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**PIONEER JUNIOR COLLEGE
JC2 Preliminary Examination**

**PHYSICS
Higher 1**

8866/01

Paper 1 Multiple Choice

25 September 2014

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 **15** 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 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.

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

- A $\text{m}^2 \text{s}^{-2} \text{K}^{-3}$
- B $\text{m}^2 \text{s}^{-2} \text{K}^{-4}$
- C $\text{kg m}^2 \text{s}^{-2} \text{K}^{-3}$
- D $\text{kg m}^2 \text{s}^{-2} \text{K}^{-4}$
- 2 A student conducted an experiment to determine the acceleration of free fall g . The following measurements were recorded.

readings / m s^{-2}				
9.23	9.25	9.24	9.24	9.25

Which of the following would be a suitable description of the readings?

- A The readings were accurate with large systematic error.
- B The readings were accurate with large random error.
- C The readings were precise with large systematic error.
- D The readings were precise with large random error.
- 3 The diameter of a ping pong ball is measured using a pair of vernier calipers and recorded as $(3.40 \pm 0.01) \text{ cm}$.

How should the total volume of the ping pong ball be expressed?

- A $(20.580 \pm 0.182) \text{ cm}^3$
- B $(20.58 \pm 0.06) \text{ cm}^3$
- C $(20.6 \pm 0.2) \text{ cm}^3$
- D $(20.6 \pm 0.1) \text{ cm}^3$

- 4 Car A travels horizontally at a uniform velocity of 15 m s^{-1} along a level road and passes car B, which is initially at rest, at time $t = 0 \text{ s}$. In order to catch up with car A, car B immediately accelerates uniformly along the same direction. At $t = 3 \text{ s}$, both cars are 27 m apart.

What additional time will it take for car B to catch up with car A?

- A 2.3 s
 - B 4.5 s
 - C 5.0 s
 - D 7.5 s
- 5 A metal ball hits a sand bed one second later after falling from rest and makes an impression of maximum depth 9.5 mm in the sand.

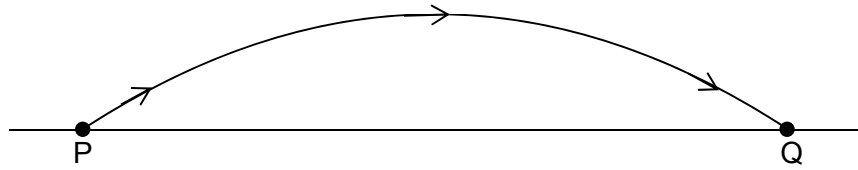
What is the average deceleration of the ball on hitting the sand?

- A 1300 m s^{-2}
 - B 2500 m s^{-2}
 - C 5100 m s^{-2}
 - D 10000 m s^{-2}
- 6 A bomb was projected with a velocity of 100 m s^{-1} at an angle of 40° above the horizontal. At the highest point, it explodes into three equal fragments. One goes vertically upwards with velocity of 50 m s^{-1} , the second moves vertically downwards with velocity of 50 m s^{-1} .

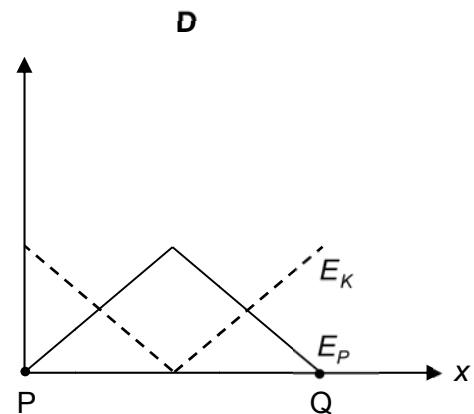
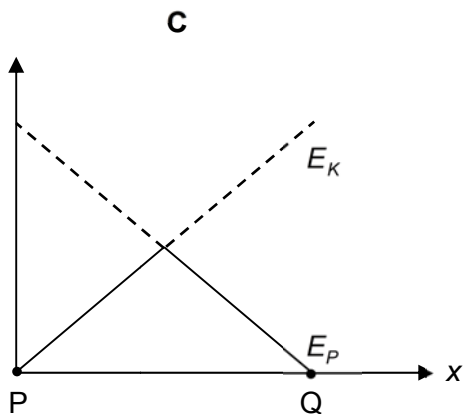
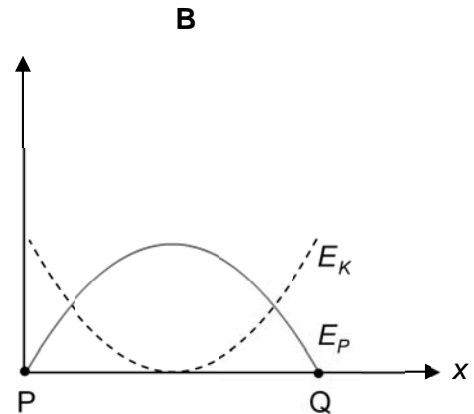
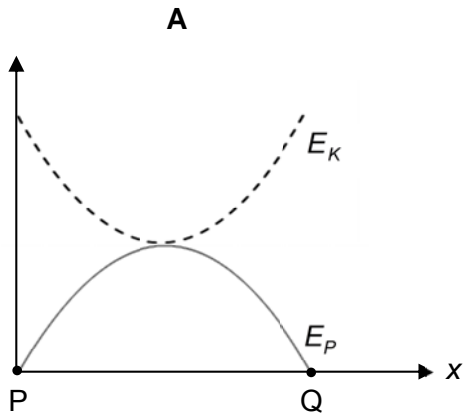
The third fragment moves with a velocity of

- A 77 m s^{-1} horizontally.
- B 230 m s^{-1} horizontally.
- C 77 m s^{-1} at an angle of 40° above the horizontal.
- D 100 m s^{-1} at an angle of 40° above the horizontal.

- 7 In the absence of air resistance, a stone is thrown from point P and follows a parabolic path before it lands at point Q.



Which of the following graphs shows the variation with horizontal distance x of the kinetic energy E_K and potential energy E_P of the ball?

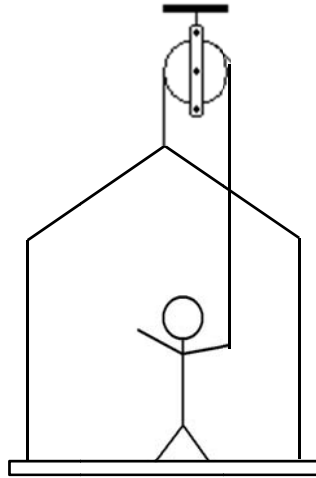


- 8 A tennis ball of mass 0.30 kg moving at 30 m s^{-1} collides with a wall normally and rebounds with half of its original kinetic energy in the opposite direction.

What is the magnitude of the impulse applied by the wall on the tennis ball?

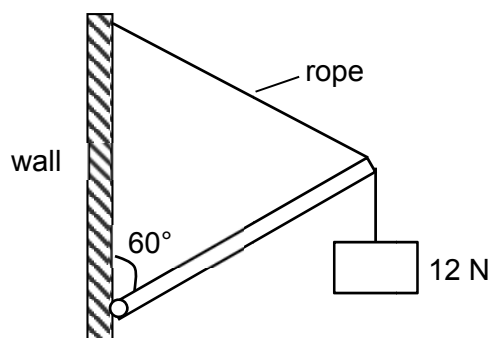
- A 2.6 N s
- B 3.7 N s
- C 15 N s
- D 22 N s

- 9 A man raises himself and the crate on which he stands with an acceleration of 2 m s^{-2} with a massless rope and frictionless pulley system as shown. The mass of the man is 80 kg and that of the crate is 50 kg.



What is the tension in the rope?

- A 590 N
 B 770 N
 C 940 N
 D 1540 N
- 10 A uniform rod of weight 20 N and length L is hinged to a wall as shown below. The rod is supported at the other end by a rope of the same length L and attached to the wall. A load of 12 N is suspended at the other end of the rod.



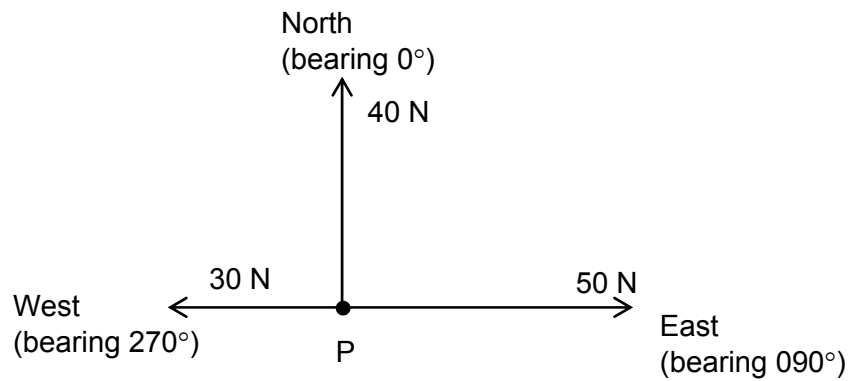
What is the tension in the rope?

- A 22 N
 B 32 N
 C 57 N
 D 64 N

11 Which body is in equilibrium?

- A A coin falling freely towards the ground.
- B A box sliding down a frictionless inclined plane.
- C A cup sliding at constant velocity across a tabletop.
- D A basketball thrown vertically upwards and at its maximum height.

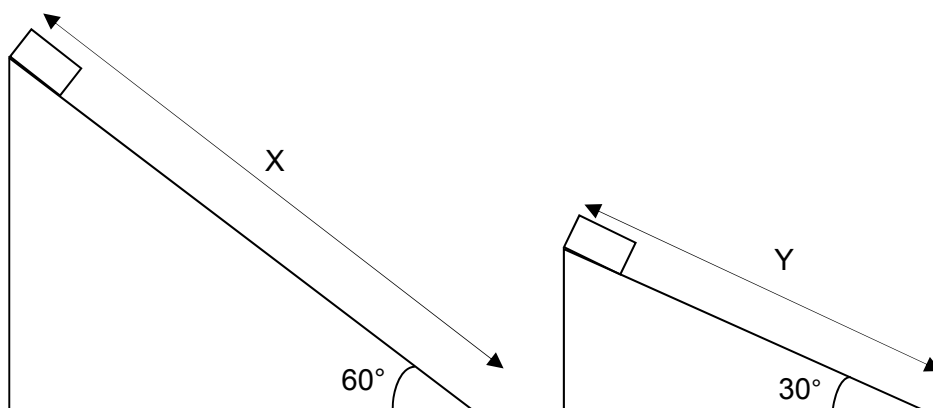
12 Three coplanar forces, of magnitude 30 N, 40 N and 50 N, act on a body in the directions as shown below.



What is the approximate bearing of the additional force required to maintain equilibrium?

- A 117°
- B 153°
- C 207°
- D 243°

- 13 Two identical blocks are released from rest from the tops of two ramps as shown below.



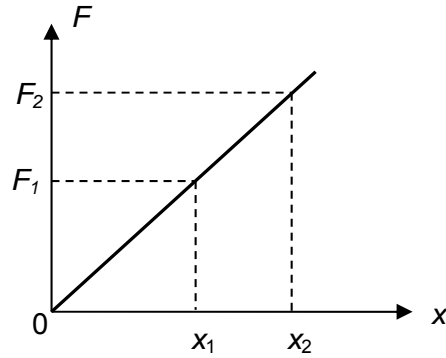
The ratio of the length X to the length Y is 2.0. Assuming that there is no friction, what is the ratio of the blocks' speeds at the bottom of the ramps?

- A 1.1
 - B 1.9
 - C 2.0
 - D 3.5
- 14 A boat moving at constant speed v through still water experiences a total frictional drag F .

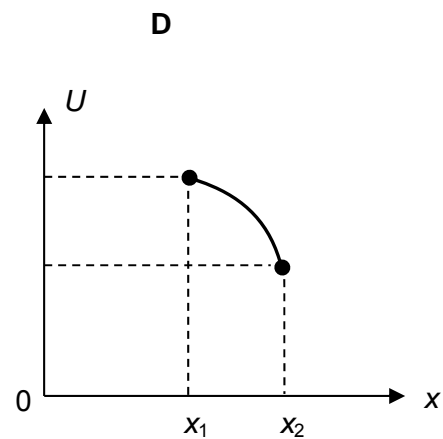
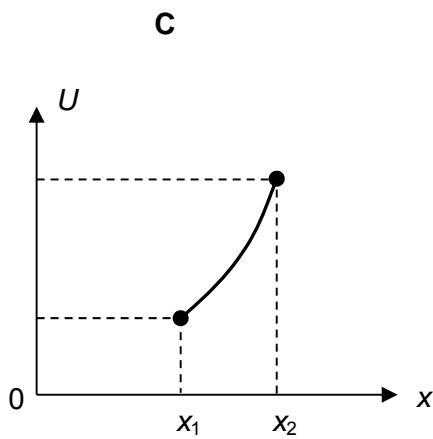
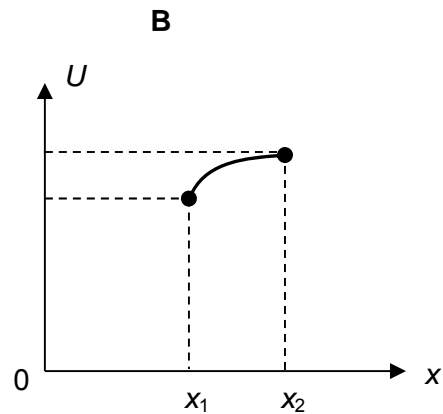
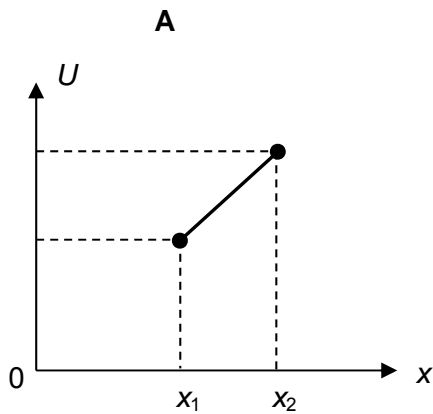
What is the power developed by the boat?

- A $\frac{1}{2}Fv$
- B Fv
- C $\frac{1}{2}Fv^2$
- D Fv^2

- 15 A spring is fixed at one end while the other end is free to move. A force of magnitude F acts on the free end of the spring, causing the spring to stretch by an extension x . The graph of F against x is shown in the figure below.



Which one of the following figures shows correctly a graph of the potential energy U of the spring against extension x for an extension from x_1 to x_2 ?



- 16 A sound wave of frequency 1500 Hz propagates from left to right through a gas. The diagram below shows the positions of some gas particles at a particular instant of time.



The distance between particles P and Q is 0.50 m.

What is the speed of sound in this gas?

- A 300 m s⁻¹
 - B 330 m s⁻¹
 - C 375 m s⁻¹
 - D 750 m s⁻¹
- 17 In a two-slit experiment, light of wavelength 600 nm gives a fringe separation of 0.40 mm on a screen. With a different monochromatic source, the fringe separation becomes 0.33 mm on the same screen.

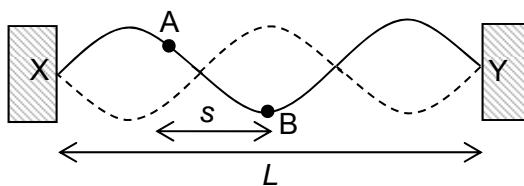
What is the wavelength of the second source?

- A 50 nm
 - B 495 nm
 - C 660 nm
 - D 727 nm
- 18 In a two-slit interference experiment, one slit transmits waves of twice the amplitude compared to the other slit.

If the maximum intensity of the interference pattern is I_o , what is the minimum intensity of the pattern?

- A zero
- B $\frac{I_o}{2}$
- C $\frac{I_o}{4}$
- D $\frac{I_o}{9}$

- 19 A string of length L is stretched between two fixed points X and Y and made to vibrate transversely as shown in the figure.



Two particles A and B on the string are separated by a distance s . The maximum kinetic energies of A and B are K_A and K_B respectively.

Which of the following gives the correct phase difference and maximum kinetic energies of the particles?

	phase difference	maximum kinetic energy
A	$\frac{3s}{2L} \times 360^\circ$	$K_A < K_B$
B	$\frac{3s}{2L} \times 360^\circ$	same
C	180°	$K_A < K_B$
D	180°	same

- 20 The belt in an electrostatic machine has width w and travels with velocity v . The amount of charge per unit area on the surface of the belt is ϵ . As the belt passes a certain point, all the charge is removed and carried away as an electric current.

Which of the following expressions gives the magnitude of this current?

- A** $wv\epsilon$
- B** $wv^2\epsilon$
- C** $\frac{w\epsilon}{v}$
- D** $\frac{v\epsilon}{w}$

- 21** A lamp of resistance R is powered by an electrical source with internal resistance r .

Which expression gives the fraction of the total power delivered to the lamp?

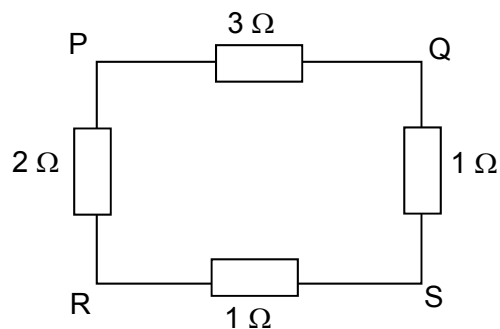
- A** $\frac{r}{R}$
- B** $\frac{R}{R+r}$
- C** $\frac{R-r}{R}$
- D** $\frac{R-r}{R+r}$

- 22** Two wires X and Y, each of the same length and the same material, are connected in parallel to a battery. The diameter of X is twice that of Y.

What fraction of the total current passes through X?

- A** 0.20
- B** 0.25
- C** 0.75
- D** 0.80

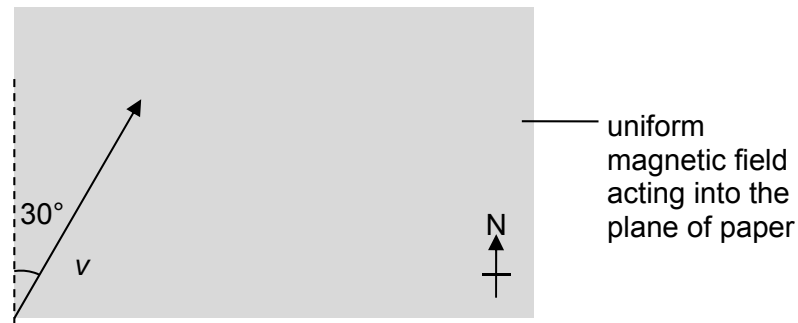
- 23** The diagram shows four resistors connected in a circuit.



Between which two points will the resistance be a minimum?

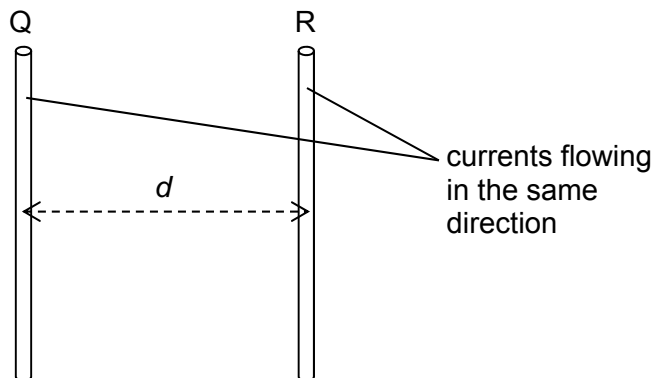
- A** P and Q
- B** P and R
- C** P and S
- D** R and S

- 24 A negative charge is injected into a region where there is a uniform magnetic field acting into the plane of paper. Its initial velocity v is directed at an angle of 30° East of North.



What is the initial direction of the magnetic force acting on the charge?

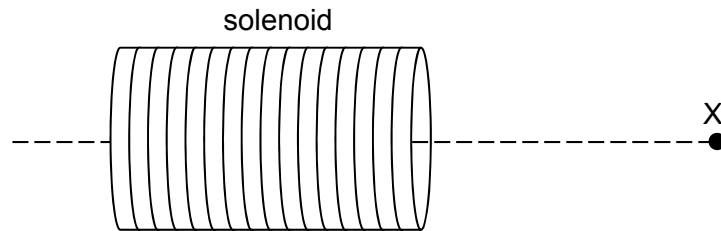
- A 30° East of North
 B 30° South of East
 C 60° North of West
 D 60° South of East
- 25 Q and R are two long straight current-carrying wires placed parallel to each other and at a small distance d apart. The wires are both carrying currents flowing in the same direction.



Which pair of arrows best represent the magnetic forces acting on the wires Q and R respectively?

	force acting on Q	force acting on R
A	\rightarrow	\rightarrow
B	\leftarrow	\rightarrow
C	\rightarrow	\leftarrow
D	\leftarrow	\leftarrow

- 26 A solenoid generates a magnetic field of 10 mT at a point X when a current is passed through it. Point X lies on the axis of the solenoid and a slight distance away from the end.



Which of the following will increase the magnetic field strength at X?

- A Move the solenoid further away from X.
 - B Place a ferrous core through the solenoid.
 - C Place a charged insulating rod in the solenoid.
 - D Decrease the current passing through the solenoid.
- 27 Light of wavelength 450 nm is incident on a metal surface. The most energetic electrons ejected from the metal surface are undeflected as they pass through a region of mutually perpendicular magnetic and electric fields of strength 2.0×10^{-3} T and 1400 V m^{-1} , respectively.

What is the work function energy of the metal?

- A $2.2 \times 10^{-19} \text{ J}$
 - B $4.4 \times 10^{-19} \text{ J}$
 - C $6.6 \times 10^{-19} \text{ J}$
 - D $8.8 \times 10^{-19} \text{ J}$
- 28 When an atom absorbs radiation of wavelength λ_1 , it makes a transition from its ground state of energy E_1 to an excited state of energy E_3 . Then it makes a second transition to a state of lower energy E_2 , emitting radiation of wavelength λ_2 .

What is the wavelength of the radiation emitted by the atom when it makes a third transition back to the ground state?

- A $\lambda_1 - \lambda_2$
- B $\lambda_2 - \lambda_1$
- C $\frac{\lambda_1 \lambda_2}{\lambda_1 - \lambda_2}$
- D $\frac{\lambda_1 \lambda_2}{\lambda_2 - \lambda_1}$

- 29 A beam of light of wavelength λ is totally reflected at normal incidence by a plane mirror. The intensity of the light is such that photons hit the mirror at a rate n .

What is the force exerted on the mirror by this beam in term of n , h and λ ?

A $nh\lambda$

B $\frac{2nh}{\lambda}$

C $\frac{nh}{\lambda}$

D $\frac{2n\lambda}{h}$

- 30 Light of frequency f falls on a metal surface of work function energy ϕ and emits electrons of maximum kinetic energy K by the photoelectric effect.

If the frequency and the intensity of this light is doubled, what will be the maximum kinetic energy of the emitted electrons?

A $2K - \phi$

B $2K$

C $2K + \phi$

D $2K + 2\phi$