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PIONEER JUNIOR COLLEGE
JC2 Preliminary Examination

PHYSICS
Higher 1

8866/01

Paper 1 Multiple Choice

25 September 2015

1 hour

Additional Material: 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, class and index number on the Answer Sheet in the spaces provided.

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 **18** printed pages.

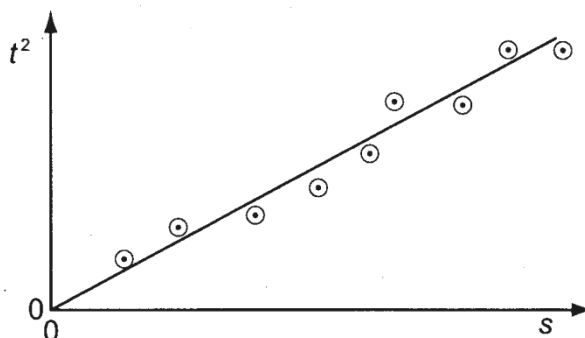
Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
acceleration of free fall,	$g = 9.81 \text{ m s}^{-2}$

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,	$R = R_1 + R_2 + \dots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \dots$

- 1 An object falls freely from rest and travels a distance s in time t . The variation with s of t^2 is plotted and used to determine the acceleration of free fall g .



The gradient of the graph is found to be 0.230.

Which statement about the value obtained for g is correct?

- A It is accurate but not precise.
 - B It is precise but not accurate.
 - C It is both precise and accurate.
 - D It is neither precise nor accurate.
- 2 To determine the spring constant k , a student makes the following measurements of a mass-spring system.

period, $T = (2.8 \pm 0.1) \text{ s}$

mass, $m = (50 \pm 1) \text{ g}$

The spring constant is determined using the equation $T = 2\pi\sqrt{\frac{m}{k}}$.

What is the value of k and its associated uncertainty?

- A $(0.25 \pm 0.01) \text{ N m}^{-1}$
- B $(0.25 \pm 0.02) \text{ N m}^{-1}$
- C $(250 \pm 20) \text{ N m}^{-1}$
- D $(252 \pm 20) \text{ N m}^{-1}$

3 Which pair does not include a vector and a scalar quantity?

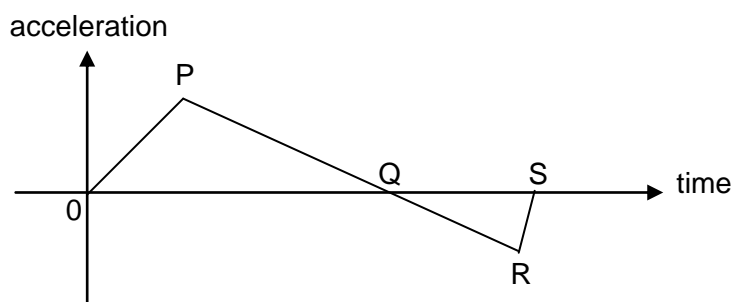
- A work and torque
- B weight and mass
- C pressure and density
- D momentum and power

4 An object changes its velocity from 4 m s^{-1} due East to 7 m s^{-1} due South.

What is its change in velocity?

- A 3 m s^{-1} at a direction of 30° East of South
- B 3 m s^{-1} at a direction of 30° West of South
- C 8 m s^{-1} at a direction of 60° South of West
- D 8 m s^{-1} at a direction of 60° South of East

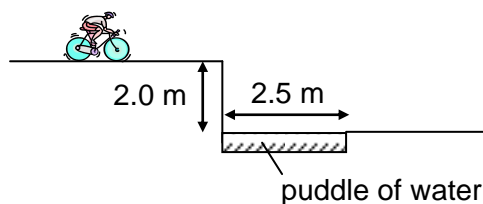
5 The acceleration-time graph of an object moving in a straight line is as shown.



If the object starts its motion from rest, at which points on the graph does the object have the greatest velocity and the greatest displacement?

	greatest velocity	greatest displacement
A	P	Q
B	P	S
C	Q	R
D	Q	S

- 6 A cyclist takes off horizontally from a point 2.0 m above the surface of a puddle of water, which is 2.5 m wide.



What is the cyclist's minimum take-off speed in order to clear the puddle of water?

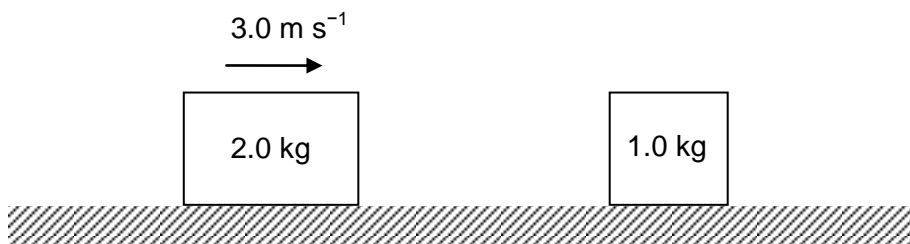
- A 2.8 ms^{-1}
 B 3.9 ms^{-1}
 C 5.5 ms^{-1}
 D 6.1 ms^{-1}
- 7 What is the gravitational force on an astronaut of mass m when a spacecraft is launched vertically upwards from a launch pad with an acceleration of $0.1 g$?
- A 0 B $0.9 mg$ C mg D $1.1 mg$
- 8 A beam of α -particles is incident on a lead sheet. Each α -particle in the beam has a mass of $6.6 \times 10^{-27} \text{ kg}$ and a speed of $1.5 \times 10^7 \text{ m s}^{-1}$.

5.0×10^4 α -particles collide with an area of 1.0 cm^2 of lead each second. All of the α -particles are absorbed by the lead so that they have zero speed after collision.

What is the average pressure exerted on the lead sheet by the α -particles?

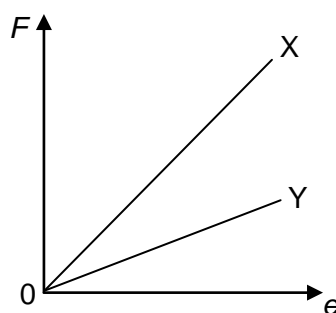
- A $5.0 \times 10^{-15} \text{ Pa}$
 B $5.0 \times 10^{-13} \text{ Pa}$
 C $5.0 \times 10^{-11} \text{ Pa}$
 D $5.0 \times 10^{-9} \text{ Pa}$

- 9 A block of mass 2.0 kg travelling at 3.0 m s^{-1} on a smooth surface collides head-on with a stationary block of mass 1.0 kg . The blocks stick together on impact.



How much kinetic energy is lost during impact?

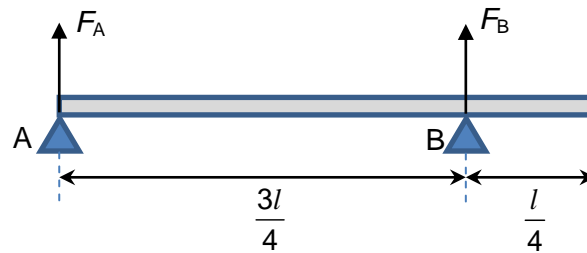
- A zero
B 2.0 J
C 2.4 J
D 3.0 J
- 10 The figure below shows the variation of the force F applied to two wires X and Y with their extension e .



Which of the following statements is correct?

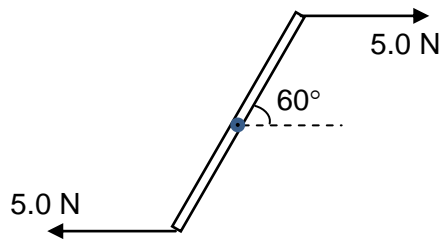
- A Y has a larger force constant.
B X obeys Hooke's law but Y does not.
C For the same extension, Y has greater elastic potential energy.
D For the same force applied to both wires, Y has a larger extension.

- 11 A uniform beam of length l is supported by two pivots A and B as shown below. The forces exerted on the beam by A and B are F_A and F_B respectively.



What is the ratio of $\frac{F_B}{F_A}$?

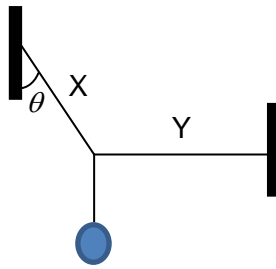
- A 0.33 B 0.50 C 1.3 D 2.0
- 12 A ruler of length 0.40 m is pivoted at its centre. Equal and opposite forces of magnitude 5.0 N are applied to the ends of the ruler as shown below.



What is the magnitude of the torque of the couple on the ruler when it is in the position shown?

- A 0.87 Nm
B 1.0 Nm
C 1.7 Nm
D 2.0 Nm

- 13 A metal ball is tied to two strings X and Y. String X is inclined at an angle θ to the vertical and has tension T_X . String Y is horizontal and has tension T_Y .



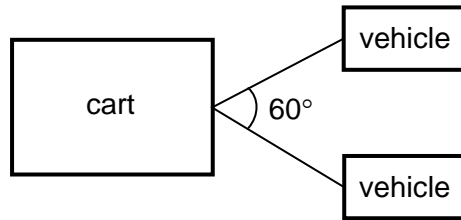
When the angle θ is increased with string Y remaining horizontal,

- A both T_X and T_Y increase.
 - B both T_X and T_Y decrease.
 - C T_X increases but T_Y decreases.
 - D both T_X and T_Y remain constant.
- 14 A man is pushing a cabinet of mass 30.0 kg up a slope inclined at 30.0° to the horizontal with a constant speed of 3.00 m s^{-1} . When the cabinet moves up the slope by 5.00 m , 600 J of heat is produced due to friction.

What is the work done by the man in moving the cabinet up the slope by 5.00 m ?

- A 1340 J
- B 1470 J
- C 1870 J
- D 2070 J

- 15** A cart is being pulled by two motorised vehicles as shown in the diagram below. The cart is moving with a constant speed of 6.0 m s^{-1} in the horizontal direction and the power required to maintain this motion is 1500 W .



What is the tension in the cables connecting the vehicles and the cart?

- A** 0 N
- B** 125 N
- C** 144 N
- D** 250 N
- 16** A sound wave of frequency 400 Hz is travelling in a gas at a speed of 320 m s^{-1} .

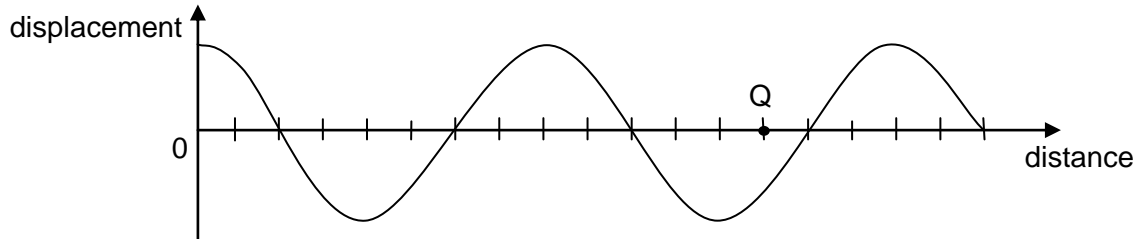
What is the phase difference between two points 0.2 m apart in the direction of travel of the wave?

- A** $\frac{\pi}{4} \text{ rad}$
- B** $\frac{2\pi}{5} \text{ rad}$
- C** $\frac{\pi}{2} \text{ rad}$
- D** $\frac{4\pi}{5} \text{ rad}$
- 17** A sheet of glass transmit 70% of the energy of an incident light. The amplitude of the transmitted light is A_t and the amplitude of the incident light is A_i .

What is the ratio $\frac{A_t}{A_i}$?

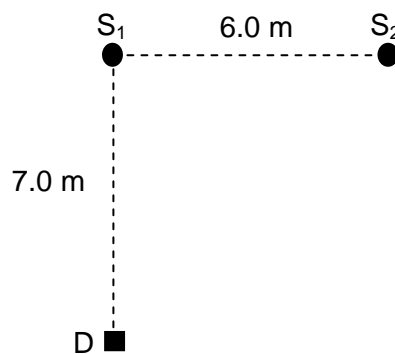
- A** 0.49
- B** 0.70
- C** 0.84
- D** 1.19

- 18 The diagram shows a transverse wave at a particular instant. The wave is travelling to the left. The frequency of the wave is 2.5 Hz.



What is the shortest time after this instant for the displacement to be zero at point Q?

- A 0.05 s
 B 0.10 s
 C 0.15 s
 D 0.30 s
- 19 Two wave generators S_1 and S_2 produce water waves of wavelength 2.0 m. They are placed 6.0 m apart as shown and are operated in phase. A sensor D which measures the amplitude of water waves is 7.0 m away from S_1 as shown in the diagram below.



The shortest distance D could be moved along the straight line S_1D in order to detect the largest amplitude of the resultant wave is

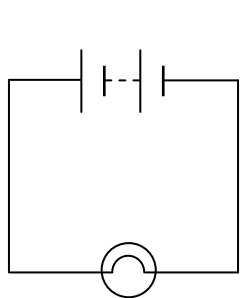
- A 1.0 m towards S_1
 B 3.0 m towards S_1
 C 1.0 m away from S_1
 D 3.0 m away from S_1

- 20** When a two-slit arrangement is set up to produce interference fringes on a screen using a monochromatic source of green light, the fringes are found to be too close to be clearly observed.

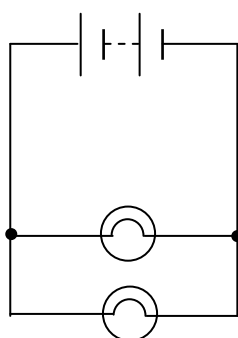
Which of the following is a possible way to increase the separation of the fringes?

- A** Increase the width of each slit.
- B** Increase the distance between the two slits.
- C** Decrease the distance between the screen and the slits.
- D** Replacing the light source with a monochromatic source of red light.

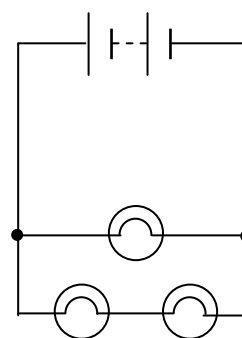
- 21** In the arrangements below, identical light bulbs and batteries with negligible internal resistance are used. Which circuit(s) contain(s) the brightest light bulb(s)?



P



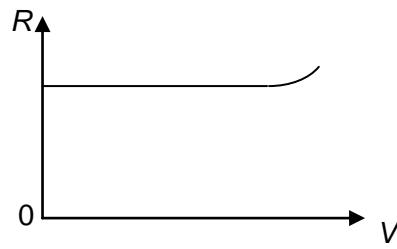
Q



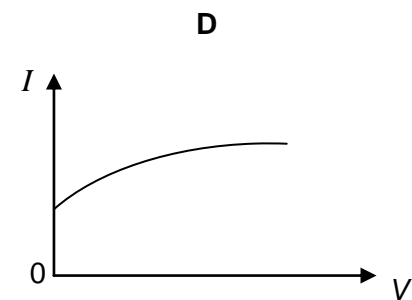
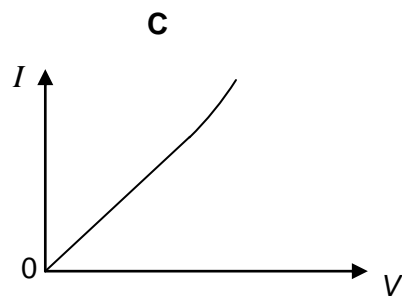
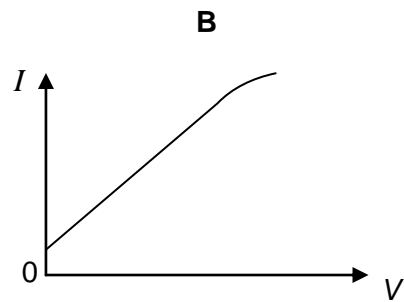
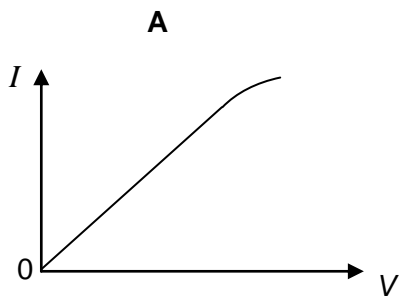
M

- A** circuit P
- B** circuit Q
- C** circuit M
- D** all three circuits

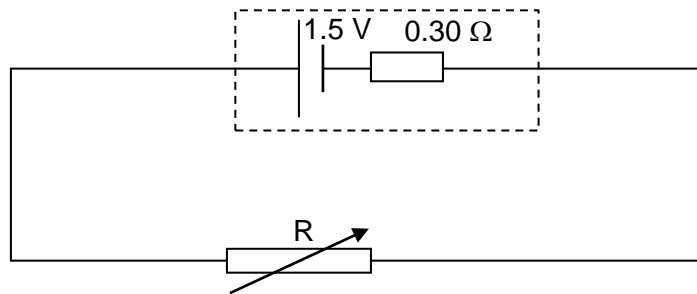
- 22** The resistance R of an electrical component varies with the potential difference V across it as shown.



Which graph best represents variation of current I through the component with V ?

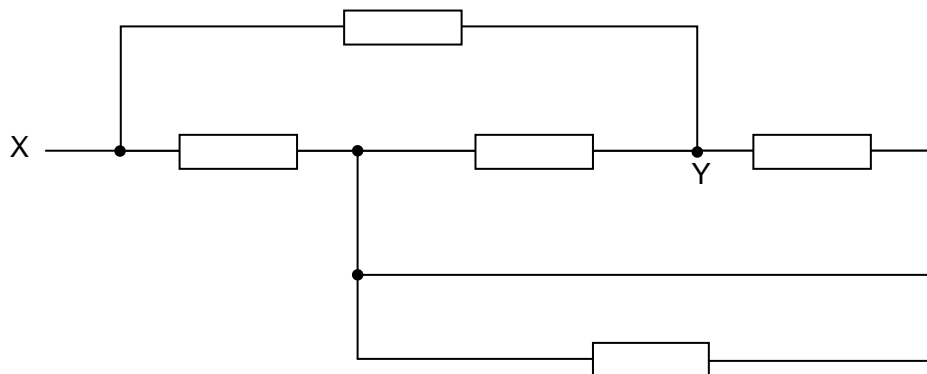


- 23** A cell of e.m.f. 1.5 V and internal resistance $0.30\ \Omega$ is connected to a variable resistor R as shown below. The current in the circuit is 0.50 A and passes through R for a time of 4.0 minutes.



What is the total energy transferred by the battery?

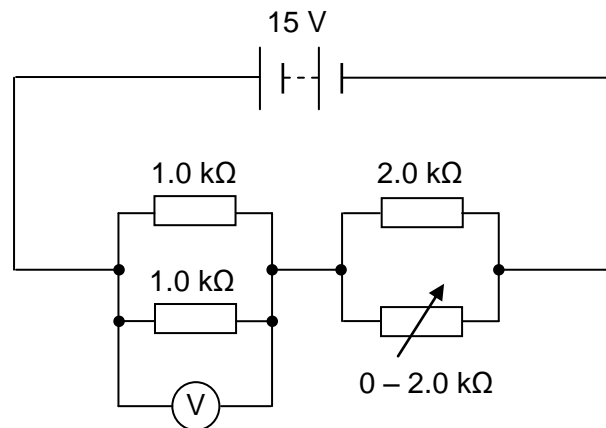
- A** $3.1 \times 10^{-3}\ \text{J}$
B 3.0 J
C 180 J
D 360 J
- 24** The circuit below shows all the resistors with identical resistance R . The connecting wires are assumed to have negligible resistance.



What is the effective resistance across XY?

- A** $\frac{1}{5}R$ **B** $\frac{3}{5}R$ **C** $\frac{5}{8}R$ **D** $\frac{3}{2}R$

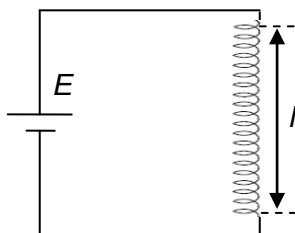
- 25** The arrangement shows a circuit connected to a 15 V battery of negligible internal resistance. The variable resistor can be adjusted from 0 – 2.0 k Ω and the voltmeter can be assumed to be ideal.



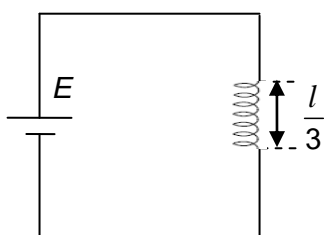
As the variable resistor is adjusted, what are the possible minimum and maximum values of the voltmeter reading?

	minimum / V	maximum / V
A	1.3	1.9
B	3.0	5.0
C	5.0	15
D	6.0	10

- 26 A long solenoid of length l is connected to a cell with e.m.f. E and negligible internal resistance. The magnetic flux density at the centre of the solenoid is B_s .



The solenoid is subsequently cut to a length of $\frac{l}{3}$ and is reconnected to the same cell as shown below.



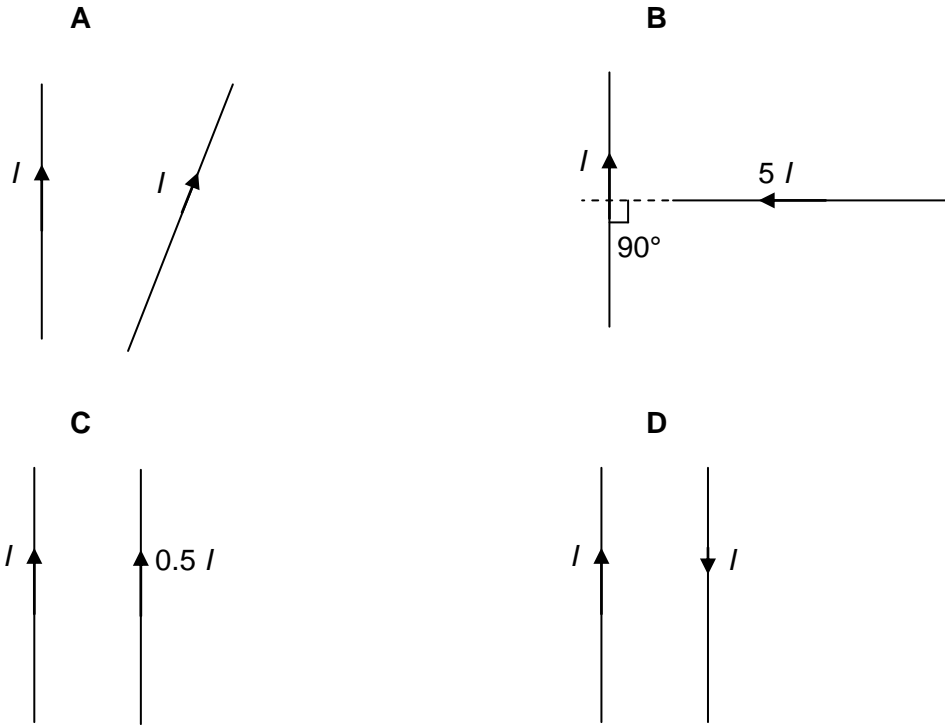
The magnetic flux density at the centre of a solenoid is equal to $\mu_0 nI$, where n is the number of turns per unit length and I is the current through the coil.

What is the magnetic flux density at the centre of the shortened solenoid?

- A $\frac{B_s}{3}$
- B B_s
- C $3B_s$
- D $6B_s$

- 27 Two current-carrying straight conductors are placed near each other in different orientations as shown below.

In which diagram will the attractive force between the conductors, due to the currents, be zero?

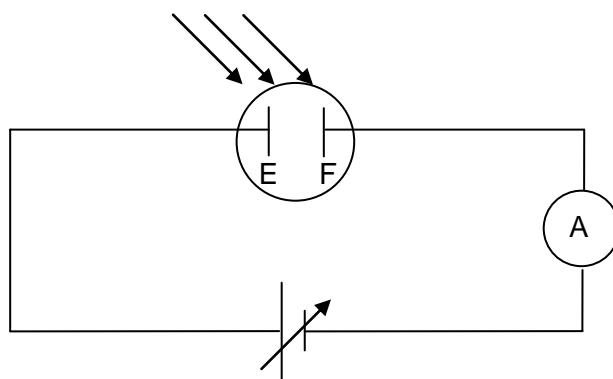


- 28 A photon is emitted from a hydrogen atom by an electron transition between two energy levels. The energy levels have energies X and Y .

Which expression, using conventional symbols, gives the momentum of this photon?

- A** $\frac{(X-Y)}{h}$
 B $\frac{(X-Y)}{c}$
 C $\frac{(X-Y)}{hc}$
 D $\frac{h(X-Y)}{c}$

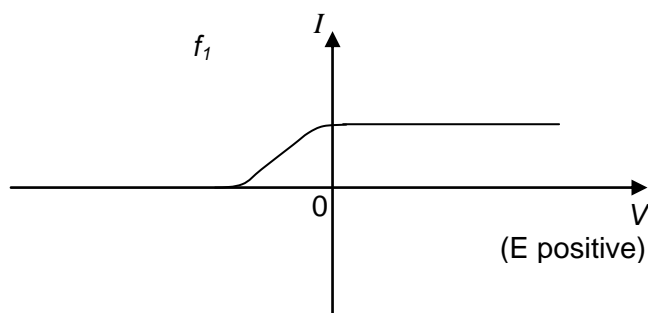
29 The diagram shows a circuit used for photoelectric emission experiments.



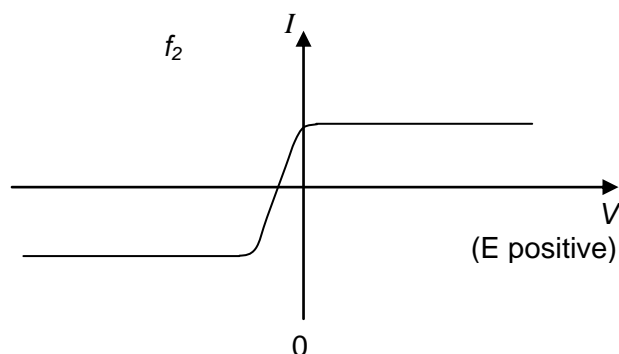
The two electrodes E and F are made of different metals. The work function energy of electrode E is ϕ_E and the work function energy of electrode F is ϕ_F .

Current-voltage (I - V) characteristics are obtained when both electrodes are illuminated with monochromatic light.

When the frequency of light is f_1 the I - V characteristic is as shown.



When the frequency of light is f_2 the I - V characteristic is as shown.



Which line in the table relates the magnitudes of the frequency and the magnitudes of the work function energy?

	frequency	work function energy
A	f_1 is less than f_2	ϕ_E is less than ϕ_F
B	f_1 is less than f_2	ϕ_E is greater than ϕ_F
C	f_1 is greater than f_2	ϕ_E is less than ϕ_F
D	f_1 is greater than f_2	ϕ_E is greater than ϕ_F

30 Which statement about line spectra is correct?

- A** A beam of electrons directed at a vessel of cold gas could cause the formation of either absorption or emission line spectrum.
- B** A beam of white light directed at a vessel of cold gas could cause the formation of only an absorption line spectrum.
- C** A beam of electrons directed at a vessel of cold gas could only cause the formation of an absorption line spectrum.
- D** A beam of electrons directed at a vessel of cold gas could only cause the formation of an emission line spectrum.

End of paper