PP-DSE
PHY
PAPER 1A

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

PRACTICE PAPER

PHYSICS PAPER 1

(2 hours 30 minutes)

This paper must be answered in English

GENERAL INSTRUCTIONS

1. There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 60 minutes.

2. Section A consists of multiple-choice questions in this question paper, while Section B contains conventional questions printed separately in Question-Answer Book **B**.

3. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book for Section B will be collected separately at the end of the examination.**

4. The diagrams in this paper are **NOT** necessarily drawn to scale.

5. The last pages of this question paper contain a list of data, formulae and relationships which you may find useful.

INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

1. Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.

2. When told to open this book, you should check that all the questions are there. Look for the words **'END OF SECTION A'** after the last question.

3. All questions carry equal marks.

4. **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.

5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

6. No marks will be deducted for wrong answers.

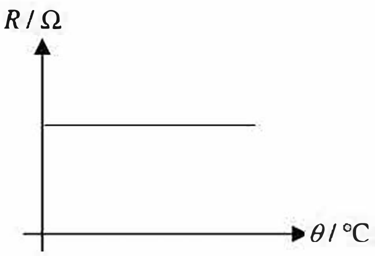
Not to be taken away before the end of the examination session

There are 36 questions. Questions marked with "*" involve knowledge of the extension component.

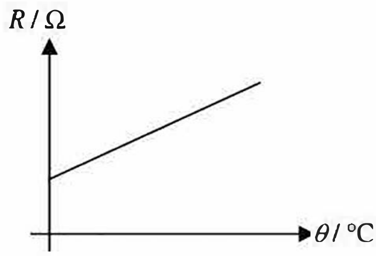
Section A

1. The graphs below show how the electrical resistances R of three different circuit elements change with temperature θ. Which of the circuit elements can be used to measure temperature ?

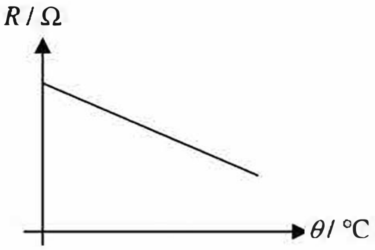
(1)



(2)



(3)



A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

2. In the figure below, a training pool B is located next to the main pool A. The training pool B has a smaller area and is shallower. If the pools are under the sunlight at the same time, which of the following statements about the rise in the water temperature of the two pools is correct ? Assume that the initial water temperatures of the pools are the same.

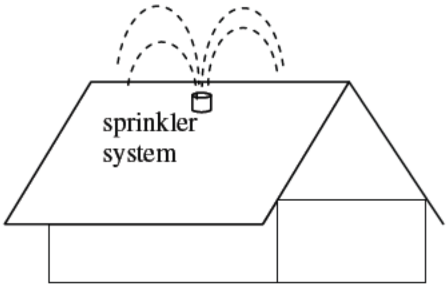
A. The water temperature of training pool B rises faster because it is shallower.
B. The water temperature of training pool B rises faster because it has a smaller surface area.
C. The water temperature of main pool A rises faster because it is deeper.
D. The water temperature of main pool A rises faster because it has a larger surface area.

3. Peter adds 50 g of milk at 20°C to 350 g of tea at 80°C, what is the final temperature of the mixture ?

Given : Specific heat capacity of milk = 3800 J kg^{-1} $°C^{-1}$
Specific heat capacity of tea = 4200 J kg^{-1} $°C^{-1}$

A. 50.0°C
B. 72.5°C
C. 73.1°C
D. 77.4°C

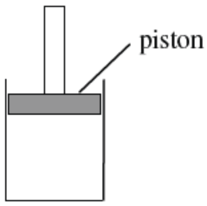
4. The sprinkler system on a rooftop is able to spray small water droplets onto the rooftop which can lower the temperature of the rooftop on hot sunny days. Which of the following explanations about the sprinkler system is/are reasonable ?



(1) Water is a good conductor, which conducts heat quickly.
(2) Water has a high specific heat capacity, absorbing a lot of energy when its temperature rises.
(3) Water has a high specific latent heat of vaporization, absorbing a lot of energy when it evaporates.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

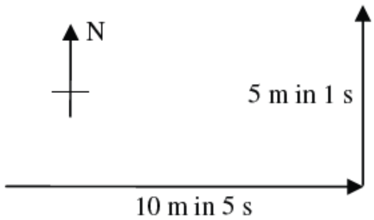
*5. A fixed mass of an ideal gas is contained in a cylinder fitted with a frictionless piston as shown in the figure below. If the gas is cooled under constant pressure,



(1) the average separation of the gas molecules will decrease.
(2) the r.m.s. speed of the gas molecules will decrease.
(3) the number of collisions per second of the gas molecules on the piston will decrease.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

6.



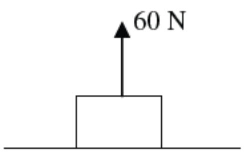
A toy car travelled due east for 10 m in 5 s, then immediately turned north and travelled 5 m for 1 s. What was the average speed of the car ?

A. 1.9 m s^{-1}
B. 2.2 m s^{-1}
C. 2.5 m s^{-1}
D. 3.5 m s^{-1}

7. A stone falls from rest. Neglecting air resistance, the ratio of the distance travelled by the stone in the 1^{st} second to that travelled in the 2^{nd} second is

A. 1 : 1
B. 1 : 2
C. 1 : 3
D. 1 : 4

8.

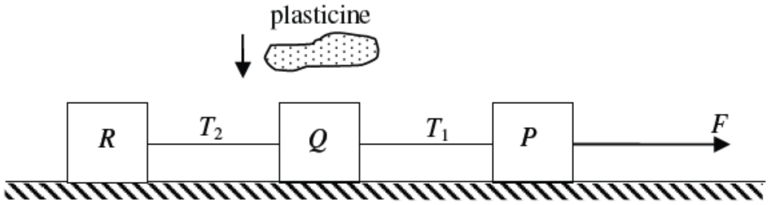


A block of weight 100 N is placed on a horizontal table and a vertical force of 60 N is exerted on the block as shown in the figure above. Which of the following statements is/are correct ?

(1) The weight of the block is balanced by the force exerted on the block by the table.
(2) The weight of the block and the force exerted on the table by the block are equal in magnitude.
(3) The force exerted on the table by the block and the force exerted on the block by the table are an action-reaction pair.

A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

9. Blocks, P, Q and R, connected by light inextensible threads, are placed on a smooth horizontal surface as shown. A constant force F is applied to P so that the whole system travels to the right with acceleration.



A lump of plasticine is placed on Q and it moves together with Q. If the applied force F remains unchanged, how would the tensions T_1 and T_2 in the two threads change ?

	Tension T_1	**Tension T_2**
A.	increase	decrease
B.	increase	increase
C.	decrease	decrease
D.	decrease	increase

10.

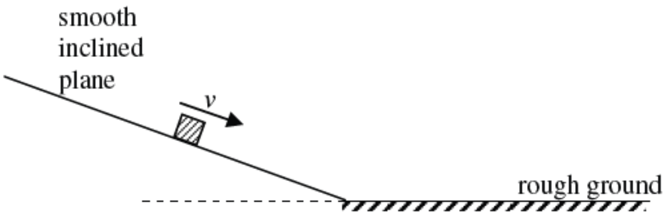


Figure (a)

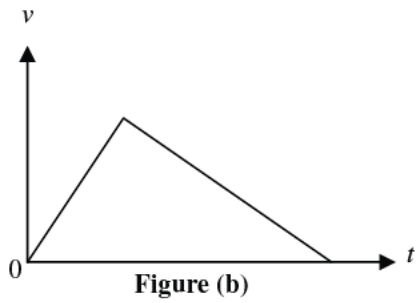
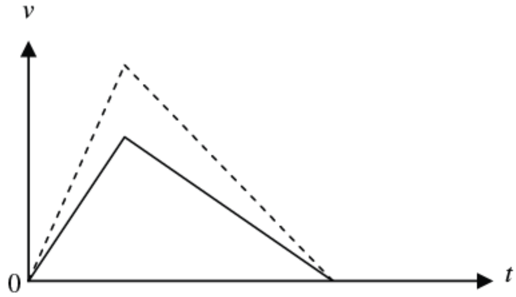


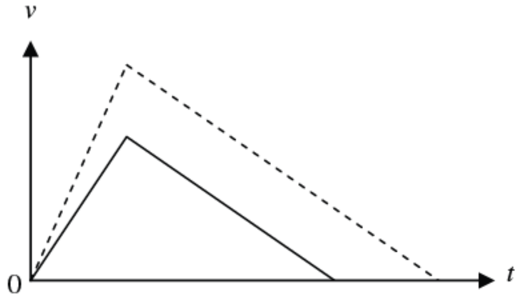
Figure (b)

As shown in Figure (a), a block slides down along a smooth inclined plane from rest. The corresponding speed-time graph of its motion is shown in Figure (b). Which of the following speed-time graphs (in dotted lines) best represents the motion of the block if it is released at a higher position on the plane instead ? Assume that the friction between the ground and the block remains unchanged.

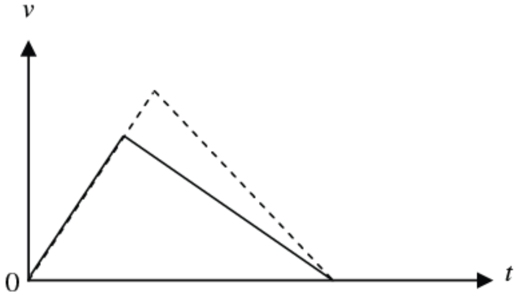
A.



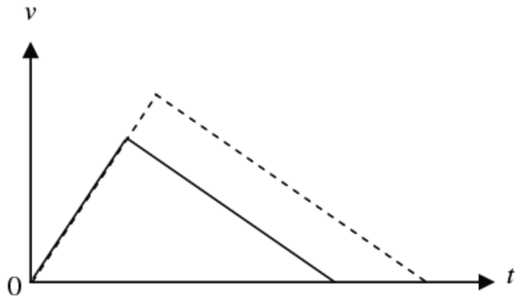
B.



C.



D.



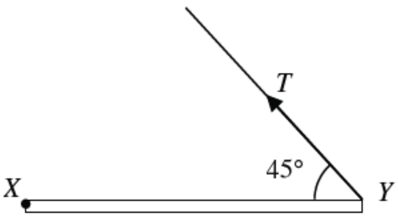
11.

A football player kicks a ball on the ground. The ball leaves the ground with speed v and hits the bar at X with a speed of 17 m s^{-1}. X is 2 m above the ground. Neglecting air resistance, what is the value of v ?

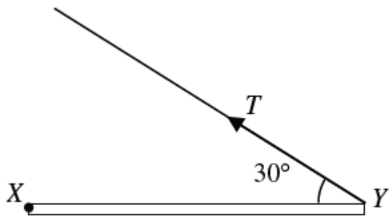
A. 15.8 m s^{-1}
B. 18.1 m s^{-1}
C. 19.0 m s^{-1}
D. 23.3 m s^{-1}

12. A rod XY hinged at X is kept horizontal by a light string. M is the midpoint of XY. In which of the following arrangements will the tension T in the string be the smallest ?

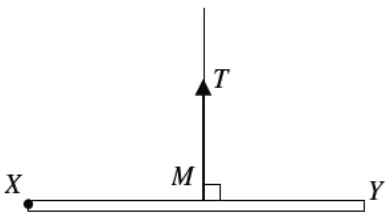
A.



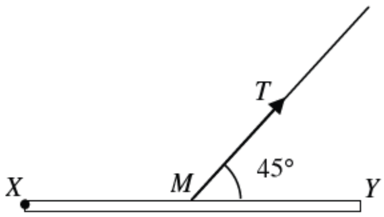
B.



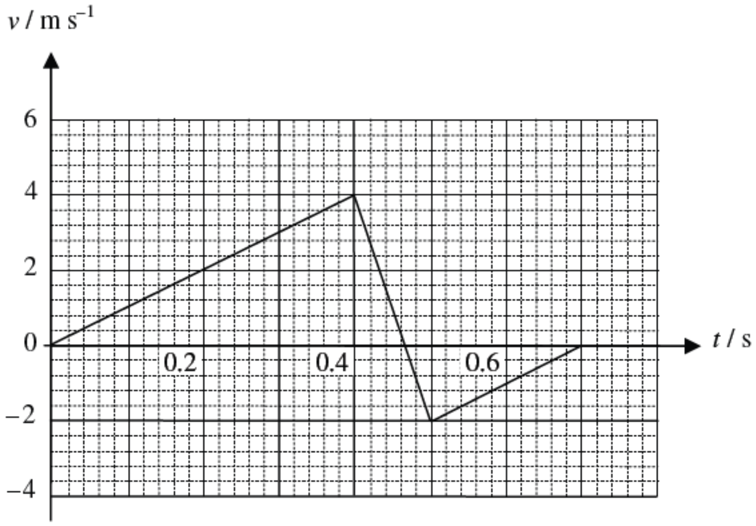
C.



D.



13.

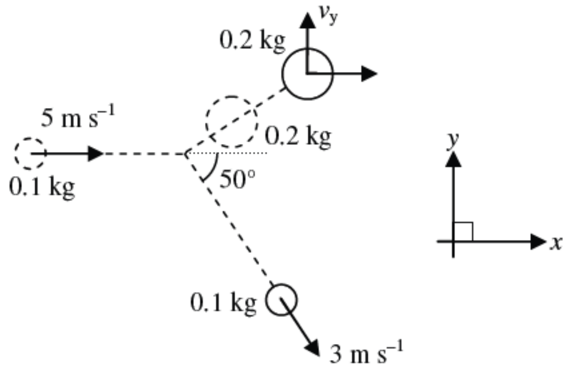


A ball of mass 0.2 kg is released from rest. It hits the ground and rebounds. The velocity-time graph of the ball is shown above. Which of the following statements are correct ?

(1) The magnitude of the change in momentum of the ball during the collision is 1.2 kg m s^{-1}.
(2) The magnitude of the average force acting on the ball by the ground during the collision is 12 N.
(3) There is mechanical energy loss during the collision.

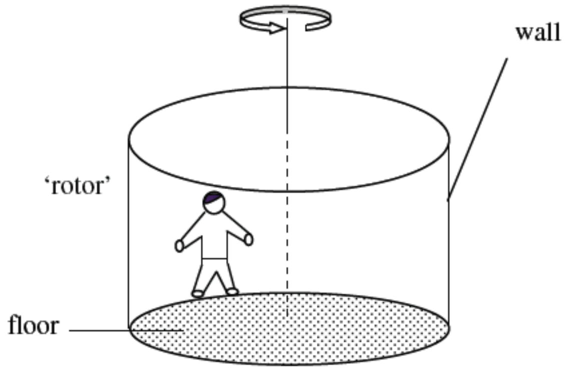
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

*14. A disc of mass 0.1 kg and velocity 5 m s^{-1} strikes a stationary disc of mass 0.2 kg on a smooth table. After the collision, the 0.1 kg disc moves with a speed of 3 m s^{-1} at 50° to the x direction. Find the component of the velocity of the 0.2 kg disc in y direction, v_y, after the collision.



A. 1.15 m s^{-1}
B. 1.54 m s^{-1}
C. 1.92 m s^{-1}
D. 2.01 m s^{-1}

*15.



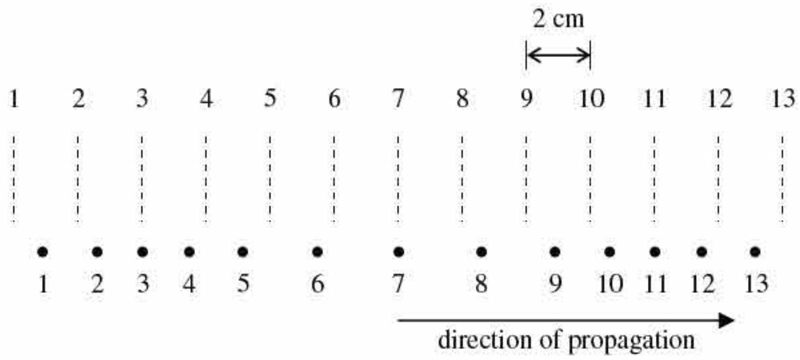
A man is rotating with constant speed inside a cylindrical 'rotor' and he remains pressed against the wall. The floor of the 'rotor' is smooth. Which of the following forces provides the centripetal force for the man ?

A. the weight of the man
B. the frictional force from the wall
C. the normal reaction from the wall
D. the supporting force from the floor

16. Which of the following phenomena demonstrates that light is an electromagnetic wave ?

A. Light carries energy.
B. Light reflects when it meets a polished metal surface.
C. Light bends when it travels across a boundary from one medium into another.
D. Light can travel from the Sun to the Earth.

17.

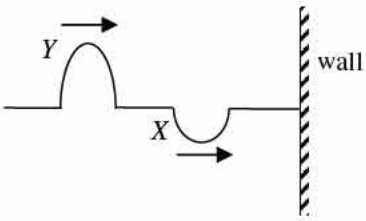


A longitudinal wave travels to the right through a medium containing a series of particles. The figure above shows the positions of the particles at a certain instant. The dotted lines indicate the equilibrium positions of the particles. Which of the following statements about the wave at the instant shown is/are correct ?

(1) The wavelength of the longitudinal wave is 16 cm.
(2) Particles 8 and 10 are moving in the same direction.
(3) Particle 3 is momentarily at rest.

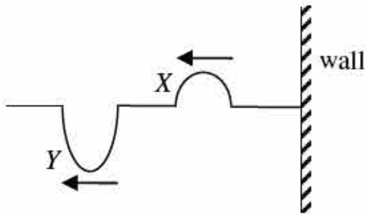
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

18.

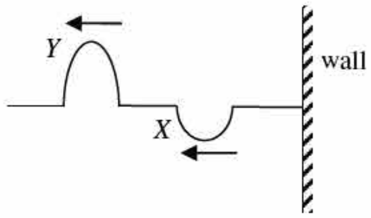


Two pulses, *X* and *Y*, are travelling along a string which is fixed at one end to the wall as shown in the figure above. Which of the following is a possible waveform of the string after the two pulses reflect ?

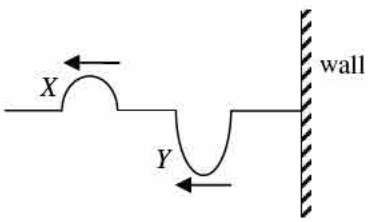
A.



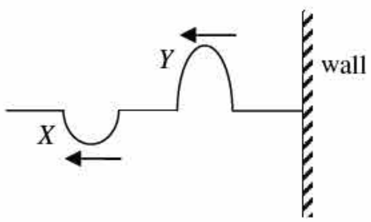
B.



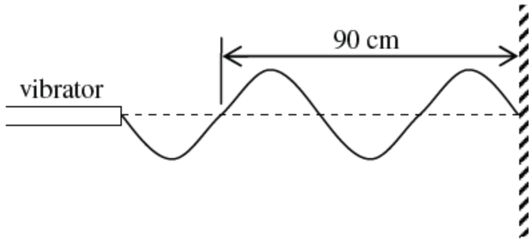
C.



D.



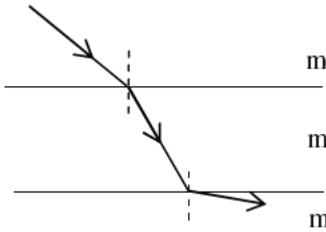
19.



A stationary wave is set up along a string by a vibrator. The waveform at a certain instant is shown above. If the frequency of the vibrator is 50 Hz, what is the wave speed along the string ?

A. 15 m s^{-1}
B. 30 m s^{-1}
C. 45 m s^{-1}
D. 55 m s^{-1}

20.



As shown above, a ray of light travels from medium 1 to medium 2, and then enters medium 3. The boundaries are parallel to each other. Arrange the speed of light, c, in the three media in **ascending** order.

A. $c_3 < c_2 < c_1$
B. $c_3 < c_1 < c_2$
C. $c_2 < c_3 < c_1$
D. $c_2 < c_1 < c_3$

*21.

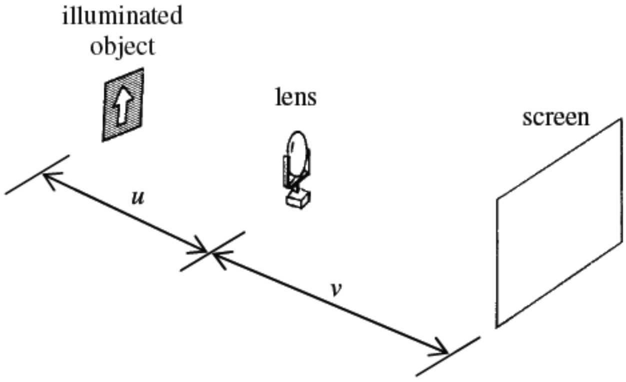


Figure (a)

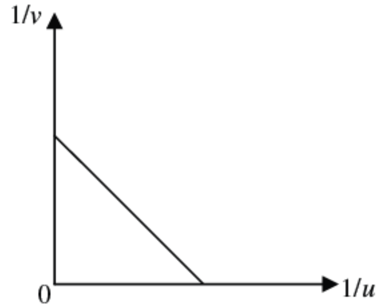
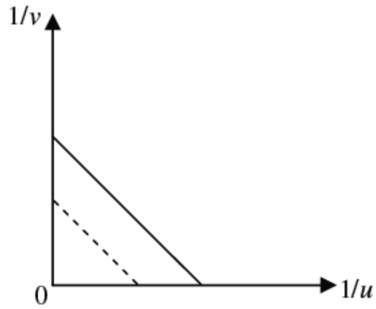


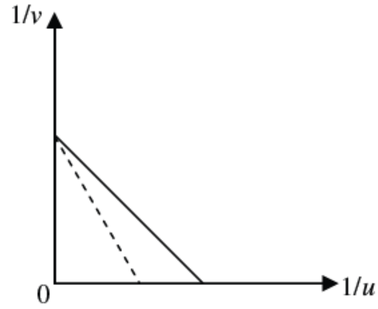
Figure (b)

A student uses the set-up in Figure (a) to study the relationship between the object distance u and the image distance v of a convex lens. A graph of $1/v$ against $1/u$ is plotted in Figure (b). If the lens is replaced by another convex lens of shorter focal length, which of the following graphs (in dotted lines) would be obtained ?

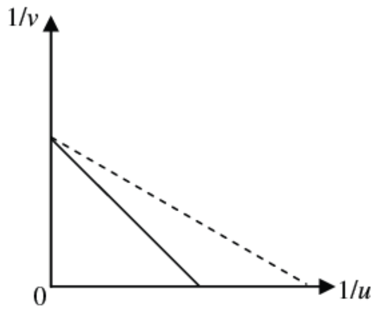
A.



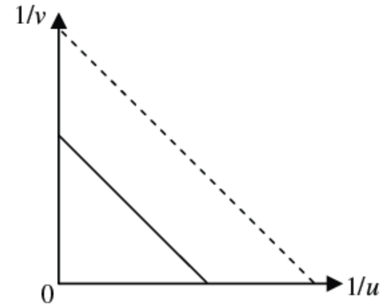
B.



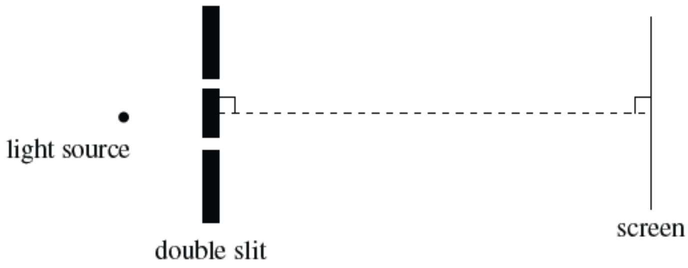
C.



D.



*22.



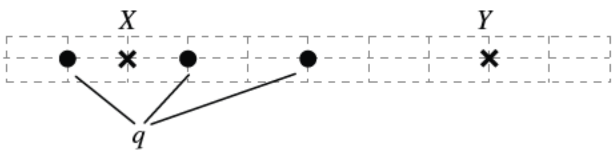
In a Young's double slit experiment, a monochromatic light source of wavelength 600 nm is used. The fringe separation is 5 mm on the screen. If the slit separation is halved and a monochromatic light source of wavelength 450 nm is used instead, what is the new fringe separation ?

A. 1.9 mm
B. 3.3 mm
C. 7.5 mm
D. 13.3 mm

*23. Yellow light of wavelength 590 nm is incident normally on a diffraction grating with 400 lines per mm. Find the difference in angular positions for the third order and the fourth order bright fringes.

A. 13.7°
B. 25.7°
C. 45.1°
D. 70.7°

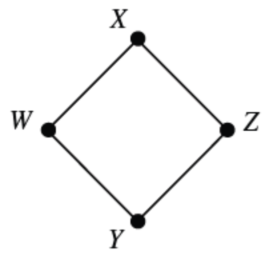
24.



Three identical point charges q (represented by dots) are situated in the space as shown. Which of the following descriptions about the direction and magnitude of the electric field E at X and at Y is correct ?

	Direction	**Magnitude**
A.	Same	$E_X > E_Y$
B.	Same	$E_X < E_Y$
C.	Opposite	$E_X > E_Y$
D.	Opposite	$E_X < E_Y$

*25.



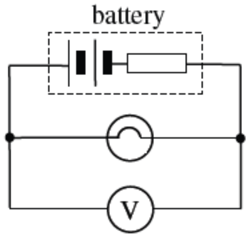
The figure above shows four points *W*, *X*, *Y* and *Z* in a uniform electric field. *WXZY* is a square. The electric potential at *W*, *X* and *Y* are 1 V, 5 V and 5 V respectively. What is the electric potential at *Z* ?

A. 1 V
B. 6 V
C. 9 V
D. 11 V

26. Two metal rods, *X* and *Y*, of uniform cross-sectional area are made of the same material and have the same volume. The length and resistance of *X* are *l* and *R* respectively. What is the resistance of *Y* if it has a length of 2*l* ?

A. *R*/4
B. *R*/2
C. 2*R*
D. 4*R*

27. The figure below shows a battery of e.m.f. 3.0 V and internal resistance 2.0 Ω is connected to a light bulb of resistance 10.0 Ω. A voltmeter of internal resistance 10 kΩ is connected in parallel with the light bulb. What is the reading of the voltmeter ?



A. 2.4 V
B. 2.5 V
C. 2.9 V
D. 3.0 V

28. In Figure (a), two identical resistors are connected in series to a cell of e.m.f. V and negligible internal resistance. The power dissipated by each resistor is P. If the two resistors are now connected in parallel as shown in Figure (b), what is the power dissipated by each resistor ?

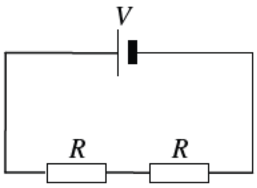


Figure (a)

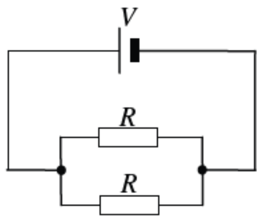
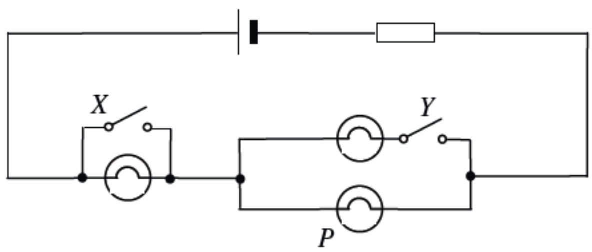


Figure (b)

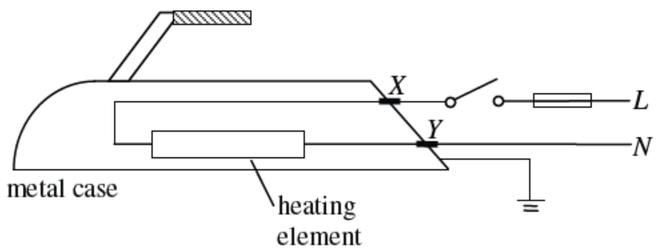
A. $2P$
B. $4P$
C. $8P$
D. $16P$

29. In the circuit below, three identical light bulbs are connected to a cell. Under what conditions will light bulb P have the maximum brightness ?



	Switch X	**Switch Y**
A.	closed	open
B.	closed	closed
C.	open	open
D.	open	closed

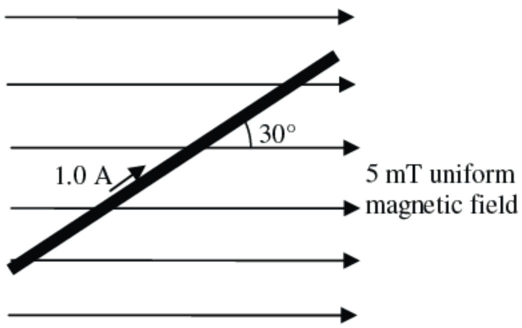
30.



The figure above shows the main parts of an electric iron. In which of the following situations will the fuse blow when the switch is closed ?

A. The heating element is broken and becomes an open circuit.
B. The earth wire is worn out and becomes disconnected.
C. The insulation at contact point X is worn out so that the wire touches the metal case.
D. The insulation at contact point Y is worn out so that the wire touches the metal case.

31. The figure below shows a current of 1.0 A flowing in a metal rod of length 0.5 m. The rod is placed inside a region with a uniform magnetic field of strength 5 mT. What is the direction and the magnitude of the magnetic force acting on the rod ?

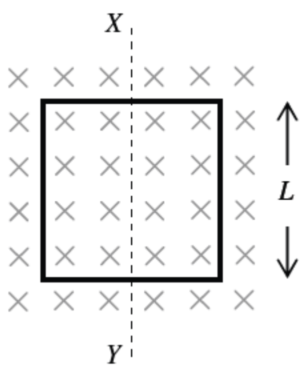


	Direction	**Magnitude**
A.	into the paper	1.25×10^{-3} N
B.	out of the paper	1.25×10^{-3} N
C.	into the paper	2.17×10^{-3} N
D.	out of the paper	2.17×10^{-3} N

*32. A Hall probe is placed in a uniform magnetic field. The slice of semiconductor inside the Hall probe is 1.3×10^{-3} m thick and has 10^{25} charge carriers per cubic metre. When a steady current of 0.4 A passes through the slice, a Hall voltage of 2×10^{-5} V is set up. What is the magnetic field strength detected by the probe ? Assume that the magnitude of the charge of each charge carrier is 1.6×10^{-19} C.

A. 0.104 T
B. 0.962 T
C. 1.04 T
D. 9.62 T

*33.



A square metal frame of side length L is placed inside a uniform magnetic field B as shown. What is the change in magnetic flux through the frame when it is rotated about the axis XY by 90° and 180° respectively ?

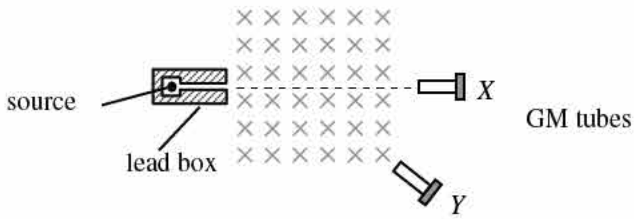
	90°	**180°**
A.	0	0
B.	0	$2BL^2$
C.	BL^2	0
D.	BL^2	$2BL^2$

34. Which of the following statements about α and β particles is/are correct ?

(1) The mass of an α particle is greater than that of a β particle.
(2) α particles have a stronger penetrating power than β particles.
(3) An α source can discharge a positively charged metal sphere nearby.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

35.



A radioactive source is placed in front of a uniform magnetic field pointing into the paper as shown above. The count rates recorded by the GM tubes at X and Y are 101 counts per minute and 400 counts per minute respectively. Which of the following deductions must be correct ?

A. The source does not emit α radiation.
B. The source emits β radiations.
C. The source emits γ radiations.
D. The background count rate is about 100 counts per minute.

*36. For the following nuclear reaction, state the type of reaction and determine the energy released.

$${}^{2}_{1}\text{H} + {}^{3}_{1}\text{H} \rightarrow {}^{4}_{2}\text{He} + {}^{1}_{0}\text{n}$$

Given: mass of ${}^{2}_{1}\text{H}$ = 2.014 u
mass of ${}^{3}_{1}\text{H}$ = 3.016 u
mass of ${}^{4}_{2}\text{He}$ = 4.003 u
mass of ${}^{1}_{0}\text{n}$ = 1.009 u

	Type of reaction	**Energy released**
A.	fusion	0.018 MeV
B.	fusion	16.76 MeV
C.	fission	0.018 MeV
D.	fission	16.76 MeV

END OF SECTION A

List of data, formulae and relationships

Data

molar gas constant	$R = 8.31$ J mol^{-1} K^{-1}
Avogadro constant	$N_A = 6.02 \times 10^{23}$ mol^{-1}
acceleration due to gravity	$g = 9.81$ m s^{-2} (close to the Earth)
universal gravitational constant	$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
speed of light in vacuum	$c = 3.00 \times 10^8$ m s^{-1}
charge of electron	$e = 1.60 \times 10^{-19}$ C
electron rest mass	$m_e = 9.11 \times 10^{-31}$ kg
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}$ C^2 N^{-1} m^{-2}
permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$ H m^{-1}
atomic mass unit	u = 1.661×10^{-27} kg (1 u is equivalent to 931 MeV)
astronomical unit	AU = 1.50×10^{11} m
light year	ly = 9.46×10^{15} m
parsec	pc = 3.09×10^{16} m = 3.26 ly = 206265 AU
Stefan constant	$\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}
Planck constant	$h = 6.63 \times 10^{-34}$ J s

Rectilinear motion

For uniformly accelerated motion :

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Mathematics

Equation of a straight line	$y = mx + c$
Arc length	$= r\theta$
Surface area of cylinder	$= 2\pi rh + 2\pi r^2$
Volume of cylinder	$= \pi r^2 h$
Surface area of sphere	$= 4\pi r^2$
Volume of sphere	$= \frac{4}{3}\pi r^3$

For small angles, $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

Astronomy and Space Science		**Energy and Use of Energy**	
$U = -\frac{GMm}{r}$	gravitational potential energy	$\frac{Q}{t} = k\frac{A(T_H - T_C)}{d}$	rate of energy transfer by conduction
$P = \sigma AT^4$	Stefan's law	$U = \frac{k}{d}$	thermal transmittance U-value
$\left\lvert\frac{\Delta f}{f_0}\right\rvert \approx \frac{v}{c} \approx \left\lvert\frac{\Delta\lambda}{\lambda_0}\right\rvert$	Doppler effect	$P = \frac{1}{2}\rho Av^3$	maximum power by wind turbine
Atomic World		**Medical Physics**	
$\frac{1}{2}m_e v_{max}{}^2 = hf - \phi$	Einstein's photoelectric equation	$\theta \approx \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)
$E_n = -\frac{1}{n^2}\left\{\frac{m_e e^4}{8h^2\varepsilon_0^2}\right\} = -\frac{13.6}{n^2}$ eV	energy level equation for hydrogen atom	power $= \frac{1}{f}$	power of a lens
		$L = 10\log\frac{I}{I_0}$	intensity level (dB)
$\lambda = \frac{h}{p} = \frac{h}{mv}$	de Broglie formula	$Z = \rho c$	acoustic impedance
		$\alpha = \frac{I_r}{I_0} = \frac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$	intensity reflection coefficient
$\theta \approx \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)	$I = I_0 e^{-\mu x}$	transmitted intensity through a medium

A1.	$E = mc\,\Delta T$	energy transfer during heating and cooling
A2.	$E = l\,\Delta m$	energy transfer during change of state
A3.	$pV = nRT$	equation of state for an ideal gas
A4.	$pV = \frac{1}{3}Nm\overline{c^2}$	kinetic theory equation
A5.	$E_K = \frac{3RT}{2N_A}$	molecular kinetic energy

B1.	$F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$	Force
B2.	moment = $F \times d$	moment of a force
B3.	$E_P = mgh$	gravitational potential energy
B4.	$E_K = \frac{1}{2}mv^2$	kinetic energy
B5.	$P = Fv = \frac{W}{t}$	mechanical power
B6.	$a = \frac{v^2}{r} = \omega^2 r$	centripetal acceleration
B7.	$F = \frac{Gm_1m_2}{r^2}$	Newton's law of gravitation

C1.	$\Delta y = \frac{\lambda D}{a}$	fringe width in double-slit interference
C2.	$d\sin\theta = n\lambda$	diffraction grating equation
C3.	$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$	equation for a single lens

D1.	$F = \frac{Q_1Q_2}{4\pi\varepsilon_0 r^2}$	Coulomb's law
D2.	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$	electric field strength due to a point charge
D3.	$V = \frac{Q}{4\pi\varepsilon_0 r}$	electric potential due to a point charge
D4.	$E = \frac{V}{d}$	electric field between parallel plates (numerically)
D5.	$I = nAvQ$	general current flow equation
D6.	$R = \frac{\rho l}{A}$	resistance and resistivity
D7.	$R = R_1 + R_2$	resistors in series
D8.	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	resistors in parallel
D9.	$P = IV = I^2R$	power in a circuit
D10.	$F = BQv\sin\theta$	force on a moving charge in a magnetic field
D11.	$F = BIl\sin\theta$	force on a current-carrying conductor in a magnetic field
D12.	$V = \frac{BI}{nQt}$	Hall voltage
D13.	$B = \frac{\mu_0 I}{2\pi r}$	magnetic field due to a long straight wire
D14.	$B = \frac{\mu_0 NI}{l}$	magnetic field inside a long solenoid
D15.	$\varepsilon = N\frac{\Delta\Phi}{\Delta t}$	induced e.m.f.
D16.	$\frac{V_s}{V_p} \approx \frac{N_s}{N_p}$	ratio of secondary voltage to primary voltage in a transformer

E1.	$N = N_0 e^{-kt}$	law of radioactive decay
E2.	$t_{\frac{1}{2}} = \frac{\ln 2}{k}$	half-life and decay constant
E3.	$A = kN$	activity and the number of undecayed nuclei
E4.	$E = mc^2$	mass-energy relationship