Anglo-Chinese Junior College

Physics Preliminary Examination
Higher 1

A Methodist Institution
(Founded 1886)

PHYSICS **8866/01**
Paper 1 Multiple Choice 18 Sep 2014
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your Name and Index number in the answer sheet provided.

There are **30** questions in this section. 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 Question Paper.

Data

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
elementary charge,	e	=	1.60×10^{-19} C
the Planck constant,	h	=	6.63×10^{-34} J s
unified atomic mass constant,	u	=	1.66×10^{-27} kg
rest mass of electron,	m_e	=	9.11×10^{-31} kg
rest mass of proton,	m_p	=	1.67×10^{-27} kg
acceleration of free fall,	g	=	9.81 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	=	$p\,\Delta V$
hydrostatic pressure,	p	=	$\rho g h$
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$

1 A student uses a digital ammeter to measure a current. The reading of the ammeter is found to fluctuate between 1.98 A and 2.02 A.

The manufacturer of the ammeter states that any reading has a systematic uncertainty of $\pm 1\%$.

Which value of the current should be quoted by the student?

A (2.00 ± 0.01) A

B (2.00 ± 0.02) A

C (2.00 ± 0.03) A

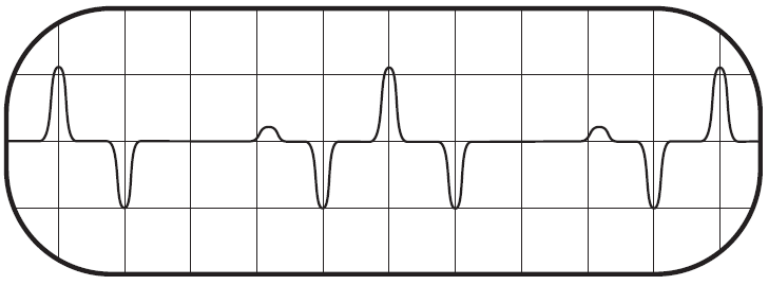
D (2.00 ± 0.04) A

2 An athlete of mass 80 kg competes in a 100 m race.

What is the best estimate of his mean kinetic energy during the race?

A 4×10^2 J **B** 4×10^3 J **C** 4×10^4 J **D** 4×10^5 J

3 A signal that repeats periodically is displayed on the screen of a cathode-ray oscilloscope.



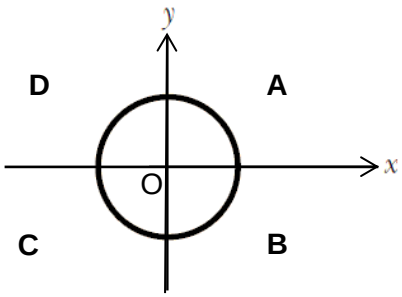
The screen has 1 cm squares and the time-base setting is 2.0 ms cm^{-1}.

What is the frequency of this periodic signal?

A 50 Hz **B** 100 Hz **C** 125 Hz **D** 200 Hz

4 The figure below shows a circular path taken by a particle. At a certain instant, the particle's horizontal velocity, v_x , is + 2 m s^{-1}, and its vertical velocity, v_y, is – 2 m s^{-1}.

Horizontally, right is taken to be positive *x*-direction.
Vertically, upward is taken to be positive *y*-direction.



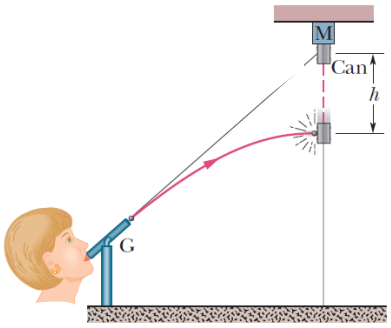
Through which quadrant is the particle moving at this instant if it is travelling anti-clockwise around the circle?

5 Two diamonds begin a free fall from rest from the same height 1.0 s apart.

How long after the first diamond begins to fall will the two diamonds be 10 m apart?

A 0.43 s **B** 1.43 s **C** 1.52 s **D** 2.43 s

6 A projectile is fired at a target can in such a way that the projectile leaves the gun at the same time the target is dropped from rest as shown below.



Which of the statement best describe the motion of the projectile and the can?

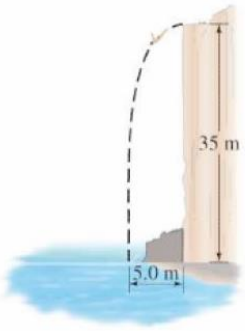
A The projectile may or may not hit the can. It depends on the velocity at which it is fired.

B The projectile may or may not hit the can. It depends on the height at which the can is dropped

C The projectile will always hit the can. This is because both the projectile and the can are under the same gravitational acceleration.

D The projectile will never hit the can. This is because the can will fall faster than the projectile.

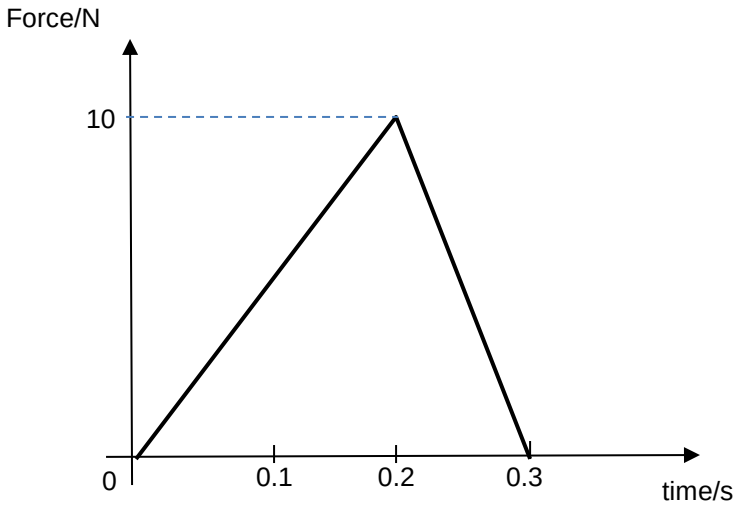
7 A cliff diver pushes off *horizontally* from a cliff 35 m above the water. There are some rocks located at the water level that extend 5.0 m from the base of the cliff directly under the launch point.



What is the minimum pushoff speed required to clear the rocks?

A 1.87 m s^{-1} **B** 1.88 m s^{-1} **C** 4.95 m s^{-1} **D** 5.05 m s^{-1}

8 A varying force acts upon an object. The graph below shows how the force acting on the object varies with time.



The magnitude of the maximum change in momentum of the object is

A 3.0 Ns **B** 2.0 Ns **C** 1.5 Ns **D** 1.0 Ns

9 When a man is standing on a digital balance in a descending lift, the magnitude of the weight recorded on the balance is always

A equal to the magnitude of his weight.
B lesser than the magnitude of his weight.
C greater than the magnitude of his weight.
D equal to the magnitude of the force exerted on the man's feet by the balance.

10 A stationary Thoron nucleus of mass 220*u* emits an alpha particle of mass 4*u* with kinetic energy E_α.

Which of the following gives the correct value of

the ratio $\dfrac{\textit{speed of alpha particle}}{\textit{speed of the recoiling daughter nucleus}}$ and

kinetic energy of the daughter nucleus immediately after the emission?

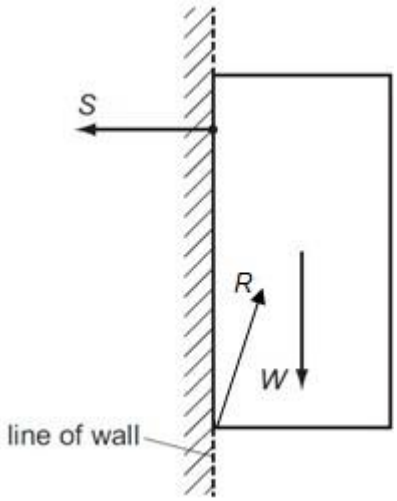
	$\dfrac{\textbf{\textit{speed of alpha particle}}}{\textbf{\textit{speed of the recoiling daughter nucleus}}}$	***kinetic energy of the recoiling daughter nucleus***
A	55	$\frac{1}{55}\ E_\alpha$
B	54	$(\frac{1}{54})^2\ E_\alpha$
C	54	$\frac{1}{54}\ E_\alpha$
D	$\frac{1}{54}$	$54\ E_\alpha$

11 A cupboard is attached to a wall by a screw.

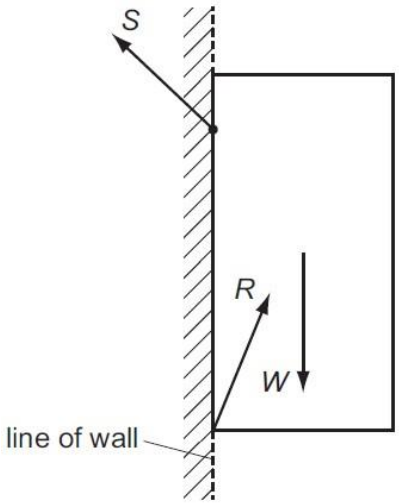
Which force diagram shows the cupboard in equilibrium, with the weight W of the cupboard, the force S that the screw exerts on the cupboard and the force R that the wall exerts on the cupboard?

The magnitude of the forces are not drawn to scale.

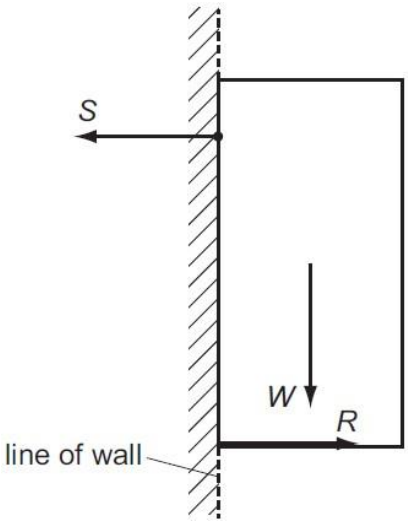
A



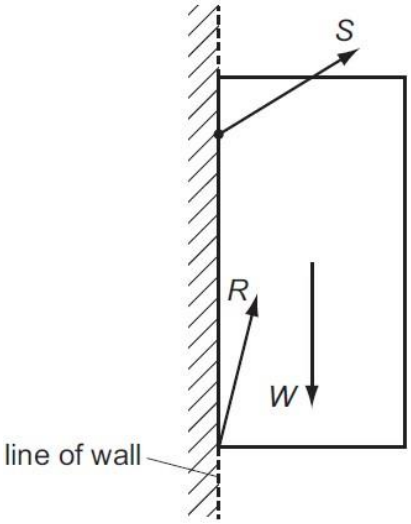
B



C

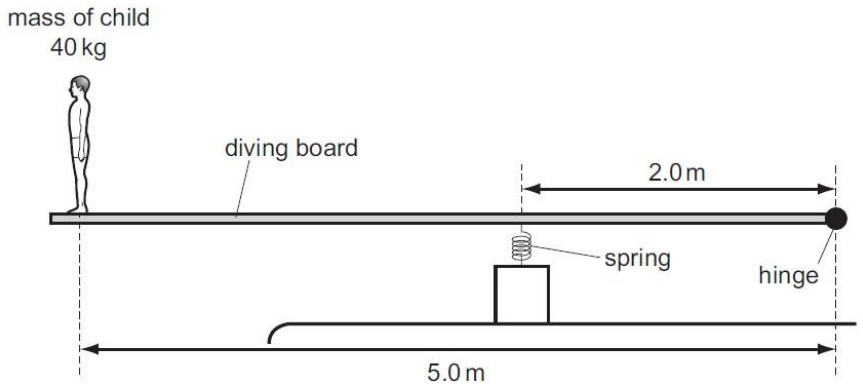


D



12 A uniform diving board of length 5.0 m and mass 35 kg hangs horizontally in equilibrium when it is hinged at one end and supported 2.0 m from this end by a spring of spring constant 10 kN m^{-1}.

When a child of mass 40 kg stands at the far end of the board as shown in the diagram below, what is the extra compression of the spring caused by the child standing on the end of the board?

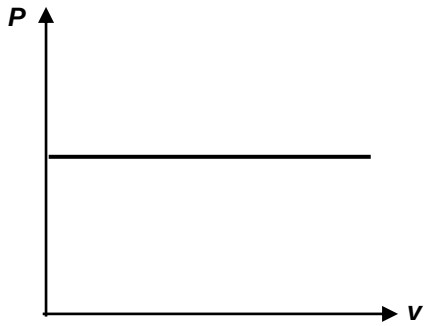


A 1.0 cm **B** 5.9 cm **C** 9.8 cm **D** 19.6 cm

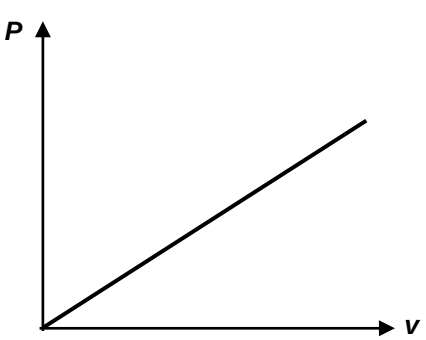
13 A car moving through air at velocity v experiences a resistive force F given by the expression $F = kv^2$ where k is a constant.

Which of the following graphs show how the power supplied to the car P will vary at various v to ensure that the car is moving without any acceleration?

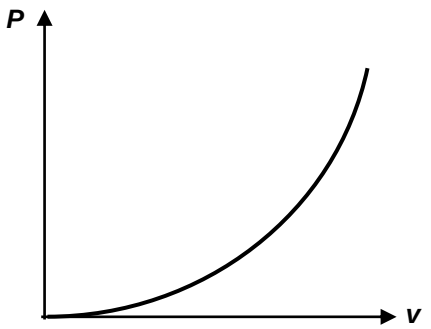
A



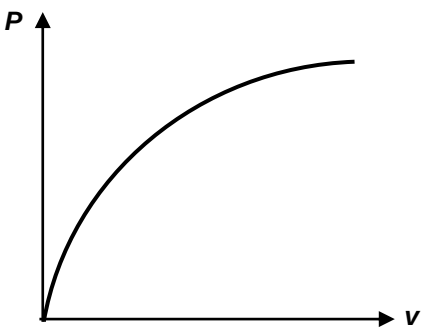
B



C



D



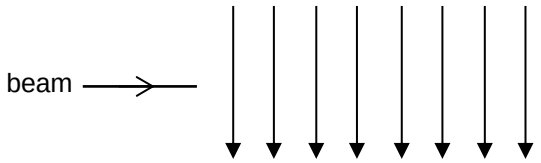
14 A small electric motor is used to raise a weight of 3.0 N through a vertical height of 70 cm in 3.0 s.

The efficiency of the motor is 30 %.

What is the electrical power supplied to the motor?

A 0.21 W **B** 2.1 W
C 2.3 W **D** 23 W

15 A beam of particles or radiation is directed horizontally into vertical gravitational, electrical and magnetic fields in turn.



The table shows features of the force on the beam and the shape of the beam in each case.

	gravitational field	electric field	magnetic field
force	downwards	downwards	into page
shape of beam	a curve	a curve	a circle

Which particles or radiation are used in the beam?

A Protons
B Electrons
C Gamma rays
D Positrons

16 A progressive wave in a stretched string has a speed of 2 m s^{-1} and a frequency of 100 Hz. What is the phase difference between two points 25 mm apart?

A zero **B** $\frac{\pi}{4}$ **C** $\frac{\pi}{2}$ **D** π

17 Which wave cannot be polarized?

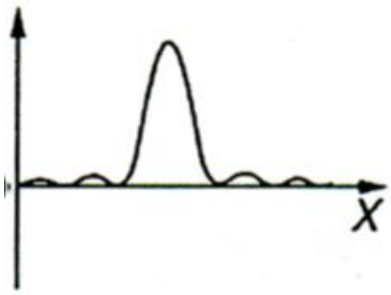
A X rays **B** Sound Wave **C** Gamma Ray **D** Infrared Wave

18 Two coherent monochromatic waves of equal amplitude are brought together to form an interference pattern on a screen.

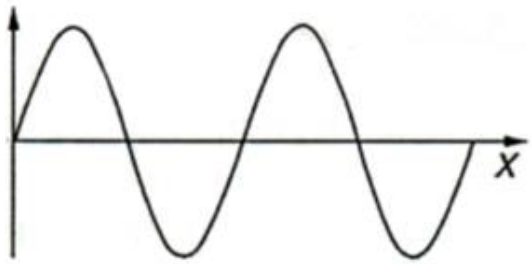
Which of the following graphs could represent the variation of intensity with position (x) across the pattern of fringes.

A

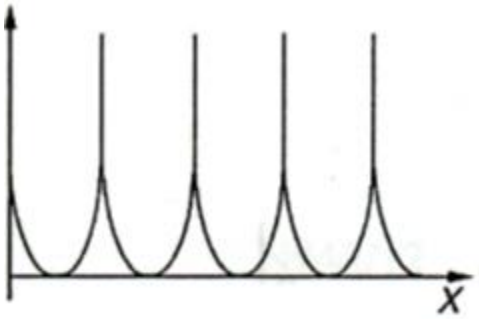
B



C



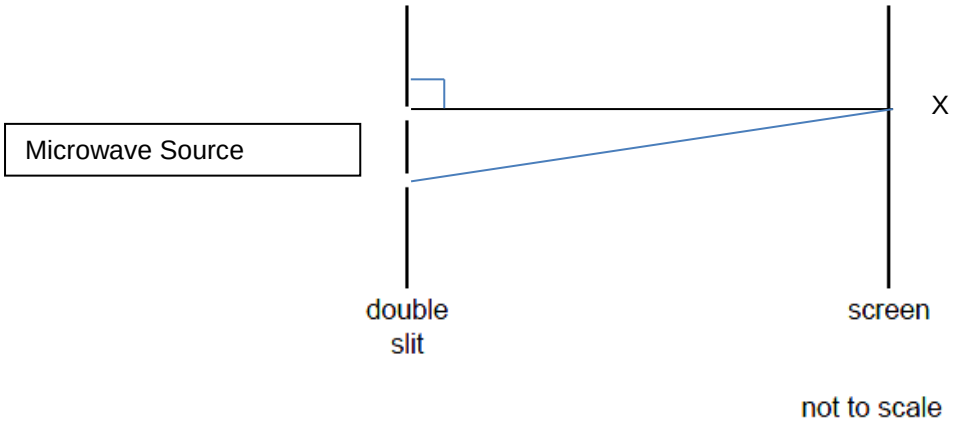
D



19 Light of wavelength 600 nm is used to illuminate a single slit 30 μm wide. If a screen is placed 1.5 m on the other side, determine the distance between the middle of the central maximum and the middle of the second maximum on either side.

A 3.0 cm **B** *4.0 cm* **C** 6.0 cm **D** 12.0 cm

20 A double-slit interference experiment is set up as shown.



Fringes are formed on the screen which is 40 cm away. The distance between the slits is 9.0 cm apart. The microwave source has a wavelength of 2.0 cm and intensity *I*.

What is the new intensity at X?

A Zero **B** *I* **C** 2*I* **D** 4*I*

21 A vertical tube is completely filled with water. A small sound source of constant frequency is held a little above the open upper end and water is run out from the lower end.

The first two resonances occur when the water surface is 14.0 cm and 46.0 cm below the top of the tube.

If the actual position of the antinode is at a fixed distance above the top end of the tube called the end correction, what is the wavelength of the sound wave?

A 32.0 cm **B** 56.0 cm **C** 60.0 cm **D** 64.0 cm

22 A copper wire of cross-sectional area 2.0 mm^2 carries a current of 10 A. How many electrons pass through a given cross-section of the wire in one second?

A 1.0×10^{1} **B** 5.0×10^{6} **C** 6.3×10^{19} **D** 3.1×10^{25}

23 A cylindrical wire of length 10m and diameter 2.0 mm has a resistance of 0.050 Ω.

From which material is the wire made?

	material	**resistivity / Ωm**
A	bronze	1.6×10^{-7}
B	nichrome	1.6×10^{-4}
C	silver	1.6×10^{-8}
D	zinc	6.3×10^{-8}

24 A battery of internal resistance *r* and e.m.f. *E* can supply a current of 6.0 A to a resistor R as shown in **Fig 24.1.**

The *I V* characteristics of the resistors R and R_1 respectively is shown in **Fig 24.2.**

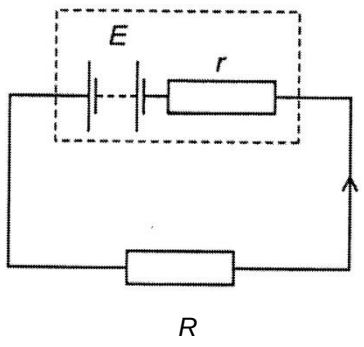


Fig 24.1.

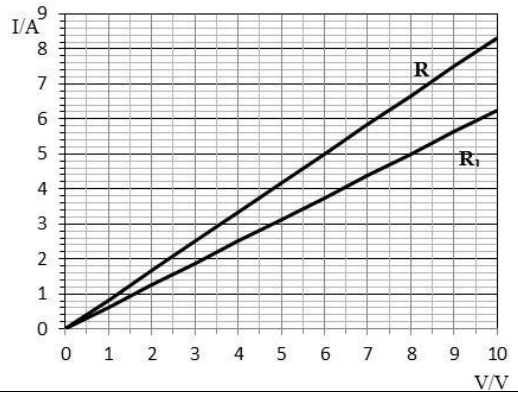


Fig 24.2

When the resistor R is replaced by R_1, the current becomes 5.0 A.

What are the values of the e.m.f. *E* and the internal resistance *r*?

	***E* / V**	***r* / Ω**
A	7.6	0.073
B	12	2.0
C	12	0.80
D	15	8.0

25 Four identical resistors are connected as shown in **Fig 25**.

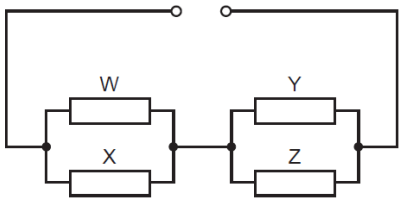


Fig 25

How will the powers to the resistors change when the resistor W is removed?

A The powers to X, Y and Z will all increase.
B The powers X will decrease and the powers to Y and Z will increase.
C The powers to X will increase and the powers to Y and Z will decrease.
D The powers to X will increase and the powers to Y and Z will remain unaltered.

26 Fig 26 shows the top view of a tcurrent balance. The wire frame ABCD is supported by the pivots P and Q. PBCQ lies within the magnetic field, whose flux density is to be measured. The sides AD and BC are equidistance from the pivots. Electrical connections are made to the frame through the pivots.

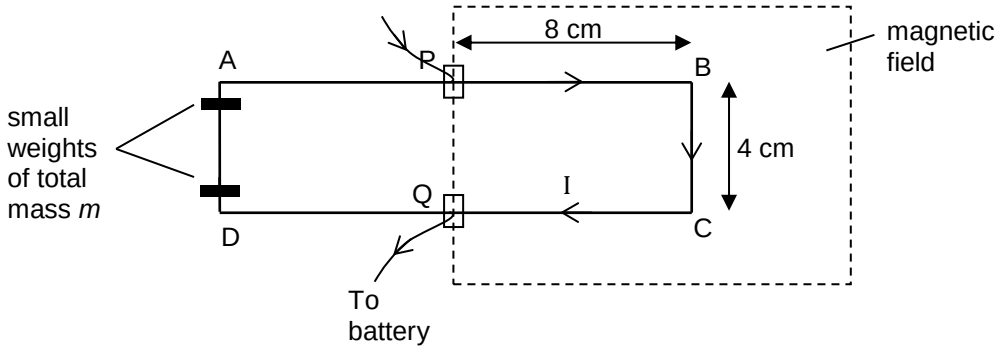


Fig 26

Given that the current I flowing in the current balance is 1.2 A, and the total mass of small weights *m* is 30 g. What is the flux density of the magnetic field?

A 0.625 T **B** 3.1 T **C** 6.1 T **D** 625 T

27 A laser point creates a spot on a screen as it reflects 70% of the light striking it. This light exerts radiation pressure on the screen.

The laser point is now moved twice as far away from the screen.

i. The radiation pressure remains the same because the intensity of the laser light remains constant.

ii. The radiation pressure decreases because the beam diverges and area of illumination increases.

iii. The radiation pressure decreases because energy of the light is lost due to scattering from air molecules and dust particles.

Which of the statements above is/are correct?

A i only

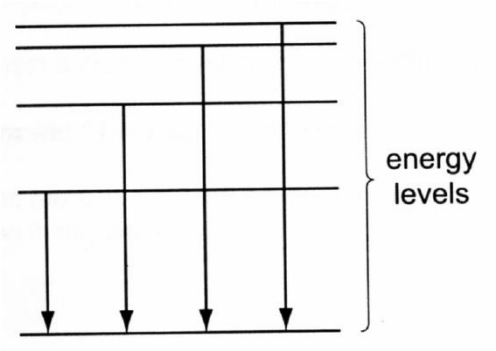
B ii only

C iii only

D ii and iii only

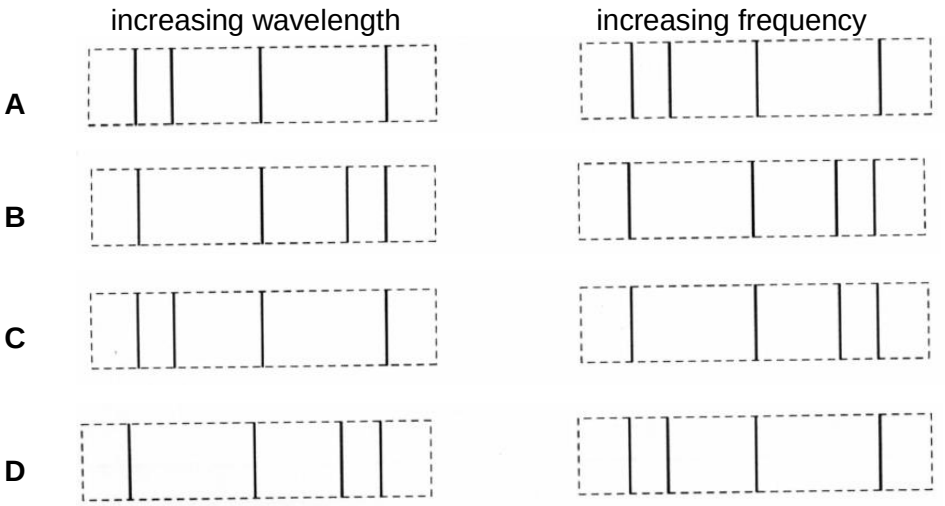
28 Electrons can move from a higher energy level to a lower energy level in an atom, emitting a quantum of electromagnetic radiation.

The diagram shows five energy levels in an atom and some transitions between them.



The line spectrum produced is in the visible spectrum and can be represented on a wavelength scale or a frequency scale.

Which diagram could represent the light emitted by the four transitions shown above?



29 Which of the following statement on photoelectric effect is **not** an evidence for particulate nature of light?

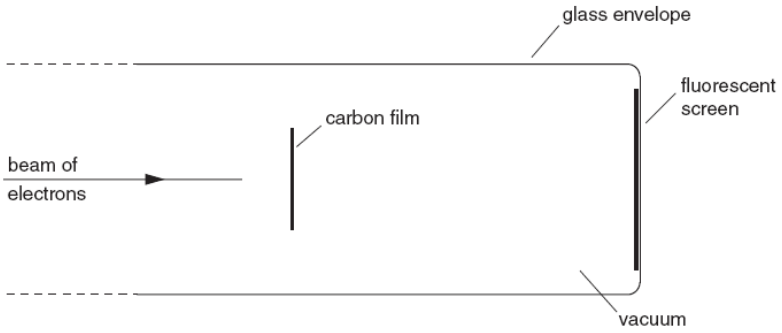
A Emission of electrons happens as soon as light shines on metal.

B Increasing intensity of light increases rate at which electrons leave metal.

C Low-intensity light is effective in causing electrons to be emitted.

D A minimum threshold frequency of light is needed.

30 A parallel beam of electrons, all travelling at the same speed, is incident normally on a carbon film. The scattering of the electrons by the film produce a pattern of concentric circles on the fluorescent screen.



As the speed of the electrons is increased, the diameter of the circles

A increases as the de broglie's wavelength of the electron decreases.
B increases as the de broglie's wavelength of the electron increases
C decreases as the de broglie's wavelength of the electron decreases.
D decreases as the de broglie's wavelength of the electron increases.