IB · DP · Physics

40 mins 40 questions

Practice Paper 1

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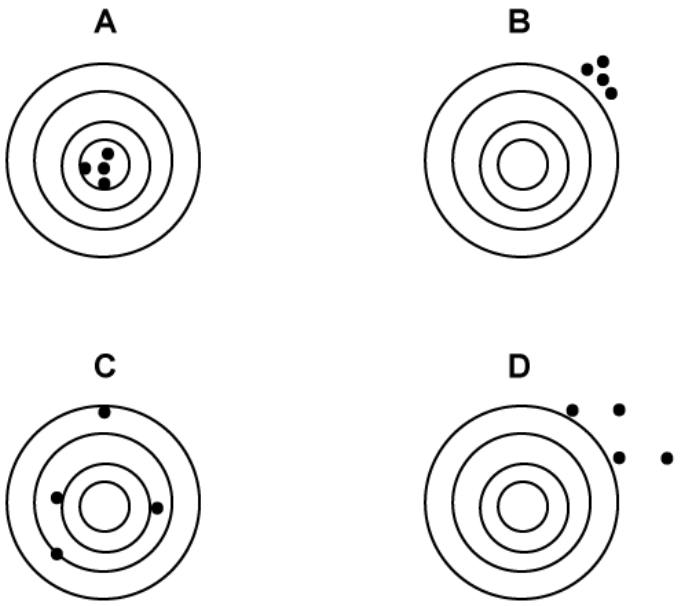
Total Marks /40

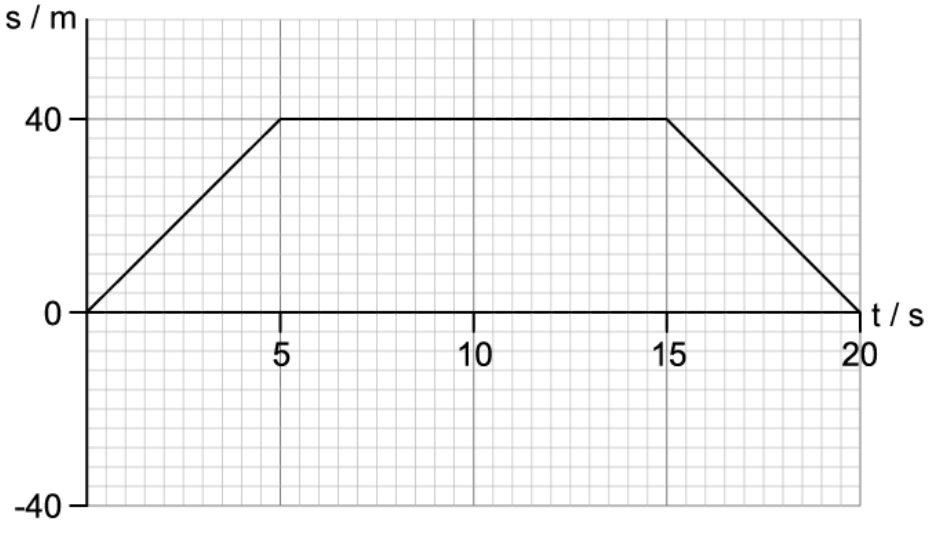
1 Four people participate in a shooting competition. Each person gets four shots. The diagram shows the target boards of each participant after their turn.

Which target has a low precision and a high accuracy?



(1 mark)

2 A particle moving in a straight line has the displacement–time graph shown.

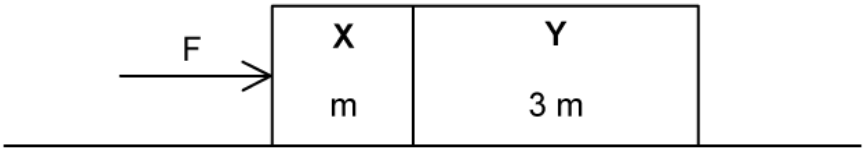


Which row is correct about the average speed and average velocity of the particle?

	Average speed / m s^{-1}	Average velocity / m s^{-1}
A.	0	4
B.	0	2
C.	4	0
D.	2	16

(1 mark)

3 Two boxes in contact are pushed in a line along a floor with a force *F*. The boxes are moving at a constant speed. Box X has a mass *m* and box Y has a mass 3*m*.



What is the resultant force acting on Y?

A. *F*

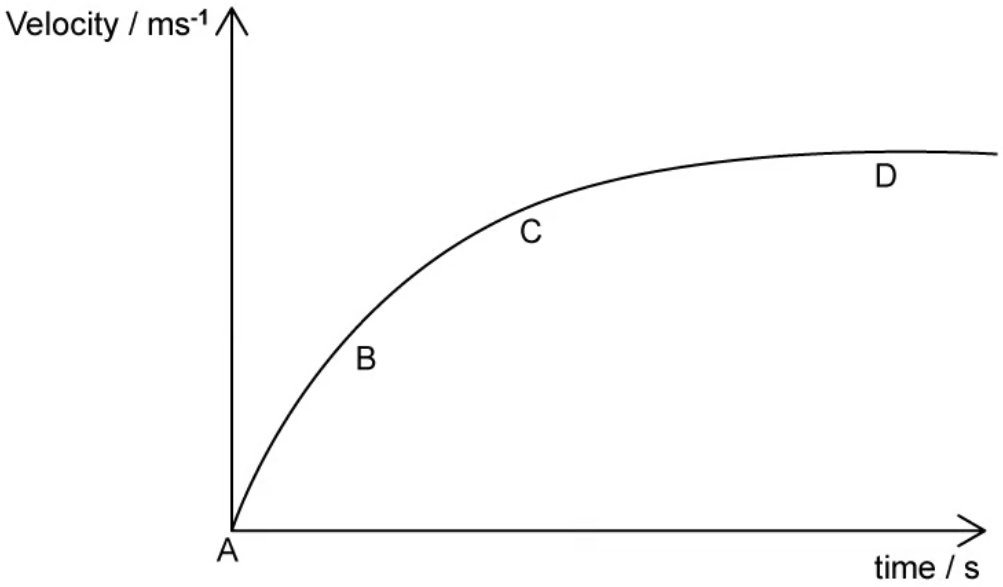
B. $\frac{F}{3}$

C. 3*F*

D. 0

(1 mark)

4 The graph below shows the motion of a skydiver in free fall.



What point on the graph represents the skydiver reaching terminal velocity?

(1 mark)

5 Two coplanar forces of 11 N and 7 N act on an object. Which force could **not** be the resultant for these two forces?

A. 18 N

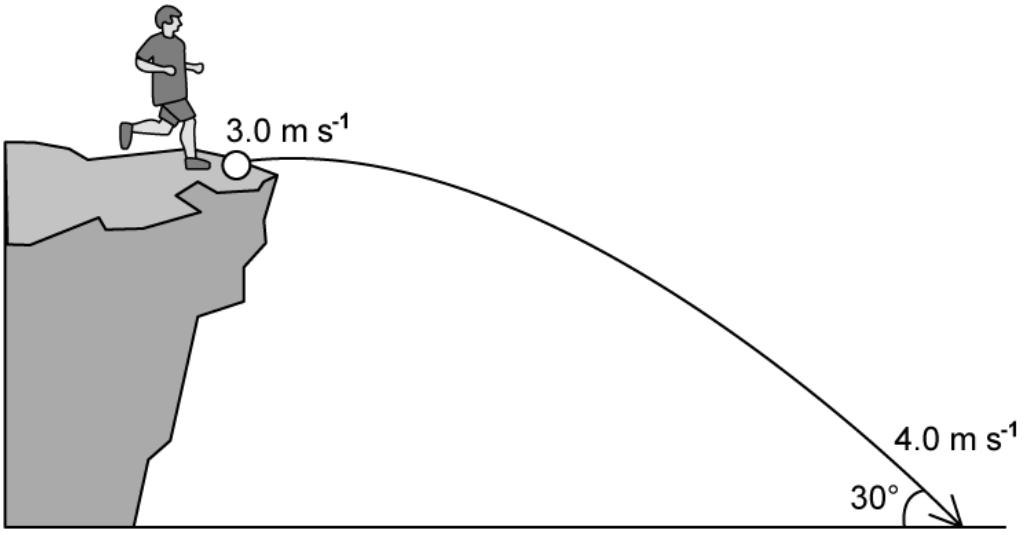
B. 1 N

C. 9 N

D. 4 N

(1 mark)

6 A ball of mass 0.60 kg is kicked off a cliff with a horizontal velocity of 3.0 m s^{-1}. It follows the path of a projectile shown below and lands with a velocity of 4.0 m s^{-1} at an angle of 30° to the ground. Air resistance is negligible during the flight.



What is the magnitude of the change in momentum of the ball between the top of the cliff and the ground below?

You may need to use the following trigonometric values to help you:

$$\cos(30) = \frac{\sqrt{3}}{2}$$

$$\sin(30) = \frac{1}{2}$$

A. $1.2\sqrt{3}$ N s

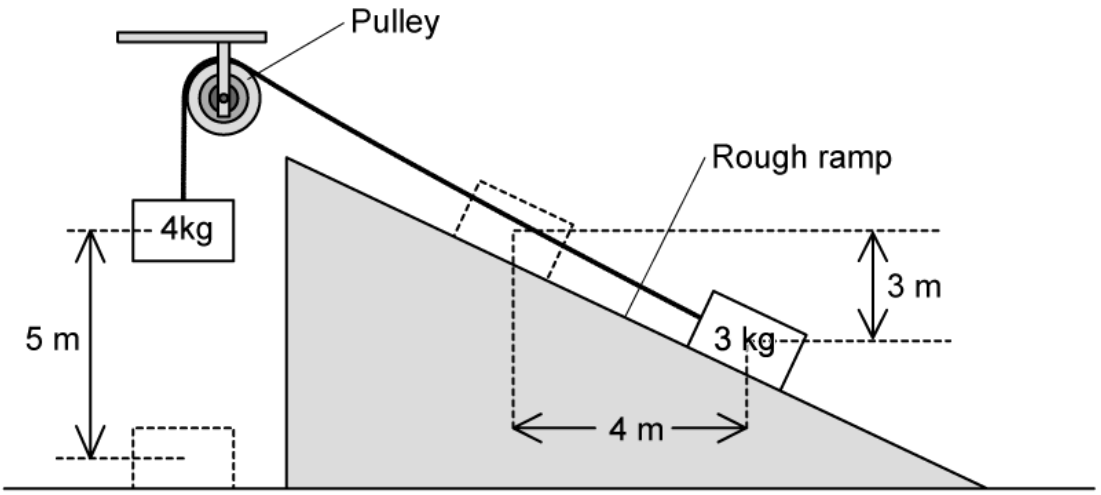
B. 0.6 N s

C. 2 N s

D. 1.2 N s

(1 mark)

7 A 4 kg mass is released from rest at a height of 5 m and falls to the ground pulling a 3 kg mass up the slope. The rough surface of the ramp provides a constant frictional force of 3 N.



Use the acceleration due to free fall $g = 10$ m s^{-2}.

What speed will the 4 kg mass hit the ground?

A. $\frac{520}{7}$ m s^{-1}

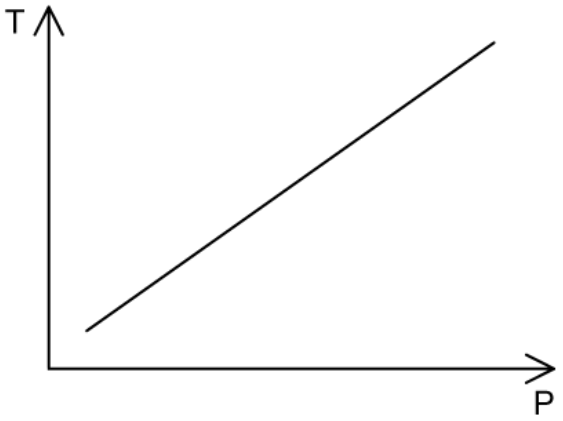
B. $\sqrt{\frac{430}{7}}$ m s^{-1}

C. $\sqrt{\frac{220}{7}}$ m s^{-1}

D. $\sqrt{\frac{520}{7}}$ m s^{-1}

(1 mark)

8 An ideal gas of N molecules is maintained at constant volume, V. The graph shows how temperature *T* varies with pressure *p*.



What is the gradient of the graph?

A. $\frac{VN_A}{NR}$

B. $\frac{VN}{N_A R}$

C. $\frac{NR}{VN_A}$

D. nRV

(1 mark)

9 Given the following data:

- Mass of oxygen = 16 g
- Temperature = 27 °C
- Length of side of cubic container = 10 cm
- Mass of one mole of oxygen = 32 g

What is the pressure of oxygen in a cubic container?

A. 1 kPa

B. 12 kPa

C. 110 kPa

D. 1200 kPa

(1 mark)

10 The temperature of 500 g of water decreases by ΔT °C when placed in a fridge for 10 minutes. This container of water is then removed and a second container of mass 250 g and temperature 25 °C is placed in the same fridge for 20 minutes.

Assume that the containers holding the water are identical and do not emit or absorb energy. The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

What is the final temperature of the second container of water after 20 minutes?

A. $25 - 4\Delta T$

B. $25 - 3\Delta T$

C. $25 + 4\Delta T$

D. $4\Delta T$

(1 mark)

11 A mass-spring system is oscillating with simple harmonic motion.

What is the total energy of the object proportional to?

A. The square of both the mass and the amplitude

B. Mass and displacement of the object

C. Angular frequency

D. Mass and the square of the amplitude

(1 mark)

12 Two microwave transmitters are arranged to ensure that their waves undergo superposition and create a stationary wave made up of nodes and antinodes.

Which line correctly identifies the formula and a likely value for the minimum distance between the nodes of the stationary wave?

	formula	distance /cm
A.	$\frac{c}{f}$	30
B.	$\frac{c}{f}$	0.05
C.	$\frac{c}{2f}$	30
D.	$\frac{c}{2f}$	0.05

(1 mark)

13 A wave has frequency f, intensity I and amplitude A. The intensity of a wave is proportional to the square of the frequency.

A second similar wave has frequency $2f$ and amplitude $\frac{1}{3}A$.

Which of the following is an expression for the intensity of the second wave, I_2?

A. $\frac{2}{9}I$

B. $\frac{2}{3}I$

C. $\frac{3}{2}I$

D. $\frac{4}{9}I$

(1 mark)

14 Organs such as those found in churches often have many different kinds of pipes with both open and closed ends. For a single pipe that has a specific length, what is the ratio of the fundamental frequency with both ends open to the fundamental frequency with one end closed?

A. 1:2

B. 1:4

C. 2:1

D. 4:1

(1 mark)

15 A power cable **X** has resistance *R* and carries current *I*. A second cable **Y** has resistance 2*R* and carries current $\frac{1}{2}$.

What is the ratio $\frac{power\ dissipated\ in\ \boldsymbol{Y}}{power\ dissipated\ in\ \boldsymbol{X}}$?

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. 2

D. 4

(1 mark)

16 Which of the following statements about magnetic fields is **incorrect**?

A. The strength of a magnetic field is also known as the magnetic flux density

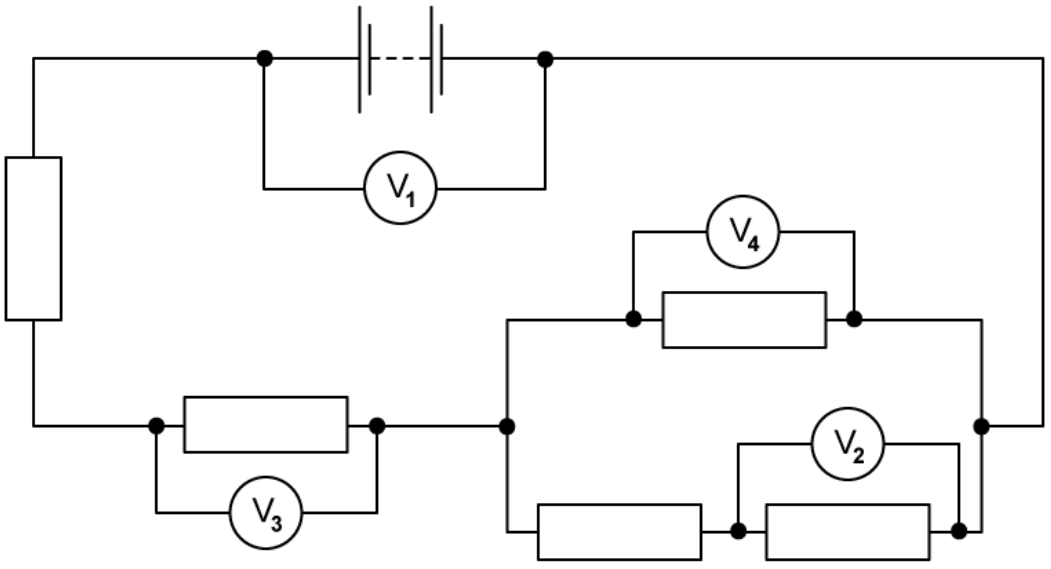
B. There is a force on a conductor carrying a current at 90° to magnetic field lines

C. The magnetic flux density is measured in units of Tesla, T

D. There is a force on a current carrying conductor parallel to magnetic field lines

(1 mark)

17 A circuit contains five identical resistors and four identical voltmeters. The reading on voltmeter V_1 is 8.0 V and the reading on voltmeter V_2 is 1.0 V. What are the readings on V_3 and V_4?



	reading on voltmeter V_3 / V	reading on voltmeter V_4 / V
A.	1.5	1.0
B.	3.0	2.0
C.	4.5	3.0
D.	6.0	4.0

(1 mark)

18 A helium nucleus is accelerated from rest across a potential difference of 5.0 kV.

If m_p and m_n is the rest mass of a proton and neutron respectively, which expression for the final velocity of the nucleus is correct?

A. $\sqrt{\frac{2e}{m_p + m_n}}$

B. $50\sqrt{\frac{2e}{m_p + m_n}}$

C. $100\sqrt{\frac{e}{m_p + m_n}}$

D. $\sqrt{\frac{e}{m_p + m_n}}$

(1 mark)

19 For a particle moving in a circle with uniform speed, which of the following statements is incorrect?

A. The speed of the particle is constant

B. The acceleration of the particle is perpendicular to its direction of motion

C. The momentum of the particle is constant

D. The particle is accelerating

(1 mark)

20 The initial activity of a radioactive source is 160 counts per second. After a time *T*, its activity becomes 5 counts per second.

If the half–life of the source is 18 hours, what is *T*?

A. $\frac{\ln(32)}{18\ln(2)}$ hours

B. $\frac{18\ln(32)}{\ln(2)}$ hours

C. $\frac{\ln(2)}{18\ln(32)}$ hours

D. $\frac{18\ln(2)}{\ln(32)}$ hours

(1 mark)

21 Three of the four isotopes below are the same element. Which isotope represents a different element?

	Nucleon number	Neutron number
A.	233	141
B.	235	143
C.	238	146
D.	239	146

(1 mark)

22 A nuclear reaction can be written in the form:

$$W + X = Y + Z$$

Energy is released during this reaction.

Which of the following is correct regarding the masses *m* and the binding energies *b* of the nuclides?

	Binding energy	Mass
A.	$b_W + b_X < b_Y + b_Z$	$m_W + m_X < m_Y + m_Z$
B.	$b_W + b_X > b_Y + b_Z$	$m_W + m_X < m_Y + m_Z$
C.	$b_W + b_X < b_Y + b_Z$	$m_W + m_X > m_Y + m_Z$
D.	$b_W + b_X > b_Y + b_Z$	$m_W + m_X > m_Y + m_Z$

(1 mark)

23 A pion can decay to produce two leptons.

Which of the following reactions is possible?

A. $\pi^0 \rightarrow \mu^+ + \nu_e$

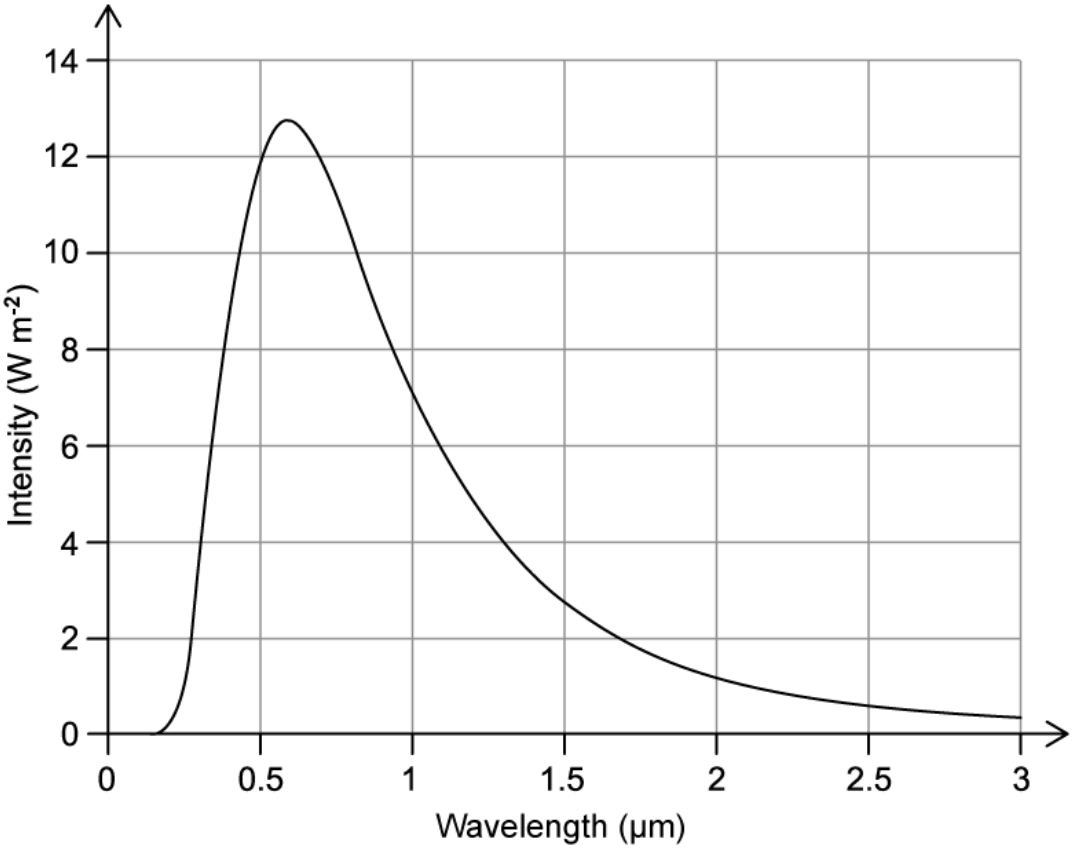
B. $\pi^0 \rightarrow \pi^+ + \mu^-$

C. $\pi^+ \rightarrow e^+ + \nu_\mu$

D. $\pi^+ \rightarrow \mu^+ + \nu_\mu$

(1 mark)

24 The graph shows the variation with wavelength of the intensity from a unit area of a black body.

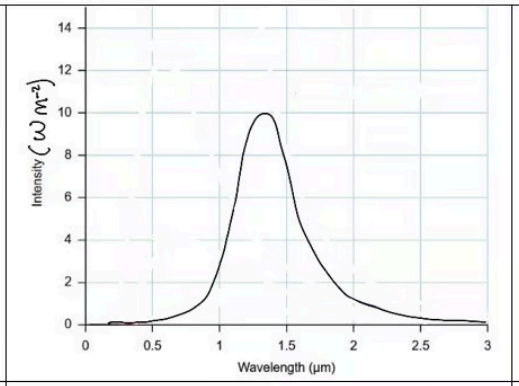


The area and temperature of the black body are both reduced by one-quarter of their original value.

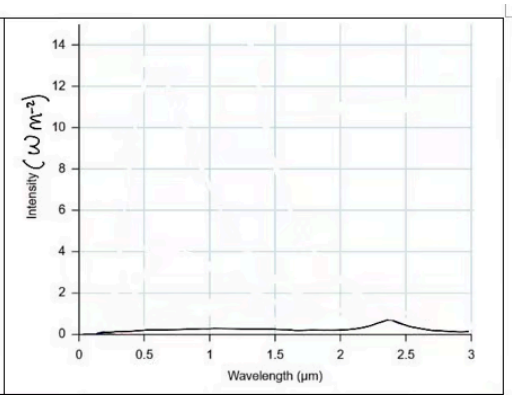
Which graph now shows the correct variation with wavelength of the intensity from a unit area of the black body?

The scale on the horizontal and vertical axis on all graphs in this question is constant.

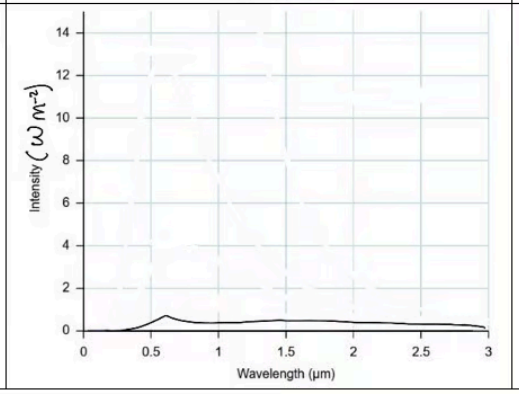
A.



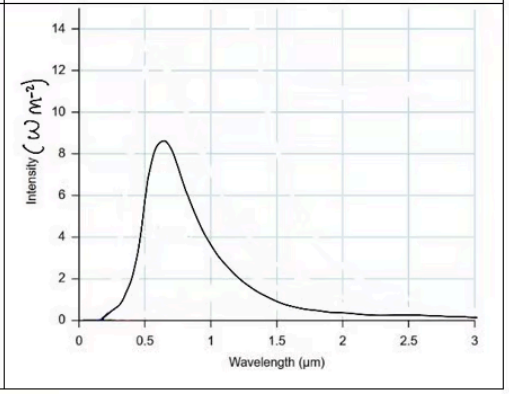
C.



B.



D.



(1 mark)

25 A black body has a total power radiated *P* and a surface area *A*. The surface area is reduced to one-quarter of *A* and the total power is increased to four times *P*.

What is the value of the peak wavelength?

A. $(1.5 \times 10^{-3}) \times \sqrt[4]{\frac{A}{p}}$

B. $(1.5 \times 10^{-3}) \times \sqrt{\frac{P}{A}}$

C. $2 \times \sqrt[4]{\frac{P}{A}}$

D. $(1.5 \times 10^{-3}) \times \left(\frac{P}{A}\right)^{-\frac{1}{4}}$

(1 mark)

26 A pendulum oscillating with simple harmonic motion has an amplitude x_0 and a maximum kinetic energy E_k.

What is the potential energy of the system when the pendulum bob is at a distance $0.4x_0$ from its maximum displacement?

A. $0.36E_k$

B. $0.4E_k$

C. $0.6E_k$

D. $0.64E_k$

(1 mark)

27 Which of the following statements about thin film interference are correct?

I. A phase change occurs at a boundary between a more dense and a less dense material

II. A phase change always involves some reflection and transmission

III. The wavelength of a wave transmitted between materials of different densities stays the same

IV. Light in a thin film travels a distance of two times the thickness of the film when it enters and leaves the film at the same surface to undergo destructive interference

A. I, II and III

B. I and II only

C. II only

D. IV only

(1 mark)

28 A siren on a fire engine emits sound of wavelength λ. The speed of sound in still air is v.

What would be the wavelength of the sound recorded by a stationary observer when the ambulance travels towards them at speed of 0.15 v?

A. 0.85λ

B. 1.15λ

C. 0.15λ

D. 7.67λ

(1 mark)

29 When white light is diffracted through a single slit which colour appears closest to the central maximum when viewed on a screen?

A. Violet

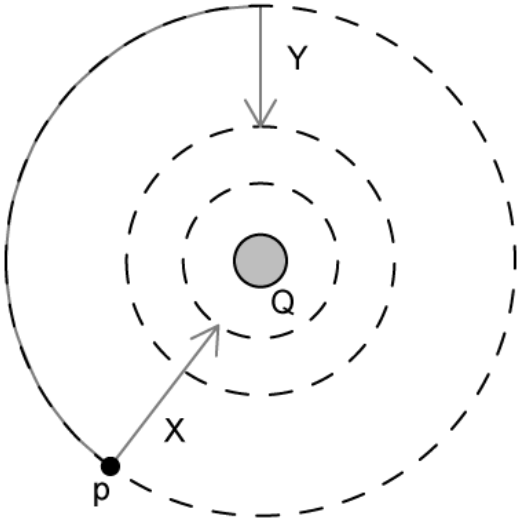
B. Blue

C. Red

D. Green

(1 mark)

30 A positive charge Q is deposited on the surface of a small sphere. The dotted lines represent equipotentials.



A small positive point charge is moved from point P closer to the sphere along two different paths X and Y. What is the best comparison of the work done along X and Y, W_X and W_Y?

A. $W_X = W_Y$

B. $W_X < W_Y$

C. $W_X > W_Y$

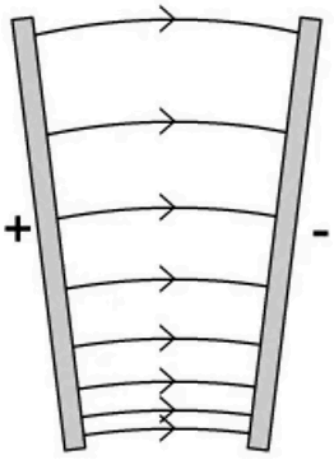
D. $W_X \approx W_Y$

(1 mark)

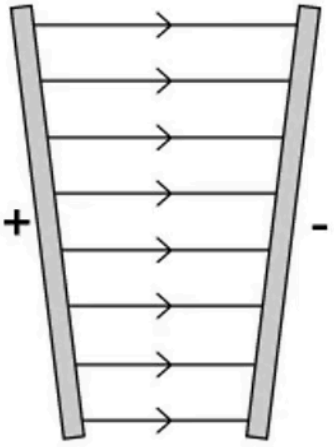
31 A potential difference is applied between two metal plates that are not parallel.

Which diagram shows the electric field between the plates?

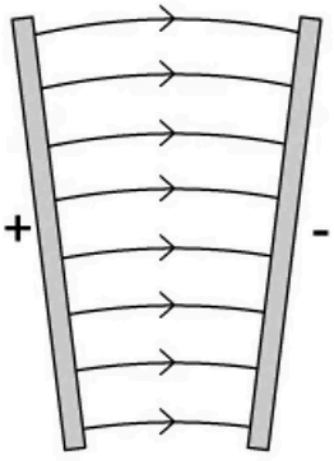
A



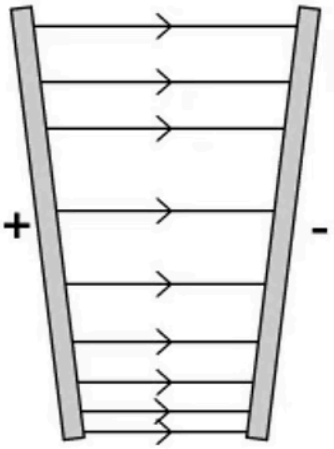
B



C



D



(1 mark)

32 A space probe with mass *m* is launched from the surface of the Earth's equator into orbit. The total energy E_t given to the space probe is:

$$E_t = \frac{3GMm}{4r_E}$$

where G is the gravitational constant and M and r_E are the mass and radius of Earth.

What is the height of the space probe's orbit above the Earth's surface?

A. r_E

B. $2r_E$

C. $3r_E$

D. $4r_E$

(1 mark)

33 Four capacitors of same capacitance are connected in parallel. When they are connected to a cell, a total charge of 2.4 μC is accumulated on them. After discharging, they are connected in series and then charged by the same cell.

What is the total charge stored on the capacitors after charging in series?

A. $\frac{192}{5}$ mC

B. $\frac{192}{5}$ μC

C. $\frac{3}{20}$ mC

D. $\frac{3}{20}$ μC

(1 mark)

34 An ac generator produces a root mean squared emf ε at frequency f. The rotational speed of the coil in the generator is increased by a factor of three. Which of the following correctly identifies the new values of frequency and output emf_{rms}?

	emf	frequency
A.	3ε	$\frac{f}{3}$
B.	3ε	$3f$
C.	$3\sqrt{2}\ \varepsilon$	$3f$
D.	$3\sqrt{2}\ \varepsilon$	$\frac{f}{3}$

(1 mark)

35 A coil of wire having a large number of turns is moved relative to a fixed magnetic field.

Which line correctly outlines the magnitude and direction of the e.m.f. which is generated?

	e.m.f. is proportional to	direction of e.m.f.
A.	rate of change of magnetic flux linkage	opposes the change making it
B.	change of the magnetic flux through the coil	reinforces the change making it
C.	rate of change of magnetic flux linkage	opposes the change making it
D.	change of the magnetic flux through the coil	reinforces the change making it

A.

(1 mark)

36 A fully charged capacitor of capacitance C = 1.00 μF is connected in parallel with a resistor with a resistance of R = 2.00 MΩ. The potential difference used to charge the capacitor is then removed. Initial current is denoted as I_0 .

What length of time does it take for the current to decrease from $\frac{7I_0}{15}$ to $\frac{I_0}{15}$?

A. $\ln\left(\frac{8}{15}\right)$ s

B. $\ln(49)$ s

C. $\ln(14)$ s

D. $\ln\left(\frac{1}{14}\right)$ s

(1 mark)

37 An atom in an excited state has an orbital radius of 10^{-12} m.

Which would be the best order of magnitude estimate for the energy of this state according to the uncertainty principle?

A. 10^{1} eV

B. 10^{3} eV

C. 10^{6} eV

D. 10^{10} eV

(1 mark)

38 Two elements are compared where the nucleus of the first element, N_1 has radius r and nucleon number Z, and the nucleus of the second element N_2 has radius $3r$ and nucleon number $\frac{5}{3}$ Z. What is the ratio of $\frac{density\ N_1}{density\ N_2}$?

A. $\frac{1}{5}$

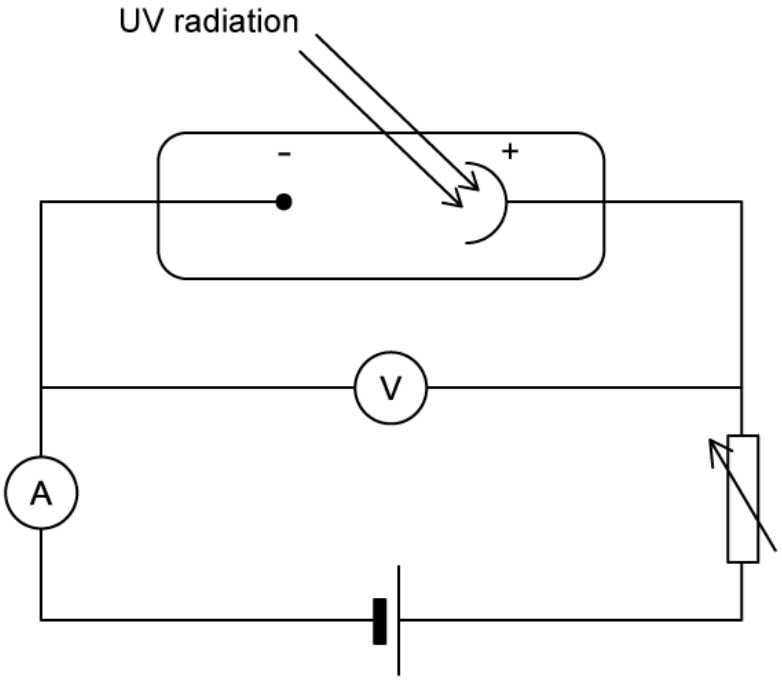
B. $\frac{4}{9}$

C. 1

D. $\frac{5}{2}$

(1 mark)

39 A vacuum photocell is connected in series with a power supply, a variable resistor, and a sensitive ammeter. A voltmeter is connected in parallel across the photocell.



Monochromatic light of frequency f illuminates the cathode, which has a threshold frequency f_0. Photoelectrons are emitted and collected by the anode. A photocurrent is measured by the ammeter.

The potential difference across the photocell, V, is increased until the ammeter reads zero.

Which of the equations below does **not** correctly relate the potential V at which the current decreases to zero to the threshold frequency f_0 and frequency f?

A. $V = \frac{h}{e}(f - f_0)$

B. $f_0 = \frac{hf - eV}{h}$

C. $h = \frac{eV}{(f - f_0)}$

D. $V = \frac{e}{hf_0 - hf}$

(1 mark)

40 Which expression is proportional to the probability of finding an electron in a particular region of space?

A. The magnitude of the wave function

B. The square of the magnitude of the wave function

C. $\frac{h}{4\pi \times uncertainty\ in\ momentum}$

D. $\frac{h}{4\pi \times uncertainty\ in\ energy}$

(1 mark)