VICTORIA JUNIOR COLLEGE
2014 JC2 PRELIMINARY EXAMINATIONS

PHYSICS **8866/01**
Higher 1

25 Sep 2014
THURSDAY
Paper 1 Multiple Choice **2 pm – 3 pm**
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, CT group and NRIC number on the Answer Sheet in the spaces provided and shade the corresponding ovals.

There are **thirty** 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 rough working should be done in this booklet.

This document consists of **14** printed pages.

Data

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

1 What is the approximate volume of a typical inflated rubber party balloon?

A 0.001 m^3 **B** 0.01 m^3 **C** 0.1 m^3 **D** 1 m^3

2 The magnetic field B produced by a solenoid with a number of turns per unit length of n and a current of I is given by

$$B = \mu_0 nI$$

where μ_0 is a constant known as the permeability of free space.

What are the base units of μ_0?

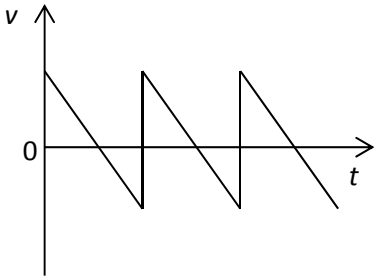
A kg m^2 s^{-1} C^{-1}
B kg m s^{-2} A^{-2}
C kg m^2 s^{-2} A^{-2}
D N m A^{-1}

3 A force of (2.0 ± 0.1) N is applied to a mass of (3.00 ± 0.05) kg. What is its acceleration?

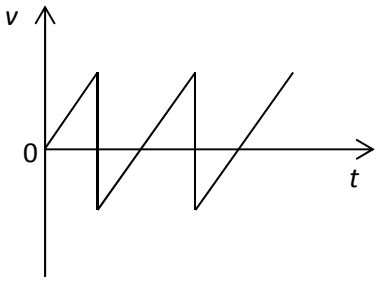
A (0.67 ± 0.02) m s^{-2}
B (0.67 ± 0.03) m s^{-2}
C (0.67 ± 0.04) m s^{-2}
D (0.67 ± 0.07) m s^{-2}

4 A ball bearing is dropped from a certain height above the ground, and bounces a few times. Which of the following graphs shows how its velocity v varies with time t ?

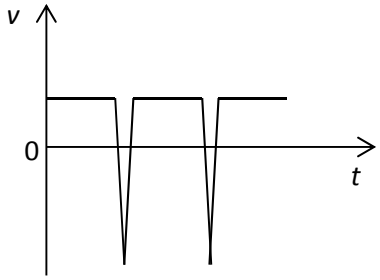
A



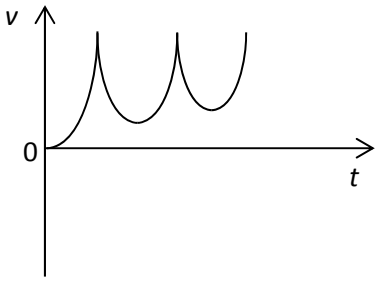
B



C



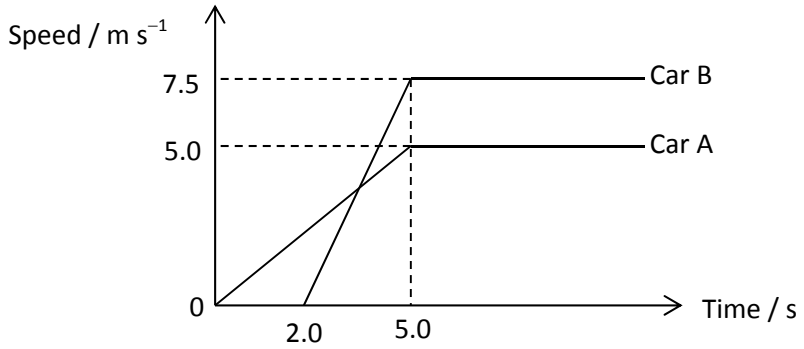
D



5 A rock is thrown with an initial kinetic energy of 15 J at an angle of 30^{o} to the horizontal. What is its kinetic energy at the highest point of its trajectory?

A 0 J **B** 3.8 J **C** 7.5 J **D** 11 J

6 Car A and car B both start from the same starting line. Car A moves off first, accelerating constantly for 5.0 s to a constant speed of 5.0 m s^{-1}. Car B starts moving 2.0 s after car A, and accelerates constantly for 3.0 s until it reaches a constant speed of 7.5 m s^{-1}. The speed-time graphs of both cars are shown in the graph below:



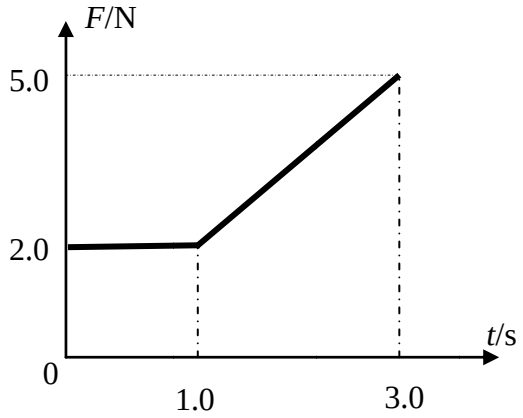
At what time does car B catch up with car A?

A 3.3 s **B** 5.0 s **C** 5.5 s **D** 7.5 s

7 A man is standing inside a descending lift. Which of the following statements about the magnitude of the force exerted on the man's feet by the floor of the lift is always correct?

A It is less than the magnitude of his weight.
B It is equal to the magnitude of his weight.
C It would not be equal to what it would be in a stationary lift.
D It is equal to the magnitude of the force exerted on the floor of the lift by the man's feet.

8 The graph below shows how the force acting on a 2.0 kg body varies with time.



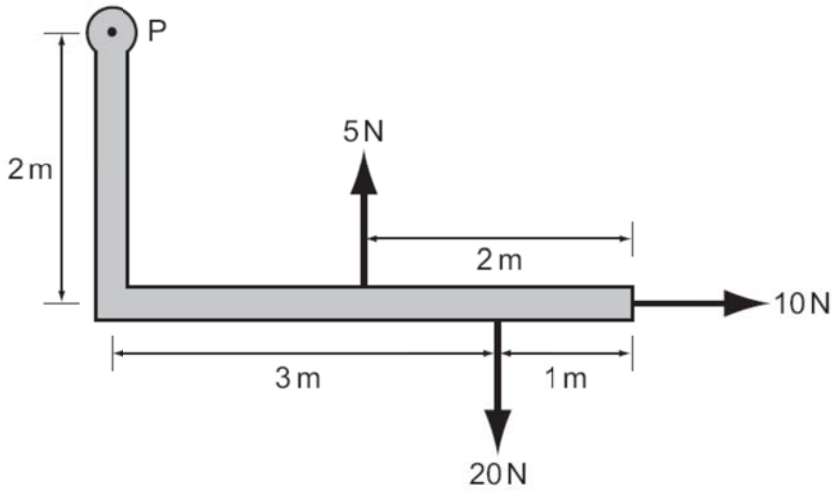
Assuming that the body is initially moving in a straight line at 2.0 m s^{-1}, what is its final velocity?

A 4.0 m s^{-1} **B** 6.5 m s^{-1}
C 9.0 m s^{-1} **D** 11.0 m s^{-1}

9 A conveyor belt is used to transfer luggage at an airport. It consists of a horizontal continuous belt running over driving rollers, moving at a constant speed of 0.80 m s^{-1}. What is the additional force exerted by the conveyor belt motor, compared with an empty belt, if baggage is placed on one end of the belt and removed at the other end at an average rate of 12 kg per second?

A 0 N **B** 9.6 N
C 15 N **D** 118 N

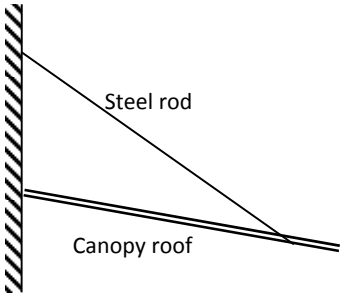
10 An L-shaped rigid lever arm is pivoted at point P.



Three forces act on the lever arm, as shown in the diagram.
What is the magnitude of the resultant moment of these forces about point P?

A 30 N m **B** 35 N m
C 50 N m **D** 90 N m

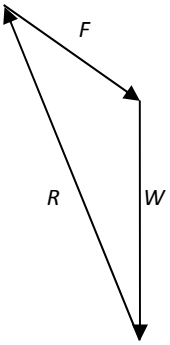
11 A canopy roof, hinged to a vertical wall at one end and secured by a steel rod at the other end as shown below, is in equilibrium.



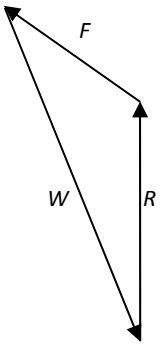
The weight of the canopy roof is *W*, the force exerted by the rod on the roof is *F* and the reaction by the wall on the roof is *R*.

Which vector triangle represents the forces acting on the canopy roof?

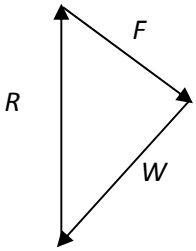
A



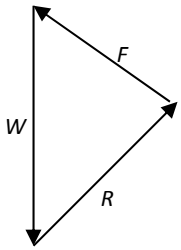
B



C



D



12 A small metal sphere of mass m is falling vertically from rest in liquid glycerine. When it reaches a constant velocity v, which of the following statements is false?

A The resistive force acting on the metal sphere is constant
B The gravitational potential energy decreases at a rate of mgv.
C The kinetic energy is constant and equal to $\frac{1}{2} mv^2$.
D The total mechanical energy of the sphere is constant.

13 An object of mass m is pushed against a spring, compressing it by a horizontal distance of d. The block is then released by launching it along a smooth horizontal surface, attaining a final speed of v. Another object of similar size and shape, but of mass $3m$, is pushed against the same spring and released in the same way. What is the distance that the spring is compressed by the second object if its final speed is $3v$?

A $1.7d$ **B** $5.2d$ **C** $9d$ **D** $15.6d$

14 An escalator rises at an angle of 30° to the horizontal. It lifts 10 people through a vertical height of 5.0 m. The frictional force in the escalator system is 1.4×10^3 N when the escalator lifts 10 people. Assume that any kinetic energy given to the passengers by the escalator is negligible and the average mass of passengers is 60 kg.

The efficiency of the escalator in lifting people up is

A 68% **B** 72% **C** 84% **D** 88%

15 A longitudinal wave of frequency 1.6 Hz travels along a stretched spring at a speed of 2.4 m s^{-1}.

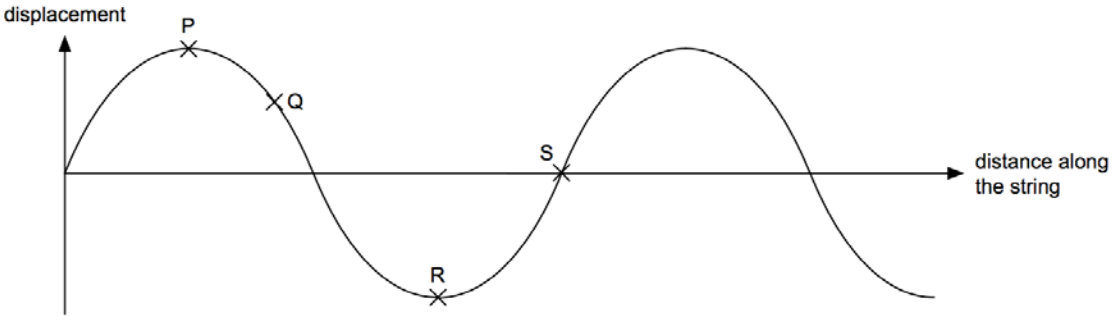
What is the phase difference between points on the spring that are 0.50 m apart?

A $\frac{\pi}{3}$ rad **B** $\frac{2\pi}{3}$ rad **C** π rad **D** 3π rad

16 Which of the following statements about electromagnetic waves is not true?

A They can be polarised.
B They are transverse waves.
C They always travel at 3.0×10^8 m s^{-1}.
D They are diffracted when they pass through a small aperture.

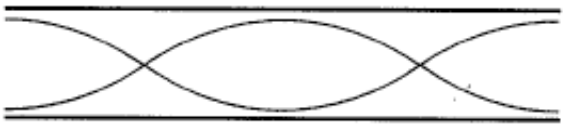
17 The figure shows the shape at a particular instant of part of a transverse wave travelling from left to right along a string.



Which statement about the motion of elements of the string at this instant is correct?

A The speed of Q is higher than S.
B Both Q and R are moving upwards.
C The energy of P and S is entirely kinetic.
D The acceleration of P and R is a maximum.

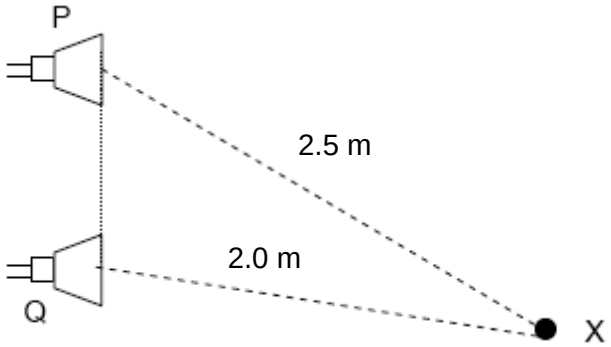
18 A stationary wave is formed in the air in an open tube as represented in the diagram.



How many antinodes are formed by a stationary wave of twice the frequency?

A 2 **B** 4 **C** 5 **D** 6

19 Microwaves of wavelength 4.0 cm are produced by two microwave transmitters P and Q operating in phase. Point X is 2.5 m from transmitter P and 2.0 m from transmitter Q as shown in the figure. Microwaves from transmitter P arrives at point X with intensity *I* and amplitude of oscillation *A* while the microwaves from transmitter Q arrives at point X with intensity 4*I*. Determine the resultant intensity at point X in terms of *I*.



A zero **B** *I* **C** 3*I* **D** 9*I*

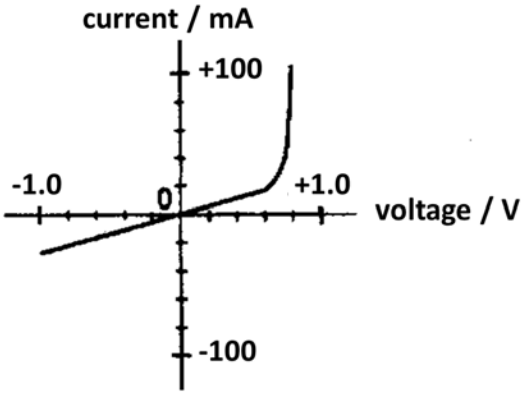
20 Monochromatic light of wavelength 4.0×10^{-7} m passes through two narrow slits and produces light and dark fringes on a screen.
What is the separation of the slits such that the angular separation between two bright fringes is 4.00×10^{-4} rad?

A 0.5×10^{-3} m
B 1.0×10^{-3} m
C 1.5×10^{-3} m
D 2.0×10^{-3} m

21 A high electric potential is applied between two electrodes of a hydrogen discharge tube so that the gas is ionised. Electrons then move towards the positive electrode and protons towards the negative electrode. In each second, 5.0×10^{18} electrons and 2.0×10^{18} protons pass a cross-section of the tube. What is the current flowing in the discharge tube?

A 0.32 A **B** 0.48 A **C** 0.80 A **D** 1.1 A

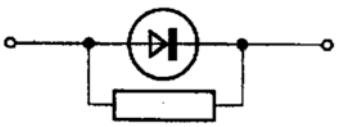
22 A student is given a sealed box containing a concealed electrical circuit. Having taken a series of current and voltage readings, the student plots the current-voltage characteristics below.

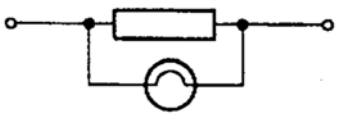


Which circuit is most likely to be enclosed within the box?

A


B

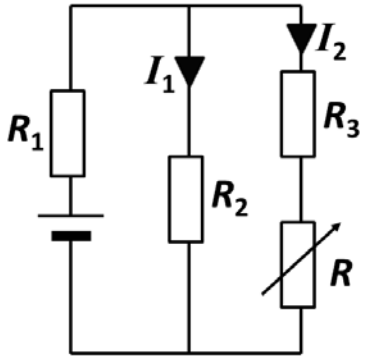

C


D


23 A generator produces 100 kW of power at a potential difference of 5.0 kV. The power is transmitted through cables of total resistance 5.0 Ω. How much power is dissipated in the cables?

A 1.0×10^2 W
B 2.0×10^3 W
C 5.0×10^4 W
D 5.0×10^6 W

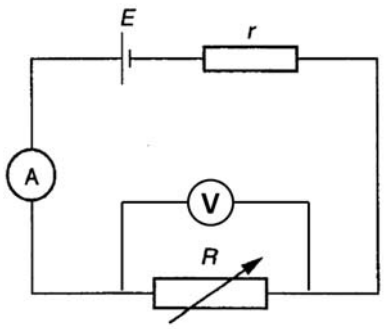
24 In the circuit below, R_1, R_2 and R_3 are fixed resistors and R is a variable resistor.



As R decreases,

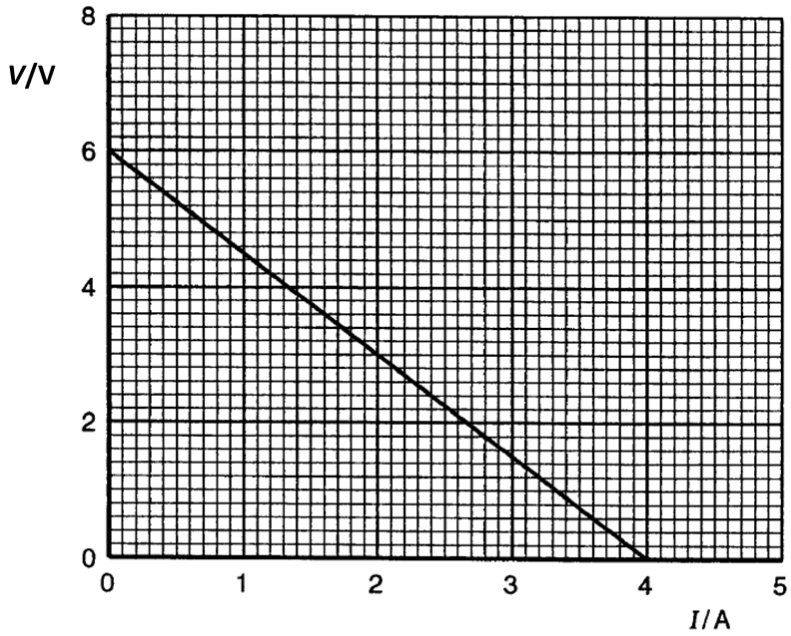
A I_1 remains unchanged, and I_2 increases.
B I_1 decreases, and I_2 remains unchanged.
C I_1 decreases, and I_2 increases.
D I_1 decreases, and I_2 decreases.

25 A battery of e.m.f. *E* and internal resistance *r* is connected to a variable resistor of resistance *R*, as shown in the figure below.



The current I in the circuit is measured with an ammeter of negligible resistance, and the potential difference *V* across *R* is measured with a voltmeter of very high resistance.

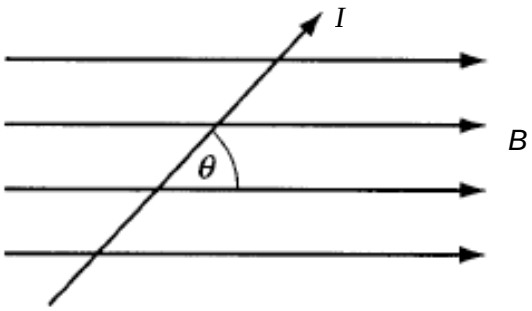
Having taken a series of voltage and current readings, the following voltage-current graph was obtained.



Which of the following set of data is correct when a current of 1.20 A flows in the circuit?

	E.m.f. of the cell, *E* / V	Internal resistance of the cell, *r* / Ω
A	4.2	1.5
B	4.2	3.5
C	6.0	1.5
D	6.0	3.5

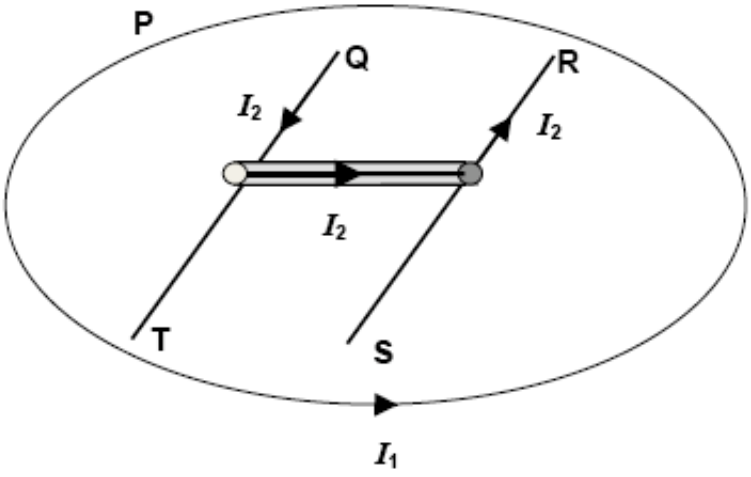
26 A wire carrying a current *I* is placed in a magnetic field of flux density *B.*



How is the magnitude *F* of the force acting on the wire related to the angle θ that it makes with the field?

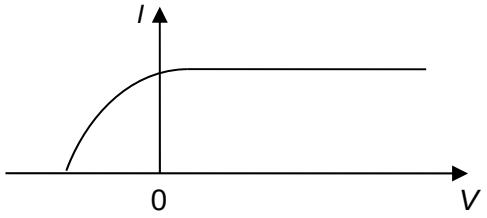
A $F \propto \theta$
B $F \propto \sin\theta$
C $F \propto \cos\theta$
D $F \propto 1/\sin\theta$

27 In the diagram below, **P** is a horizontal circular coil of wire carrying a steady current. A conducting rod, which is free to move, is supported by 2 fixed horizontal parallel rails **TQ** and **SR** which are perpendicular to the length of the conducting rod and carry a constant current as shown in the diagram below.



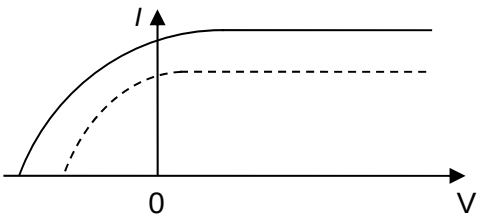
The conducting rod will
A move towards **TS** with increasing speed.
B move towards **QR** with increasing speed.
C move towards **QR** with decreasing speed.
D be lifted off the horizontal parallel rails momentarily.

28 A metal surface in an evacuated tube is illuminated with monochromatic light causing the emission of photo-electrons which are collected at an adjacent electrode. For a given intensity of light, the way in which the photocurrent *I* depends on the potential difference *V* between the electrodes is as shown in the diagram below.

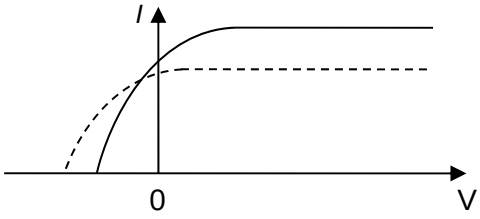


Which of the following graphs show the result when the frequency of the light is increased while the intensity remains constant? (The solid curve represents the original graph and the dotted curve represent the new graph.)

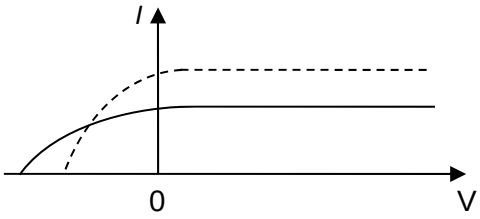
A



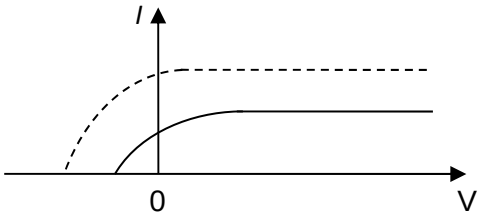
B



C



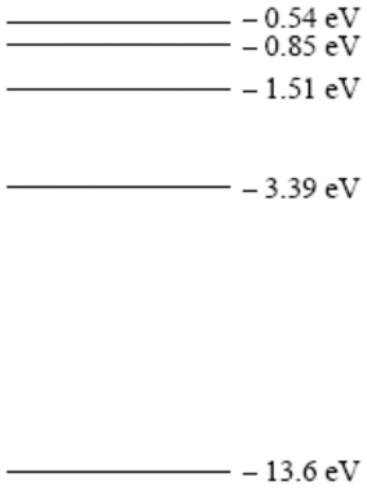
D



29 Which one of the following provides direct evidence for the existence of discrete energy levels in an atom?

A The continuous spectrum of the light emitted by a white-hot metal.
B The emission of photoelectrons from a metal.
C The ionisation of gas atoms when bombarded by alpha particles.
D The line emission spectrum of a gas at low pressure.

30 Some of the energy levels of the hydrogen atom are shown below.



Electrons are excited to the –1.51 eV level. How many different photon frequencies will be detected when the electrons de-excite?

A 3 **B** 4 **C** 5 **D** 6