2014-15 MOCK
F.6 PHY
PAPER 1A

TWGHs Wong Fut Nam College
MOCK Examination 2014-15

PHYSICS PAPER 1

8:30 am – 11:00 am (2 hours 30 minutes)
This paper must be answered in English

Setter: Leung Shu Kei

2 Feb 2015 (MON)

GENERAL INSTRUCTIONS

(1) There are **TWO** Sections, A and B, in this Paper. You are advised to finish Section A in about 50 minutes.
(2) Section A consists of multiple-choice questions in this question book, 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. **The Answer Sheet for Section A and 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 two 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 write down the information required in the spaces provided on the **MC answer sheet**. No extra time will be given for writing down the required information 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 your answers on the **MC Answer Sheet,** so that wrong marks can be completely erased with a 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.

Section A

There are 33 questions. Questions Marked with "*" involve knowledge of the extension component.

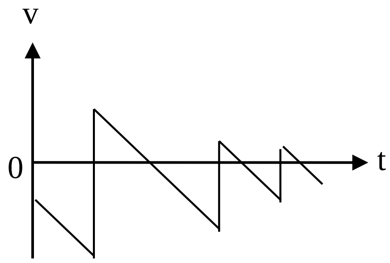
1. Steven pours 0.6 kg of water at 20 ^oC into a cup containing 0.9 kg of water at 100 ^oC. Estimate the final temperature of the water in the cup.
   A. 48 ^oC
   B. 58 ^oC
   C. 68 ^oC
   D. 78 ^oC

2. Which of the following about boiling of water is correct?
   A. The average K.E. of the water molecules remains constant in boiling
   B. The temperature of the water decreases since energy is needed to change water to steam.
   C. Specific latent heat of vaporization of water is the amount of energy absorbed when water changes into steam.
   D. The total P.E. of the water molecules remains constant in boiling.

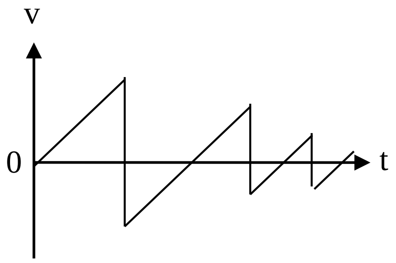
*3. A vessel of volume 2×10^{-3} m^3 contains 8 g of ideal gas at a pressure of 3×10^5 Pa. What is the r.m.s. speed of the gas molecules?
   A. 120 m s^{-1}
   B. 150 m s^{-1}
   C. 340 m s^{-1}
   D. 474 m s^{-1}

4. A ball is thrown downwards from a point above the ground and rebounds several times on the ground. The velocity pointing downwards is taken to be positive. Which of the following velocity-time graphs best represent the motion of the ball?

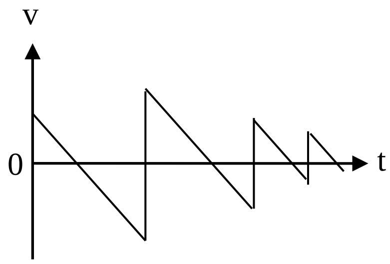
A.



B.



C.



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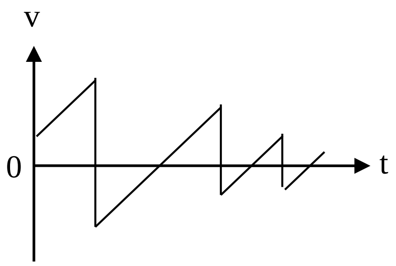
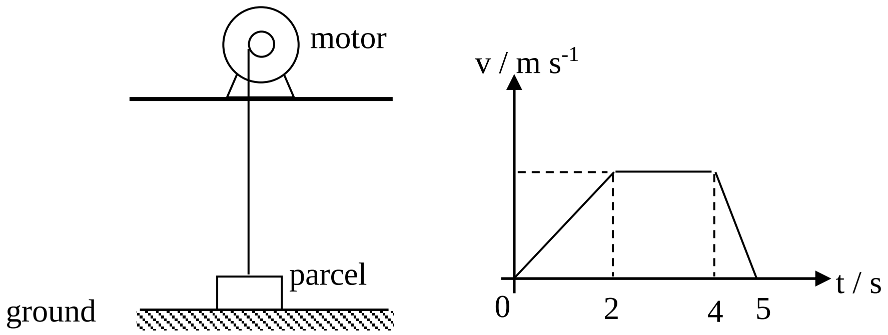


5. When a car travels at a speed u, it takes a distance d to stop after the brake is applied. The car is now travelling at a speed v, it takes a distance $4d$ to stop after the brake is applied. Assume that the acceleration of the car is constant when the brake is applied. Find v in terms of u.

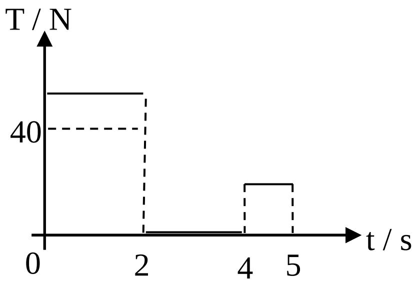
A. $15u$
B. $8u$
C. $4u$
D. $2u$

6.



A parcel of mass 4 kg is being raised from the ground by a light string connected to a motor at the rooftop of a building as shown above The speed-time graph of the parcel is also shown above. Neglect air resistance. Which of the following graphs best represents the variation of the tension T in the string with time t?

A.



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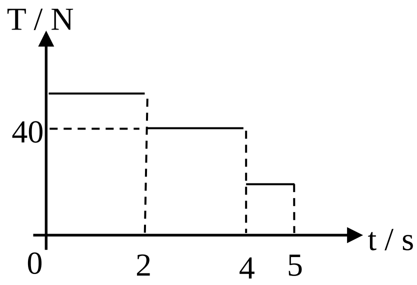
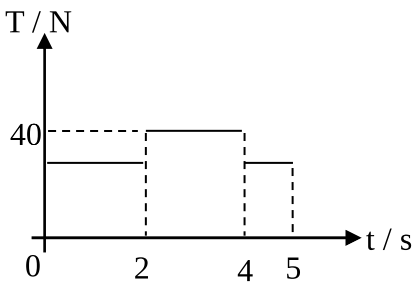
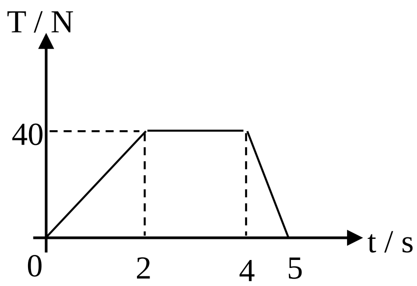


C.



D.



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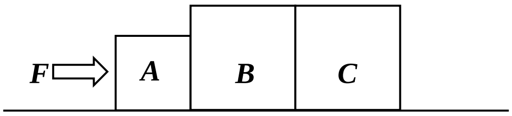
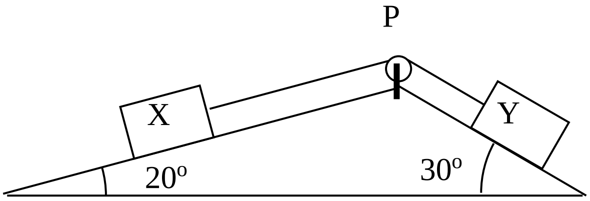
7.



Three blocks A, B and C of masses 2*m*, 3*m* and 3*m* respectively are placed on a smooth horizontal ground as shown above. A constant horizontal force *F* is applied to block A so that the three blocks move with the same acceleration towards the right. What is the force acting on block C by block B?

A. $F/8$
B. $3F/8$
C. $2F/6$
D. $5F/6$

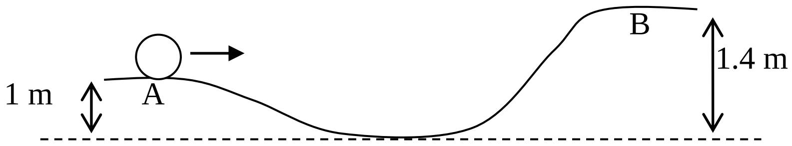
8.



In the figure above, X and Y are two identical blocks of mass 2 kg. P is a smooth pulley fixed at the top of two smooth inclined planes. Find the acceleration of the block X.

A. 0.79 m s^{-2}
B. 1.58 m s^{-2}
C. 1.71 m s^{-2}
D. 3.42 m s^{-2}

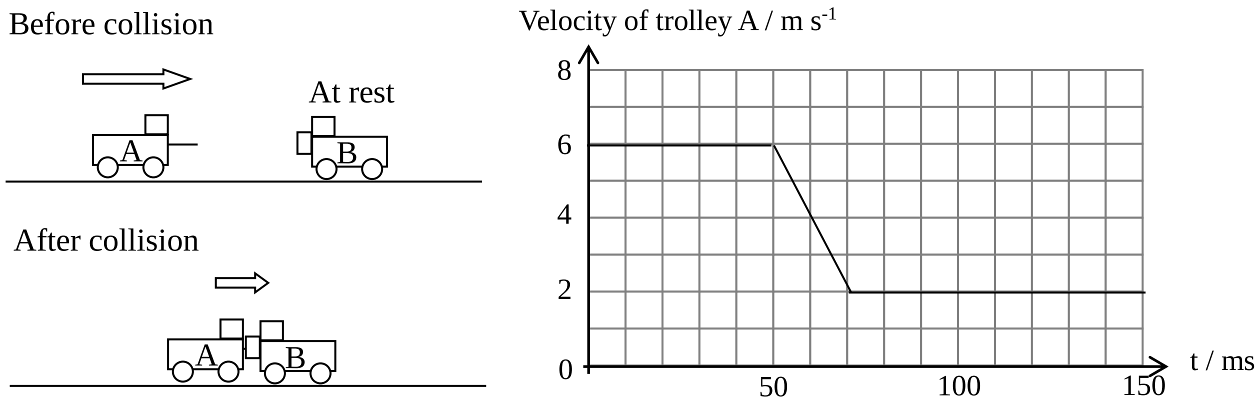
9



A small object of mass 2 kg moves along a rough track as shown above. The speeds of the object at point A and B are 4 m s^{-1} and 1 m s^{-1} respectively. The length of the track AB is 2.5 m. what is the average value of frictional force acting on the object as it is moving from A to B?

A. 22.8 N
B. 11.5 N
C. 5.70 N
D. 2.80 N

10.



Trolley A collides with trolley B which is at rest on a smooth surface. After the collision, the two trolleys move off together. The mass of trolleys A and B are 1 kg and 2 kg respectively. The velocity of trolley A is recorded in the v-t graph above. Which of the following statement(s) is / are correct?

(1) It is an inelastic collision.

(2) The force of impact on trolley B is 200 N.

(3) The loss in K.E. during the collision is 16 J.

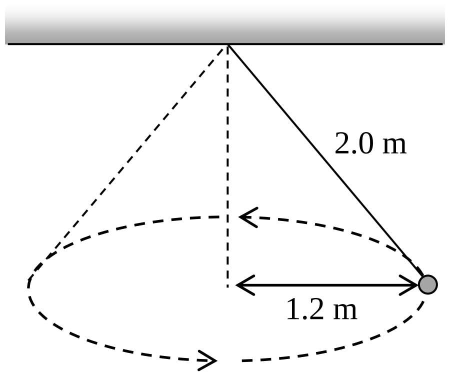
A. (1) and (2) only

B. (2) and (3) only

C. (1) and (3) only

D. (1), (2) and (3)

*11.



An object of unknown mass is suspended by a string of 2.0 m and is set to move in a horizontal circular path of radius 1.2 m as shown above. What is the centripetal acceleration of the object?

A. 2.5 m s^{-2}

B. 5.0 m s^{-2}

C. 7.5 m s^{-2}

D. Cannot be determined

*12. Assume that the earth is a uniform sphere of radius R. The gravitational acceleration near the Earth's surface is g. What would be the distance of an object from the Earth's centre to have acceleration due to gravity to be 0.25 g?

A. 0.25 R

B. R

C. 2R

D. 3R

*13. Two satellites, P and Q, are placed in circular orbits about the Venus. If the orbital radius of P is 16 times the orbital radius of Q, what would be the ratio of their speeds $v_P : v_Q$?

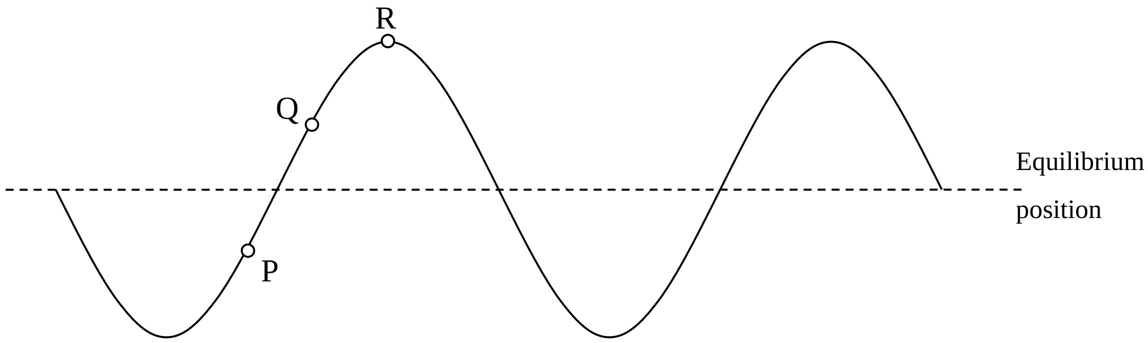
A. 16 : 1

B. 4 : 1

C. 1 : 4

D. 1 : 16

14.



The diagram above shows a transverse travelling wave. It is known that particle P is moving downwards. Which of the following statement(s) is / are correct?

(1) The wave is moving to the right.

(2) Particle R is momentarily at rest.

(3) Particle Q always moves in the same direction as particle P.

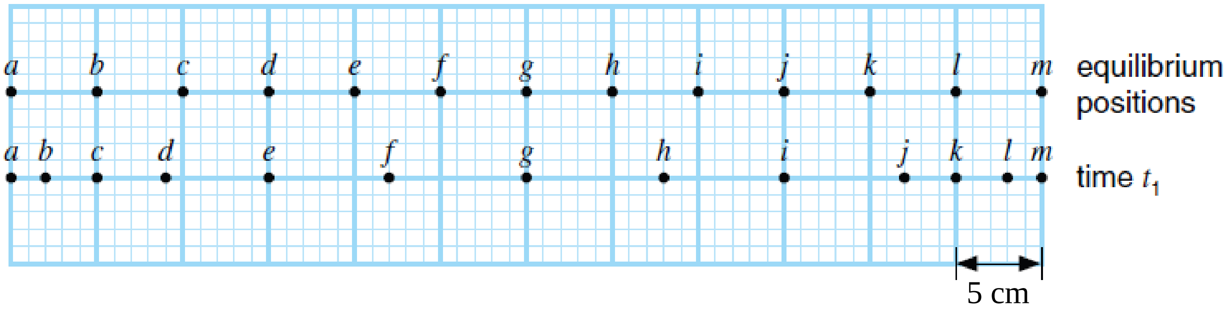
A. (1) only

B. (3) only

C. (1) and (2) only

D. (2) and (3) only

15.



The diagram above shows a longitudinal travelling wave travelling to the left.
Which of the following statement(s) is / are correct?

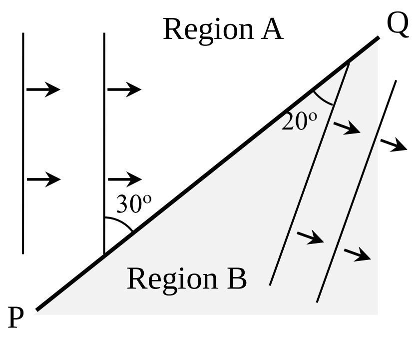
(1) Particle ***e*** is at the centre of rarefaction at time t_1.

(2) The wavelength of the wave is 0.6 m.

(3) Particle ***b*** is in anti-phase with particle ***h***.

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

16.



A ripple tank is divided into two regions A and B having different depth. Straight waves are generated at frequency of 50 Hz in region A and pass through the straight boundary PQ to region B. Which of the following statement(s) is / are correct?

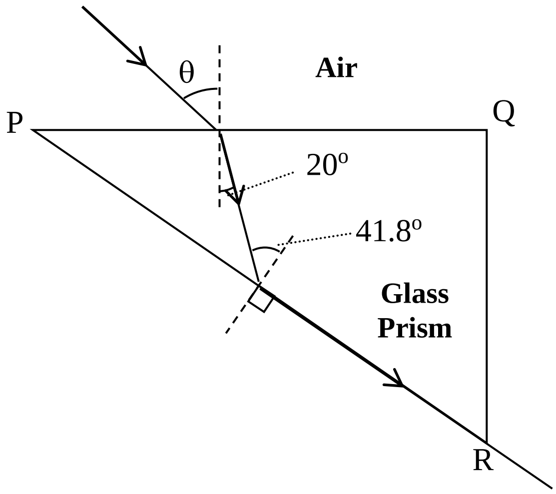
(1) Region A is deeper than region B.

(2) The speed of waves in region A is the same as that in region B.

(3) Frequency of the waves in region B is smaller than 50 Hz.

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

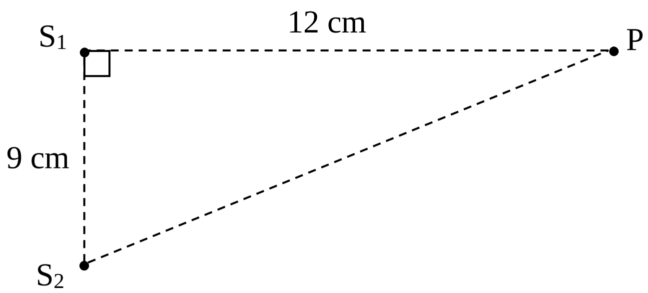
17.



A light ray enters a glass prism PQR from air with an angle of incident θ as shown in the diagram above. The light ray is then refracted and leaves the glass prism from the surface PR. The light ray finally emerges from the glass prism parallel to the surface PR. Find the angle θ.

A. 30.9°
B. 32.8°
C. 35.2°
D. 40.0°

18.



Water waves are produced by two coherent sources S_1 and S_2 in a ripple tank. Constructive interference is found to occur at point P. Which of the following value(s) is / are possible wavelength of the waves if the two sources are vibrating in phase?

(1) 1 cm
(2) 2 cm
(3) 3 cm

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

19. Which of the followings does not have diffraction?

A. Ultrasound

B. X-ray

C. α-radiation

D. Infrared radiation

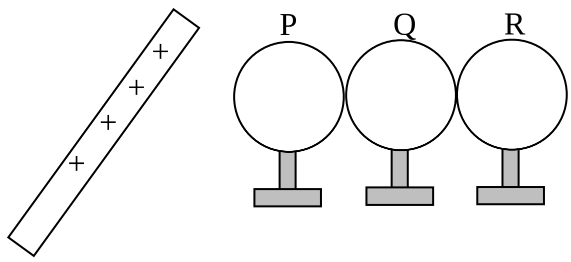
*20. In a Young's double slit experiment, monochromatic light shines on a pair of narrow slits and evenly spaced bright fringes are observed on a screen. The experiment is repeated using lights of different wavelengths. The following table shows the data recorded.

Trial	Wavelength of light / nm	Slit separation / mm	Fringe separation / mm	Distance from the slits to the screen / m
1	500	0.2	2.0	Y
2	600	0.2	X	0.5 Y

Find X and Y.

	X / mm	**Y / m**
A.	1.2	0.8
B.	1.2	1.0
C.	2.4	0.8
D.	2.4	1.0

21.

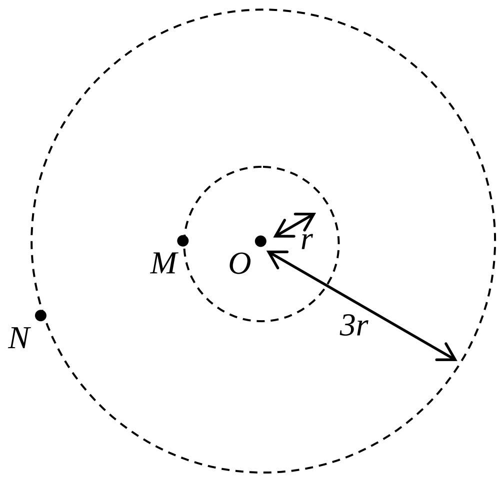


Three initially uncharged metal spheres, P, Q and R, are placed in contact. A positively charged rod is held near P. With the charged rod kept in position, R is removed first. Then the rod is removed. Finally, P and Q are separated. Which of the following correctly shows the charges stored in the sphere?

	P	**Q**	**R**
A.	–	Neutral	Neutral
B.	–	+	–
C.	–	–	+
D.	Neutral	Neutral	Neutral

Out of Syllabus NOW

*22.



A point charge q is placed at point M which is at a distance r from another point charge Q fixed at point O. The point charge q is then moved to another point N which is at a distance $3r$ from point O. Find the change in potential energy of charge q when it is moved from point M to N.

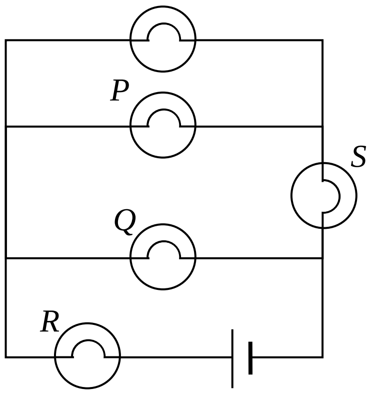
A. $\frac{Qq}{4\pi\varepsilon_o r}$

B. $\frac{2}{3}\left(\frac{Qq}{4\pi\varepsilon_o r}\right)$

C. $\frac{4}{9}\left(\frac{Qq}{4\pi\varepsilon_o r}\right)$

D. $\frac{8}{9}\left(\frac{Qq}{4\pi\varepsilon_o r}\right)$

23.



Which of the lamps shows the greatest brightest?

A. *S*

B. *R*

C. *Q*

D. *P*

24. The resistance of a length of copper wire X is 20 Ω. A piece of copper wire Y has 3 times the length and 2 times the diameter of X. What is the resistance of the copper wire Y?

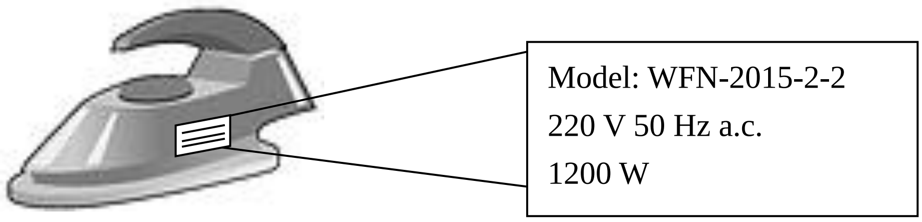
A. 15 Ω

B. 30 Ω

C. 13.3 Ω

D. 3.33 Ω

*25.



A label showing the power specification of an electric kettle is shown in the above diagram. Which of the following statement(s) is / are correct when the iron is operating at its rated voltage?

(1) The peak voltage is 311 V.

(2) The resistance of the iron is 40.3 Ω.

(3) The total energy consumed when the iron operates for 200 minutes is 240 kWh.

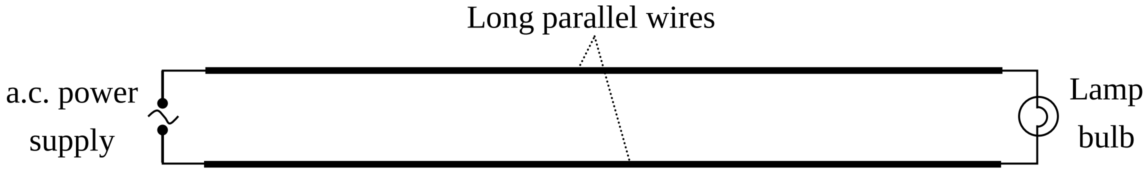
A. (1) and (2) only

B. (2) and (3) only

C. (1) and (3) only

D. (1), (2) and (3)

26.



The above diagram shows an a.c. power supply used to light up a lamp bulb by using a pair of very long parallel wires. Which of the following statements is correct when the lamp bulb lights up?

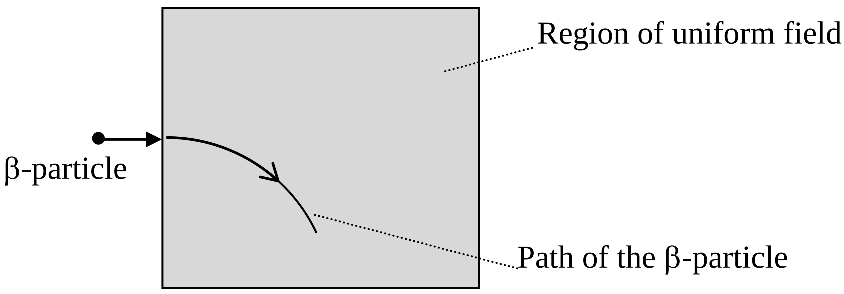
A. The magnetic force acting between the two wires is attractive.

B. The magnetic force acting between the two wires is repulsive.

C. The magnetic force acting between the two wires is sometime attractive and sometime repulsive.

D. There is no magnetic force acting between the two wires.

27.



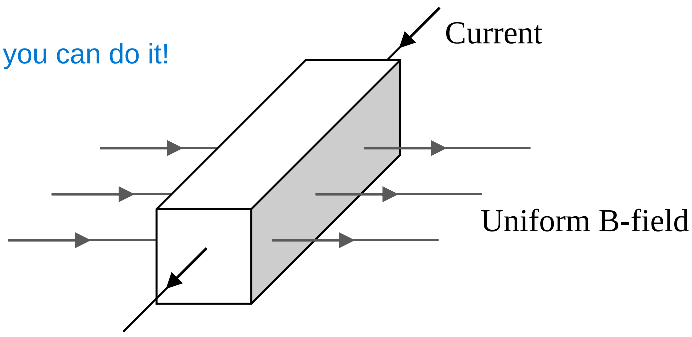
A β-particle is projected into a uniform field and is deflected as shown in the above diagram. Which of the followings about the uniform field is correct?

	Nature of the Field	Direction of the field
A.	It is an electric field	Downwards
B.	It is an electric field	Into the page
C.	It is a magnetic field	Downwards
D.	It is a magnetic field	Into the page

Out of Syllabus NOW

*28.

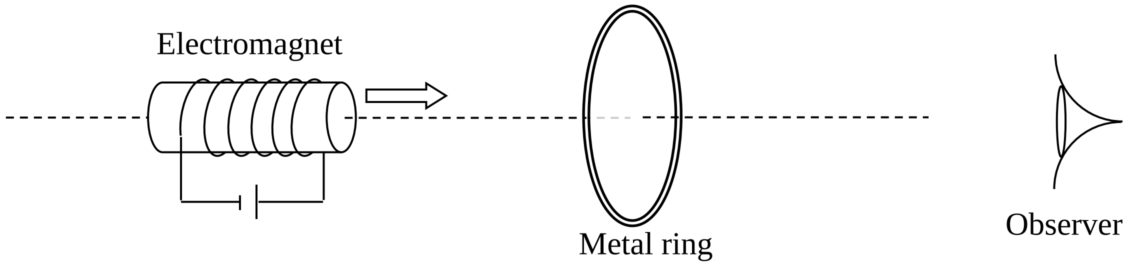
But you can try. Some of you can do it!



A current is passed along a square semiconductor rod as shown above. Half of the current is carried by electrons (–) and half by holes (+). A magnetic field is then applied to the rod at right angles to its axis. Which of the following correctly describes the movement of the electrons and holes in the rod when the magnetic field is applied?

	electrons	holes
A	Moves down	Moves down
B.	Moves down	Moves up
C.	Moves up	Moves down
D.	Moves up	Moves up

29.



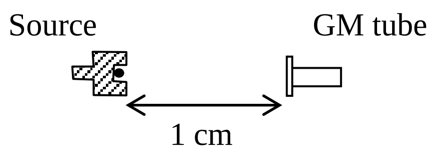
The above diagram shows an electromagnet moving along a line which is passing through the centre of a metal ring and at right angle to the plane of the metal ring. Which of the followings is correct?

A. A current is induced to flow in a clockwise direction in the ring.
B. A current is induced to flow in an anti-clockwise direction in the ring.
C. A current is induced in the ring depending on the strength of the magnet.
D. No induced current will be produced in the ring.

*30. In a step-down transformer, the turn ratio of primary coil to secondary coil is 2 : 1. The primary coil is connected to an a.c. supply at 200 V and with power at 100 W. If the efficiency of the transformer is 90%, what is the current in the secondary coil?

A. 0.8 A
B. 0.9 A
C. 1.0 A
D. 1.1 A

31. To identify the type of radiation emitted by an unknown source, a GM tube is placed **1 cm** in front of the source. Different kinds of absorbers are placed in turn between the GM tube and the source.
The readings for each absorber were taken and the results are tabulated below.



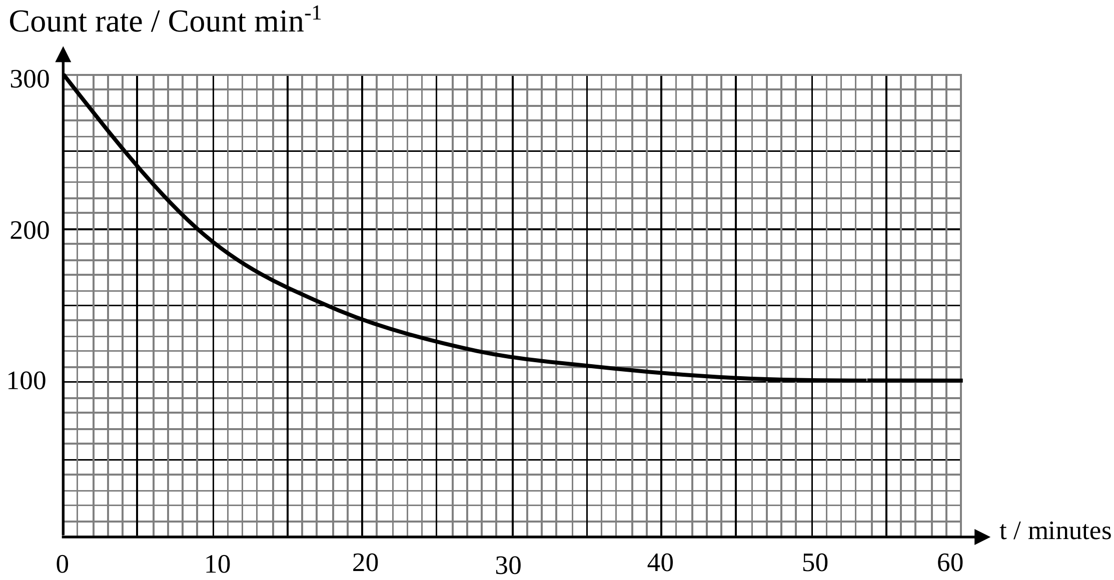
Absorber	**Count rate (count min^{-1})**
Nil	**648**
Al (5 mm thick)	**426**
Lead (5 cm thick)	**427**

Which of the following statement(s) **MUST be correct**?

(1) There is α-radiation emitted by the source.
(2) There is β-radiation emitted by the source.
(3) There is no γ-radiation emitted by the source.

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

*32.



The uncorrected count rate measured by a GM counter from a radioactive source is plotted in the graph above. Which of the following statement(s) is / are correct?

(1) At t = 0 s, the corrected count rate measured is 200 count min^{-1}.

(2) The half-life of the radioactive source is about 9 min.

(3) The decay constant of the radioactive source is about 0.0770 s^{-1}.

A. (1) and (2) only

B. (2) and (3) only

C. (1) and (3) only

D. (1), (2) and (3)

*33. A possible fission of uranium-235 is

$$^{235}_{92}\text{U} + {}^{1}_{0}\text{n} \rightarrow {}^{144}_{56}\text{Ba} + \mathbf{X} + 2\,{}^{1}_{0}\text{n} + 180\text{ MeV}$$

where X is an unknown nuclide produced after the fission.

Given that

mass of one nuclide of U-235 = 235.043 930 u

mass of one nuclide of Ba-144 = 143.922 952 u

mass of one neutron n = 1.008665 u

With the information given above, estimate the mass of the unknown nuclide X.

A. 90.112 u

B. 90.923 u

C. 89.765 u

D. 89.919 u

END OF SECTION A

List of data, formulae and relationships

Data

molar gas constant	R = 8.31 J mol^{-1} K^{-1}
Avogadro constant	$N_A = 6.02\times10^{23}$ mol^{-1}
acceleration due to gravity	g = 9.81 m s^{-2} (close to the Earth)
universal gravitational constant	G = 6.67×10^{-11} N m^2 kg^{-2}
speed of light in vacuum	c = 3.00×10^8 m s^{-1}
charge of electron	e = 1.60×10^{-19} C
electron rest mass	m_e = 9.11×10^{-31} kg
permittivity of free space	ε_o = 8.85×10^{-12} C^2 N^{-1} m^{-2}
permeability of free space	μ_o = 4π×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	= 5.67×10^{-8} W m^{-2} K^{-4}
Planck constant	h = 6.63×10^{-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 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

$U = -\frac{GMm}{r}$	gravitational potential energy
$p = \sigma AT^4$	Stefan's law
$\left\lvert\frac{\Delta f}{f_o}\right\rvert \approx \frac{v}{c} \approx \left\lvert\frac{\Delta\lambda}{\lambda_o}\right\rvert$	Doppler effect

Energy and Use of Energy

$E = \frac{\Phi}{A}$	illuminance
$\frac{Q}{t} = k\frac{A(T_H - T_C)}{d}$	rate of energy transfer by conduction
$U = \frac{k}{d}$	thermal transmittance U-value
$P = \frac{1}{2}\rho A v^3$	maximum power by wind turbine

Atomic World

$\frac{1}{2}m_e v_{\max}^2 = hf - \Phi$	Einstein's photoelectric equation
$E_n = \frac{1}{n^2}\left\{\frac{m_e e^4}{8h^2\varepsilon_o^2}\right\} = -\frac{13.6}{n^2}eV$	energy level equation for hydrogen atom
$\lambda = \frac{h}{p} = \frac{h}{mv}$	de Broglie formula
$\theta = \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)

Medical Physics

$\theta = \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)
$power = \frac{1}{f}$	power of lens
$L = 10\log\frac{I}{I_o}$	intensity level (dB)
$Z = \rho c$	acoustic impedance
$\alpha = \frac{I_r}{I_o} = \frac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$	intensity reflection coefficient
$I = I_o e^{-\mu x}$	transmitted intensity through a medium

A1.	$E = mc\Delta T$	energy transfer during heating and cooling	D1.	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_o r^2}$	Coulomb's law
A2.	$E = l\Delta m$	energy transfer during change of state	D2.	$E = \frac{Q}{4\pi\varepsilon_o r^2}$	electric field strength due to a point charge
A3.	$pV = nRT$	equation of state for ideal gas	D3.	$V = \frac{Q}{4\pi\varepsilon_o r}$	electric potential due to a point charge
A4.	$pV = \frac{1}{3}Nm\overline{c^2}$	kinetic theory equation	D4.	$E = \frac{V}{d}$	electric field between parallel plates (numerically)
A5.	$E_k = \frac{3RT}{2N_A}$	molecular kinetic energy	D5.	$I = nAvQ$	general current flow equation
			D6.	$R = \frac{\rho l}{A}$	resistance and resistivity
B1.	$F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$	Force	D7.	$R = R_1 + R_2$	resistor in series
B2.	$moment = F \times d$	moment of a force	D8.	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	resistor in parallel
B3.	$E_p = mgh$	gravitational potential energy	D9.	$P = IV = I^2R$	power in a circuit
B4.	$E_k = \frac{1}{2}mv^2$	kinetic energy	D10.	$F = BQv\sin\theta$	force on a moving charge in a magnetic field
B5.	$P = Fv = \frac{W}{t}$	mechanical power	D11.	$F = BIl\sin\theta$	force on a current-carrying conductor in a magnetic field
B6.	$a = \frac{v^2}{r} = \omega^2 r$	centripetal acceleration	D12.	$V = \frac{BI}{nQt}$	Hall voltage
B7.	$F = \frac{Gm_1m_2}{r^2}$	Newton's law of gravitation	D13.	$B = \frac{\mu_o I}{2\pi r}$	magnetic field due to a long straight wire
			D14.	$B = \frac{\mu_o NI}{l}$	magnetic field inside a long solenoid
C1.	$\Delta y = \frac{\lambda D}{a}$	fringe width in double-slit interference	D15.	$\varepsilon = N\frac{\Delta\Phi}{\Delta t}$	induced e.m.f.
C2.	$d\sin\theta = n\lambda$	diffraction grating equation	D16.	$\frac{V_s}{V_p} \approx \frac{N_s}{N_p}$	ratio of secondary voltage to primary voltage in a transformer
C3.	$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$	equation for a single lens			
			E1.	$N = N_o e^{-kt}$	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