $\Delta E \Delta t \geq \frac{h}{2\pi}$
electrostatic potential energy	$W = \frac{Q_1 Q_2}{4\pi\epsilon_0 r}$	Wien's displacement law	$\lambda_{\text{max}} \propto \frac{1}{T}$
gravitational force	$F = -\frac{Gm_1 m_2}{r^2}$	Stefan's law	$L = 4\pi\sigma r^2 T^4$
gravitational potential energy	$E = -\frac{Gm_1 m_2}{r}$	electromagnetic radiation from a moving source	$\frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$
magnetic force	$F = BIl \sin \theta$ $F = BQv \sin \theta$		

1 Which row contains three vector quantities?

- A acceleration, force, weight
- B acceleration, mass, velocity
- C displacement, force, work
- D displacement, power, work

2 The diagram shows how the velocity of a skydiver changes with time from when she leaves an aeroplane until she lands safely on the ground.

At which time is the magnitude of her acceleration the greatest?



3 What is **not** conserved in an inelastic collision?

- A kinetic energy
- B linear momentum
- C mass
- D total energy

4 A rocket is travelling vertically upwards from the Earth's surface.

The rocket's total mass, including fuel, is M . In a short time t , a mass m of hot exhaust gases is ejected downwards at a velocity v relative to the rocket.

Which expression gives the upward acceleration of the rocket? Ignore air resistance.

- A $\frac{mv}{Mt}$ B $\frac{mv}{t} - Mg$ C $\frac{\frac{mv}{t} - Mg}{M}$ D $\frac{(M - m)v}{Mt}$

5 Which statement about gravitational field strength g is **not** correct?

- A It has a value 9.81 m s^{-2} near the Earth's surface.
- B It can be determined by dividing the weight of an object by its mass.
- C It has the unit N kg^{-1} .
- D It is a scalar quantity.

- 6 Near the surface of Titan, Saturn's largest moon, a mass of 5.0 kg experiences a gravitational force of 6.8 N.

What is its speed of impact on the surface when released from rest at a height of 5.0 m?

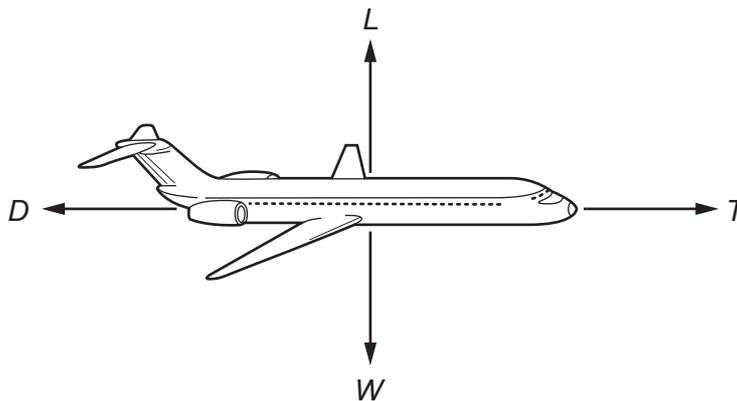
- A 3.7 ms^{-1} B 8.2 ms^{-1} C 9.9 ms^{-1} D 13.5 ms^{-1}

- 7 An apple sits on a table in an aeroplane that is approaching the ground for landing.

Newton's third law tells us that the weight of the apple is equal in size but opposite in direction to

- A the pull of the apple on the Earth.
 B the pull of the Earth on the apple.
 C the push of the apple on the table.
 D the push of the table on the apple.

- 8 Four forces acting on an aeroplane are weight W , horizontal thrust T , vertical lift L , and horizontal drag D . Any other forces can be ignored.



When the aeroplane has a constant horizontal speed of 200 ms^{-1} and is ascending at a steady rate of four metres per minute, which statement is correct?

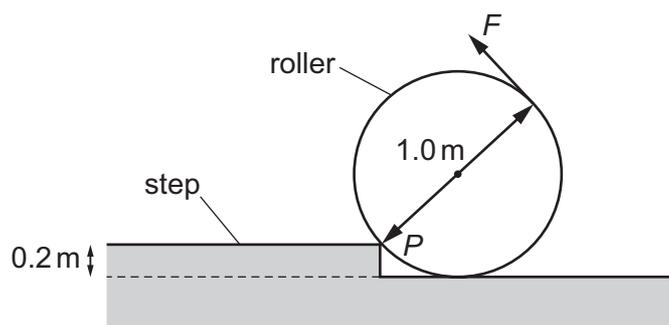
- A $L > W$ and $T > D$
 B $L > W$ and $T = D$
 C $L > W$ and $T < D$
 D $L = W$ and $T = D$

- 9 A projectile is launched at a speed of 30 m s^{-1} at an angle of 20° above the horizontal.



What is the velocity of the projectile at its highest point? Ignore air resistance.

- A 0 m s^{-1} B 8.6 m s^{-1} C 28 m s^{-1} D 30 m s^{-1}
- 10 A roller of weight 240 N and diameter 1.0 m rests against a step of height 0.2 m at point P.



The minimum force F required to cause the roller to roll to the left may be determined by taking moments about point P.

What is the minimum force F ?

- A 96 N B 120 N C 192 N D 320 N
- 11 Which row identifies a brittle material and a ductile material at room temperature?

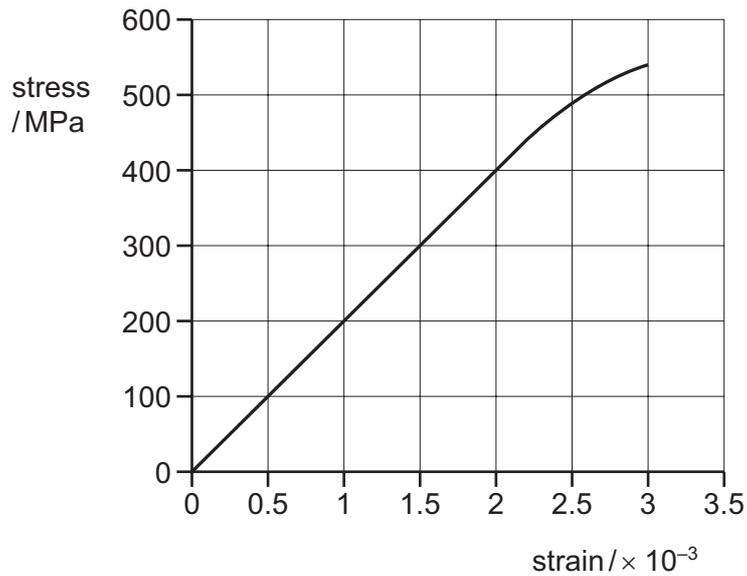
	brittle	ductile
A	copper	glass
B	glass	copper
C	concrete	glass
D	glass	concrete

- 12 The spring used in the suspension mechanism of a vehicle has a stiffness of 100 kN m^{-1} . Four such springs share equally the weight of the vehicle when it is at rest on a level road.

If each spring is compressed by 4 cm from its natural length when the vehicle is in this situation, what is the mass of the vehicle?

- A 400 kg B 1600 kg C $40\,000 \text{ kg}$ D $160\,000 \text{ kg}$

- 13 The graph shows the behaviour of a steel cable, of cross-sectional area 2.0 cm^2 , when it is put under tension until it breaks.



What are the breaking force and Young modulus for the cable?

	breaking force /MN	Young modulus /GPa
A	0.11	180
B	0.11	200
C	11	180
D	11	200

- 14 A boy of mass 40 kg descends a slide. His final speed at the bottom of the slide is 6.0 m s^{-1} .

What is the change in gravitational potential? Assume no energy losses.

- A** decrease of 18 J kg^{-1}
B decrease of 720 J kg^{-1}
C increase of 18 J kg^{-1}
D increase of 720 J kg^{-1}
- 15 The kinetic energy of object X is K . Object Y has half the mass and twice the speed.

What is the kinetic energy of Y?

- A** $\frac{K}{2}$ **B** K **C** $2K$ **D** $4K$

- 16 An aluminium block of mass m and specific heat capacity c is heated by an electrical heater, which supplies a current of I amps when it has a voltage of V volts across it.

At the instant that the electrical heater is switched on, the temperature of the block is T_1 . After time t , the temperature of the block is T_2 .

Which expression correctly gives c in $\text{J kg}^{-1} \text{K}^{-1}$? Assume no energy loss to the surroundings.

- A $\frac{VIt}{m(T_1 - T_2)}$ B $\frac{m(T_2 - T_1)}{VIt}$ C $\frac{VIt}{m(T_2 - T_1)}$ D $\frac{m(T_1 - T_2)}{VIt}$

- 17 200 g of water at 60°C is mixed with 600 g of alcohol at 16°C .

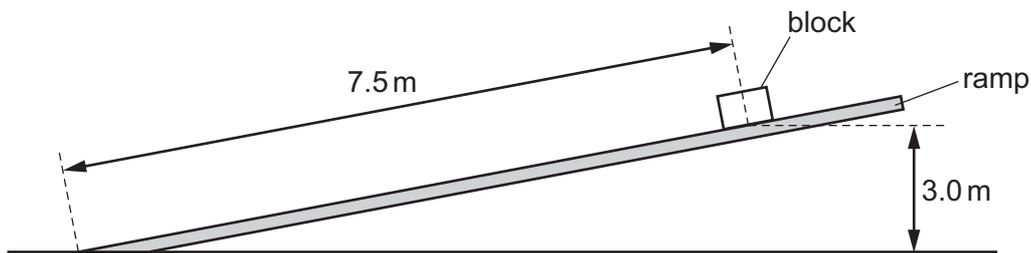
What will be the final temperature of the mixture, if there are no heat losses?

Specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{K}^{-1}$.

Specific heat capacity of alcohol = $2300 \text{ J kg}^{-1} \text{K}^{-1}$.

- A 30°C B 33°C C 38°C D 45°C

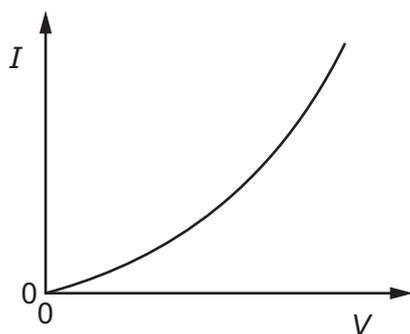
- 18 A 2.5 kg block is placed on a ramp. The block is released from a vertical height of 3.0 m. An average frictional force of 6.0 N acts on the block as it travels down along the ramp. The block travels a distance of 7.5 m along the ramp.



What is the speed of the block at the bottom of the ramp?

- A 4.7 ms^{-1} B 7.7 ms^{-1} C 23 ms^{-1} D 59 ms^{-1}

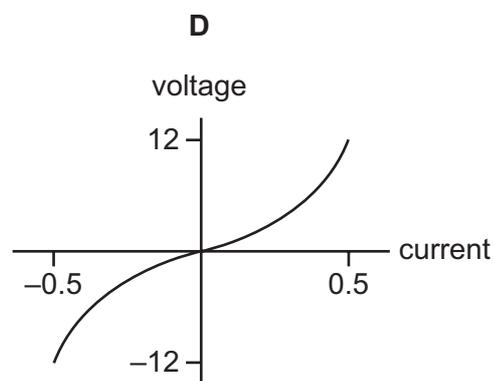
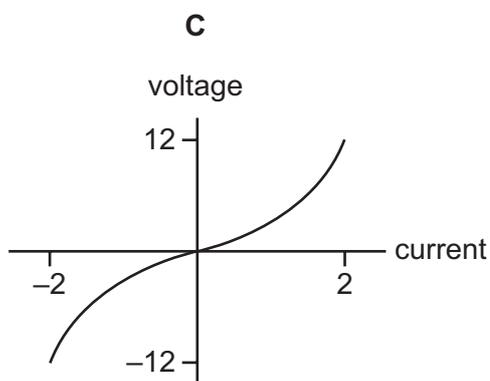
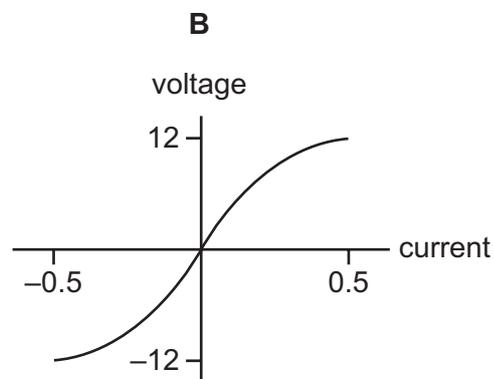
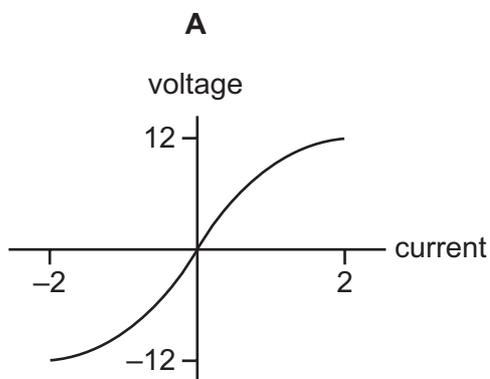
- 19 The graph shows how the current I varies with the potential difference (p.d.) V for a component. The physical dimensions of the component do not change.



The p.d. across the component is increased.

Which statement is correct?

- A** The power dissipated by the component is constant.
B The resistance of the component is equal to the gradient of the graph.
C The resistance of the component is constant.
D The resistivity of the material of the component changes.
- 20 Which graph correctly shows the voltage-current characteristic of a filament bulb rated 12V, 6W?

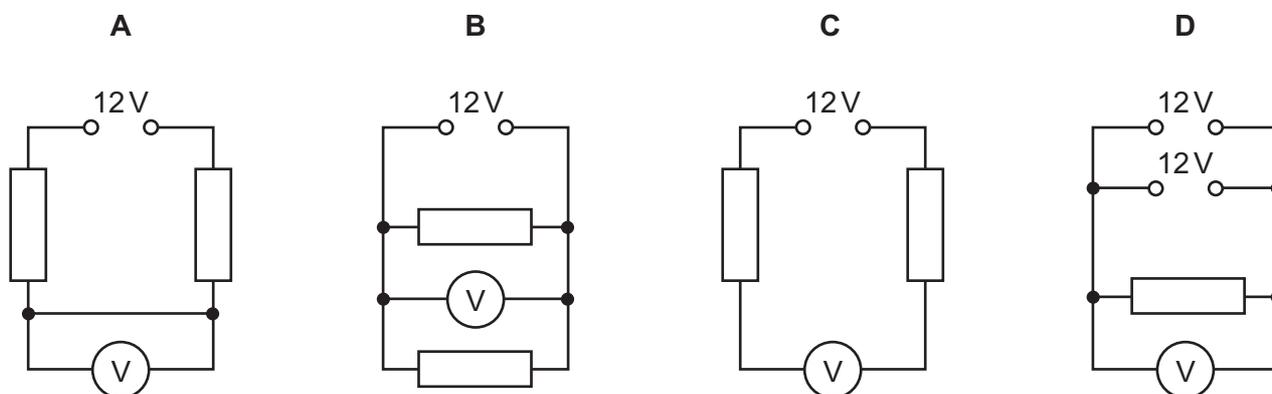


21 The current in a bulb is 2.0 A.

How many electrons flow through the bulb in one minute?

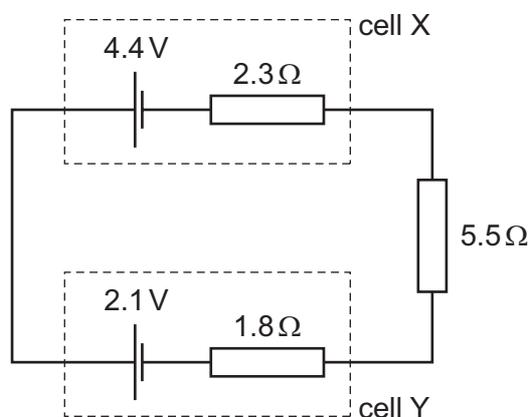
- A 2.0 B 120 C 1.3×10^{19} D 7.5×10^{20}

22 In which circuit does the voltmeter **not** read 12 V?



23 Cell X of emf 4.4 V and internal resistance 2.3Ω is connected in series with cell Y of emf 2.1 V and internal resistance 1.8Ω .

They are connected in series with a resistor of resistance 5.5Ω , as shown.



What is the current through the 5.5Ω resistor?

- A 0.24 A B 0.38 A C 0.42 A D 0.68 A

24 A battery of emf 12 V and internal resistance 2Ω is connected in turn across four resistors of resistance 1Ω , 2Ω , 3Ω and 4Ω .

For which resistance will the power dissipated in the resistor be a maximum?

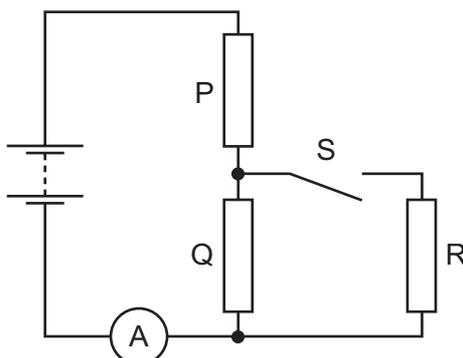
- A 1Ω B 2Ω C 3Ω D 4Ω

- 25 Three identical resistors are connected in series across a cell. The same three resistors are then connected in parallel across the same cell. Assume that the cell has zero internal resistance and does not run down during the experiment.

What is the value of the ratio $\frac{\text{power from cell with resistors in parallel}}{\text{power from cell with resistors in series}}$?

- A $\frac{1}{3}$ B $\frac{1}{9}$ C $\frac{3}{1}$ D $\frac{9}{1}$

- 26 A battery is connected in series with an ammeter and a network of three resistors, P, Q and R, as shown. Initially the switch S is open.



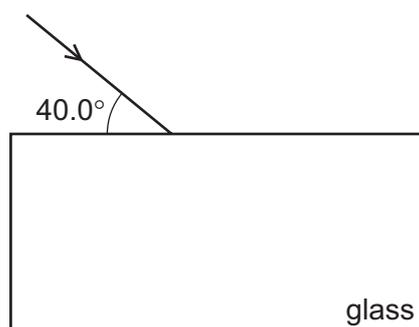
How do the potential difference (p.d.) across Q and the current through the ammeter change when switch S is closed?

	p.d. across Q	current through ammeter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

- 27 Which row contains waves which can **all** be plane polarised?

- A light, radio and sound
 B light, radio and ultraviolet
 C light, sound and ultraviolet
 D radio, sound and ultraviolet

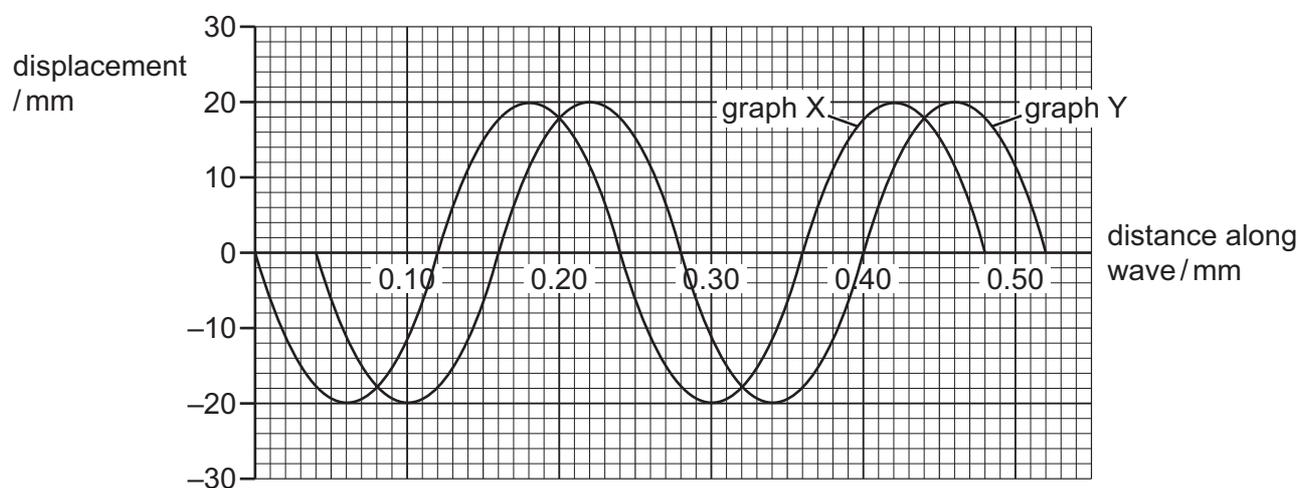
- 28 The diagram shows a ray of light entering a glass block. The glass has a refractive index of 1.5. The ray enters at 40.0° to the surface of the block.



Which row gives the correct values for the angle of incidence and the angle of refraction?

	angle of incidence / $^\circ$	angle of refraction / $^\circ$
A	40.0	25.4
B	40.0	30.7
C	50.0	25.4
D	50.0	30.7

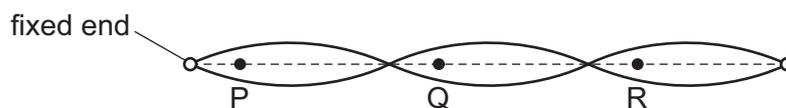
- 29 The diagram shows the displacement of two transverse progressive waves, X and Y, plotted against position at one instant of time.



What is the phase difference between the waves?

- A** 45° **B** 60° **C** 90° **D** 120°

- 30 The string of a musical instrument, fixed at both ends, is set into vibration and forms the stationary wave shown. P, Q and R indicate three points on the string.

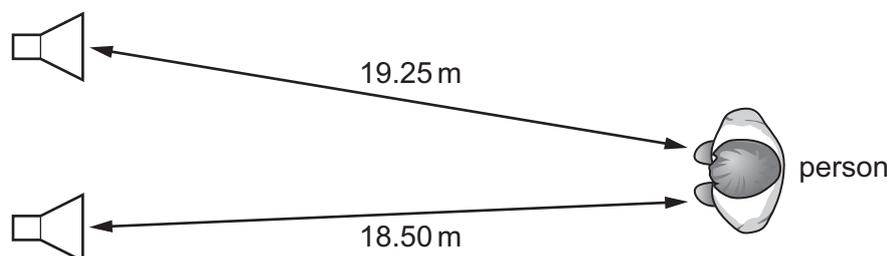


At one instant, the displacement of point P is s .

What are the corresponding values of the displacement at point Q and at point R at the same instant?

	displacement at point Q	displacement at point R
A	$+s$	$+s$
B	$+s$	$-s$
C	$-s$	$+s$
D	$-s$	$-s$

- 31 A person stands in front of two loudspeakers which are connected to the same generator giving a signal of wavelength 0.50 m. Initially only one of the loudspeakers emits a sound.



What happens to the sound heard by the person when both loudspeakers are working?

- A** about four times louder
B about twice as loud
C about the same loudness
D almost no sound
- 32 What is the relationship between phase difference $\Delta\phi$ in radians, path difference x and wavelength λ ?

A $\Delta\phi = \frac{x}{\lambda}$ **B** $\Delta\phi = \frac{\lambda}{x}$ **C** $\Delta\phi = \frac{2\pi x}{\lambda}$ **D** $\Delta\phi = \frac{2\pi\lambda}{x}$

- 33 An optical telescope can just resolve two distant stars that are separated by an angle of 2×10^{-6} radians for yellow light. The wavelength of yellow light is about 6×10^{-7} m.

Which statement is correct?

- A The aperture of the telescope has a diameter of about 0.3 m.
- B The resolving power of the telescope is independent of the wavelength of light.
- C The telescope can be used to distinguish stars separated by 3×10^{-7} radians.
- D The telescope can be used to distinguish two red stars at similar distance.

- 34 The table shows properties of the three radiations α , β^- and γ .

Which row in the table is correct?

	property	α	β^-	γ
A	electrical charge	positive	negative	zero
B	ionising ability	low	medium	high
C	nature	helium nucleus	orbital electron	electromagnetic wave
D	penetrating power	high	low	medium

- 35 When uranium-238, atomic number 92, absorbs a neutron, it becomes unstable and undergoes two successive beta-minus decays.

What is the atomic number, K, and the mass number, L, of the resulting nucleus?

	K	L
A	88	230
B	88	231
C	94	238
D	94	239

- 36 A nucleus of ${}_{92}^{235}\text{U}$ absorbs a neutron before undergoing fission to two new nuclei, X and Y, plus three neutrons.

Which pair of nuclei could be the result of this process?

- A ${}_{55}^{137}\text{X}$ and ${}_{37}^{99}\text{Y}$
- B ${}_{56}^{139}\text{X}$ and ${}_{36}^{93}\text{Y}$
- C ${}_{56}^{141}\text{X}$ and ${}_{36}^{92}\text{Y}$
- D ${}_{52}^{143}\text{X}$ and ${}_{38}^{90}\text{Y}$

37 A radioisotope has a half-life of 18 hours.

At 9:00 am on 1 May, a sample was prepared which contained 4.00 mg of the radioisotope.

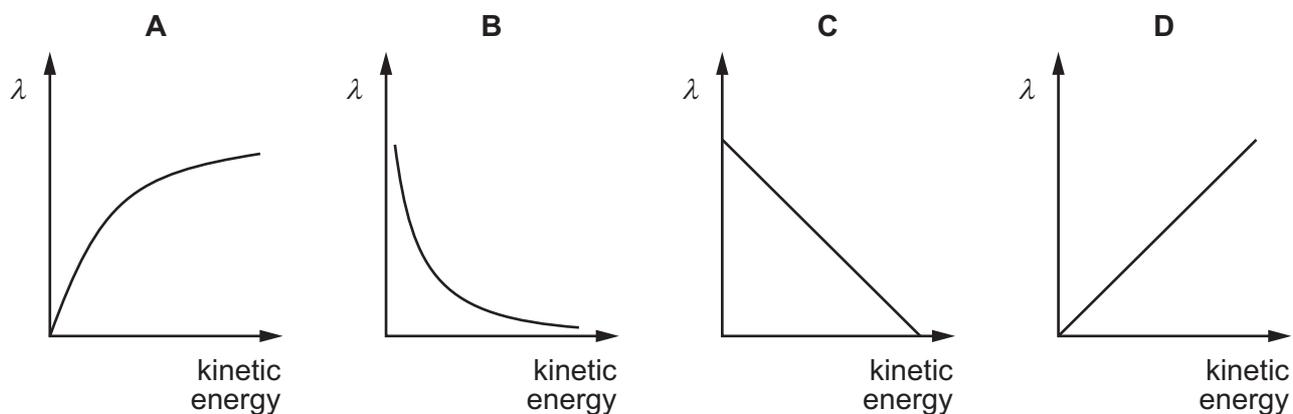
At what time will the mass of the radioisotope remaining be 0.50 mg?

- A 3:00 am on 2 May
- B 3:00 pm on 3 May
- C 9:00 am on 4 May
- D 9:00 pm on 7 May

38 Which statement about a photon is correct?

- A A single photon can eject a single electron from a metal surface.
- B In a vacuum, a photon of red light travels slower than a photon of blue light.
- C The energy of a photon is directly proportional to its wavelength.
- D The energy of a photon depends on the intensity of the light source.

39 For velocities much less than the speed of light, which graph shows how the de Broglie wavelength of an electron and its kinetic energy (k.e.) are related?



- 40** White light falls on a metal surface causing the release of photoelectrons, many of which are moving when released.

The threshold frequency for this surface is 5.3×10^{14} Hz, which corresponds to yellow light.

Which statement is correct?

- A** When a red filter is placed between the light source and the metal surface, the number of photoelectrons released per second will decrease to zero.
- B** If a violet filter is interposed, the number of photoelectrons released per second will increase.
- C** If the light is focused onto a small patch, the electrons released will, on average, be moving more quickly.
- D** It takes a little while for enough energy to accumulate on the surface before any photoelectrons are released.

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