2018-S6MK

PHY

PAPER 1A

SACRED HEART CANOSSIAN COLLEGE

17 – 18 S6 MOCK EXAMINATION

PHYSICS PAPER 1

Time allowed: 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 50 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 the 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 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 write your name and insert the information required in the spaces provided. No extra time will be given for writing the information after the 'Time is up' announcement.
2. When told to open this book, you should check that all 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.

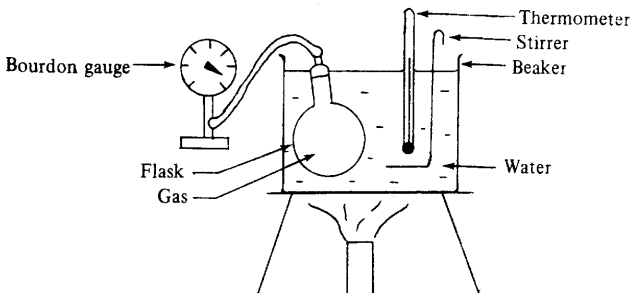
Not to be taken away before the end of the examination session

Section A

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

1. To defreeze a meat of 2 kg at −35.1°C, it is put into a cup of water of 3 kg at 25°C. Estimate the final temperature of the water when thermal equilibrium has reached.
Given: specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$
specific heat capacity of the meat = 1800 J kg^{-1} $°C^{-1}$

A. 11.6°C
B. 14.7°C
C. 23.1°C
D. 27.2°C

2. 

The above apparatus is used to study the relation between the temperature and the pressure of a fixed mass of gas at constant volume. Which of the following is NOT a precaution of the experiment ?

A. Ensure the flask is air-tight.
B. Immerse the whole flask in water.
C. Connect the Bourdon gauge to the flask with a long tube.
D. Prevent the flask from touching the bottom of the beaker.

3. Which of the following designs of a vacuum flask help to keep the liquid inside warm?

(1) the cork on the top of the flask

(2) the vacuum layer between the outer and the inner walls

(3) the silvery layer of the inner wall

A. (1) and (2) only

B. (1) and (3) only

C. (2) and (3) only

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

*4. If the mass of a helium atom is approximately four times that of a hydrogen atom, estimate the ratio $\frac{\text{r.m.s. speed of hydrogen gas}}{\text{r.m.s. speed of helium gas}}$ at 0°C.

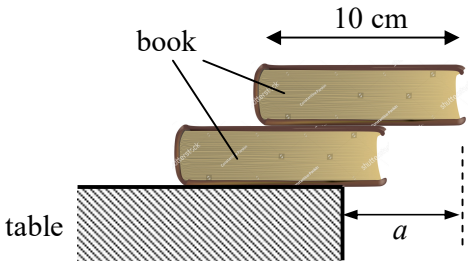
A. 1

B. 2

C. 4

D. 16

5.



Two identical books with length 10 cm are stacked on a table as shown. Find *a*, the largest distance the books extended out of the table's edge without toppling. Assume the mass density of each book is uniform.

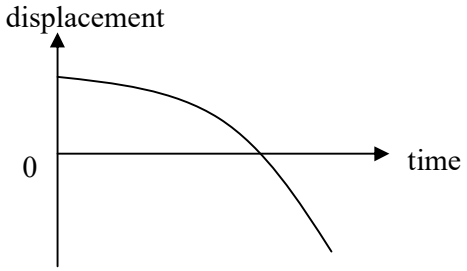
A. 5 cm

B. 7.5 cm

C. 8.25 cm

D. 10 cm

6. The figure below shows the displacement-time graph of an object.



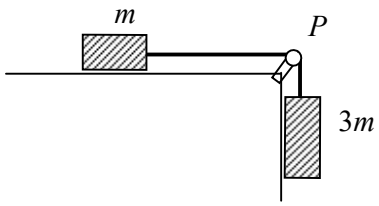
Which of the following statements about the motion must be correct ?

A. The speed of the object is decreasing.
B. The direction of motion of the object changes once.
C. The object accelerates towards the negative direction.
D. The object is moving downwards.

7. Which of the following causes a moving body to resist a change in its state of motion ?

A. inertia
B. acceleration
C. speed
D. weight

8.

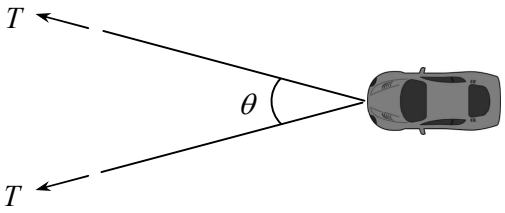


Two blocks of masses m and $3m$ are connected by a light string over a smooth pulley P as shown. If all surfaces are smooth, what is the tension in the string when the blocks are released ?

A. $mg/4$
B. $mg/3$
C. $3mg/4$
D. $3mg$

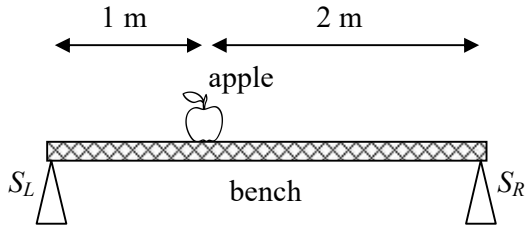
9. The figure below shows a car being 'towed' by two cables. At a certain moment, the angle θ is 20° and the tension T in both cables is 2000 N. Find the resultant force exerted by the cables on the car.

A. 1.88 kN
B. 1.97 kN
C. 3.76 kN
D. 3.94 kN

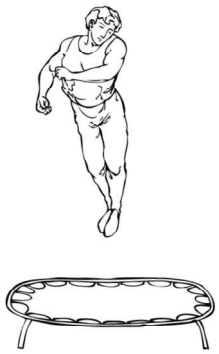


10. An apple of weight 4 N is put on a uniform wooden bench of 3 m as shown. If the normal force at the left supporter S_L is 3.5 N, what is the normal force at the right supporter S_R ?

A. 0.5 N
B. 1.67 N
C. 2.17 N
D. 3.73 N



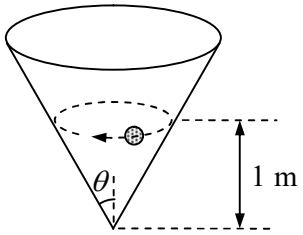
11. A man is jumping vertically on a trampoline as shown. When he falls on the trampoline and is at the *lowest* position, which of the following is/are correct ?



(1) His speed is zero.
(2) The net force on his body is zero.
(3) The normal force on his body and his weight form an action and reaction pair.

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

*12.



In the figure, a small sphere steadily describes a horizontal circular path in an inverted cone at a height of 1 m from the vertex. Find the speed of the sphere.

A. 1.44 m s^{-1}
B. 2.16 m s^{-1}
C. 2.68 m s^{-1}
D. 3.13 m s^{-1}

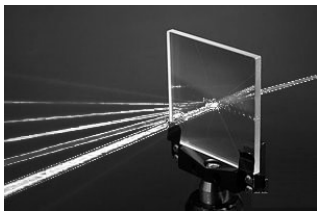
*13. Which of the following statements about the gravitational field lines of a point mass is/are correct ?

(1) All the field lines point towards the mass.
(2) The field line density is higher at a region closer to the mass.
(3) The field lines never cross each other.

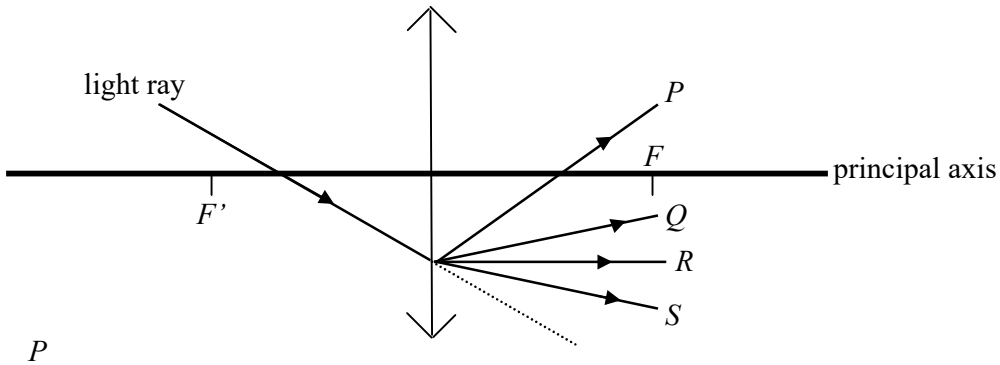
A. (1) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

*14. A monochromatic light is incident normally on a plane transmission grating which has 500 slits per mm. If the angular separation between the two 'first order' fringes is 35.7°, what is the angular separation between the two 'second order' fringes ?

A. 37.8°
B. 54.6°
C. 71.4°
D. 75.6°



15. In the figure below, *F* and *F'* are the foci of a convex lens. Which of the following best represents the emergent ray ?

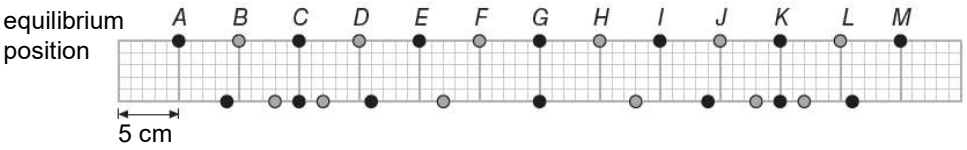


A. *P*
B. *Q*
C. *R*
D. *S*

16. Which of the following about virtual image is **INCORRECT** ?

A. It can be observed by human eyes.
B. It can be projected on a screen.
C. It can be formed by convex lens.
D. It can be magnified or diminished.

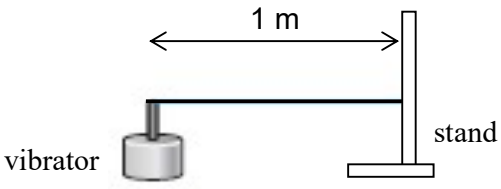
17. The figure below shows a longitudinal wave travelling through some particles.



What is the amplitude of the wave ?

A. 2 cm
B. 3 cm
C. 4 cm
D. 5 cm

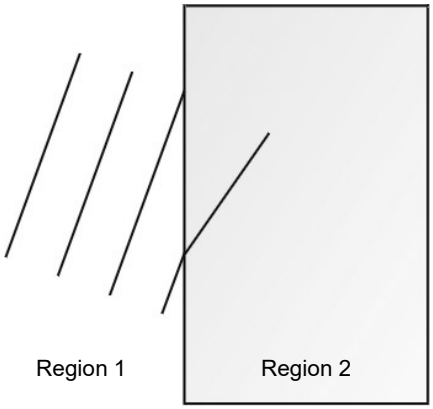
18.



An elastic string stretched to 1 m long is fixed with one end to a vibrator and the other to a stand as shown in the figure. Stationary wave patterns are produced when the vibrator vibrates at 12 Hz and 16 Hz. No stable pattern is produced at frequencies between these two. Find the speed of the wave along the string.

A. $4\ m\ s^{-1}$
B. $8\ m\ s^{-1}$
C. $16\ m\ s^{-1}$
D. $24\ m\ s^{-1}$

19.



A train of straight water waves travels from region 1 to region 2 as shown above. Which of the following statements is/are correct ?

(1) Region 1 is shallower than region 2.
(2) The wavelength of the water waves in region 1 is shorter than that in region 2.
(3) The frequency of the water waves in region 1 is higher than that in region 2.

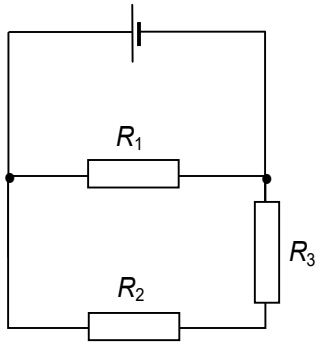
A. (1) only
B. (1) and (2) only
C. (2) and (3) only
D. (1), (2) and (3)

20. Which of the following about ultrasound is/are correct ?

(1) The frequency of ultrasound is above 20 000 Hz.
(2) All animals including human beings cannot hear ultrasound.
(3) Ultrasound is commonly used in scanning of foetus.

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

21. In the following circuit, the ratio of the resistance of R_1, R_2 and R_3 is 1 : 2 : 3. What is the ratio of the power dissipated by R_1, R_2 and R_3 ?



A. 1 : 2 : 3
B. 3 : 2 : 1
C. 5 : 2 : 3
D. 25 : 2 : 3

22. An electric toaster rated at 440 W is connected to a 220 V main supply via a three-pin plug. What are the currents carried in the neutral and earth wires under normal operation ?

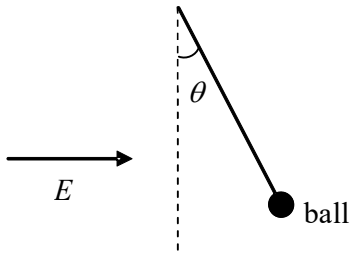
	Neutral wire	**Earth wire**
A.	2 A	2 A
B.	2 A	0 A
C.	0 A	2 A
D.	1 A	1 A

*23. The output power of a heater is 1 kW when it is connected to a sinusoidal a.c. supply of peak voltage 340 V. What is the output power of this heater when it is connected to a d.c. supply of 340 V ?

A. 0.5 kW
B. 1 kW
C. 1.41 kW
D. 2 kW

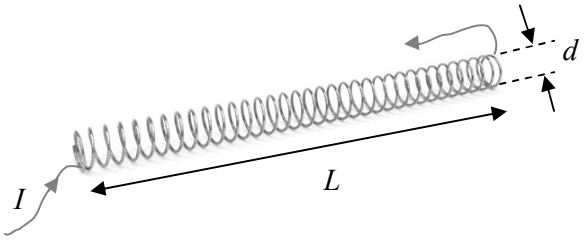
24. A charged ball is suspended by a string. When a uniform electric field E is applied horizontally, the ball is displaced so that the string makes an angle θ with the vertical. The value of E is directly proportional to

A. θ.
B. $\cos\theta$.
C. $\tan\theta$.
D. $\sin\theta$.



25. A current I passes through a long solenoid of N turns. The length and diameter of the solenoid are L and d respectively as shown in the figure. The magnetic field produced in the middle of the solenoid is B. Another long solenoid has $4N$ turns, a length of $2L$ and a diameter of $\frac{d}{2}$. If the current passing through this solenoid is $2I$, what is the magnetic field produced in the middle of this solenoid ?

A. $4B$
B. $2B$
C. B
D. $\frac{B}{2}$



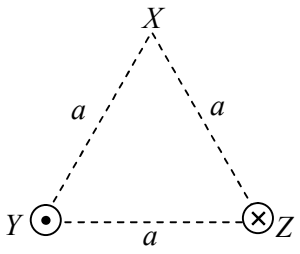
26. As shown below, *XYZ* are the vertices on an equilateral triangle of side length *a*. Two long straight parallel wires, each carrying a current *I*, are placed at points *Y* and *Z* respectively. What is the magnitude of the magnetic field at *X* ?

A. $\frac{\mu_o I}{2\pi a}$

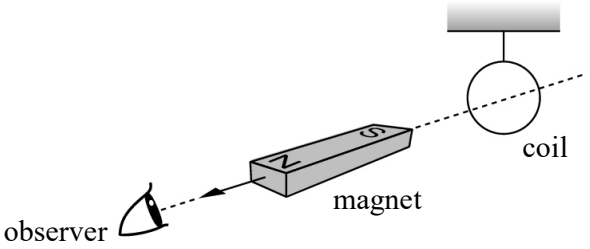
B. $\frac{\mu_0 I}{\pi a}$

C. $\frac{2\mu_o I}{\pi a}$

D. $\frac{\mu_0 I\sqrt{2}}{2\pi a}$

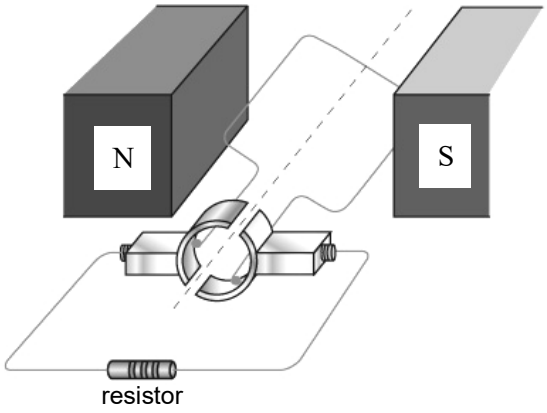


27. A bar magnet is pulled away from a coil as shown in the figure below. The coil is hung by a nylon thread. Which of the following statements is correct to the observer ?

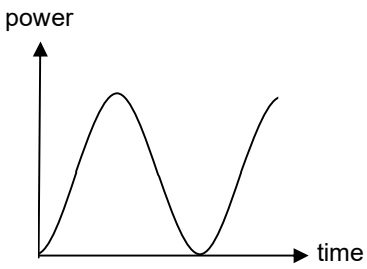


	direction of current in the coil	**motion of the coil**
A.	clockwise	swings toward the observer
B.	anticlockwise	swings away from the observer
C.	clockwise	swings away from the observer
D.	anticlockwise	swings toward the observer

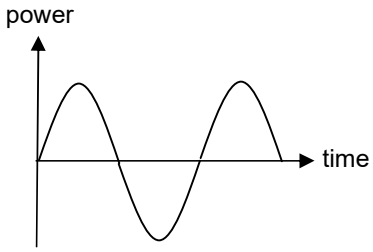
28. The following figure shows the coil of a generator rotating at a constant speed. Which of the following graphs best shows the power dissipated in the resistor ?



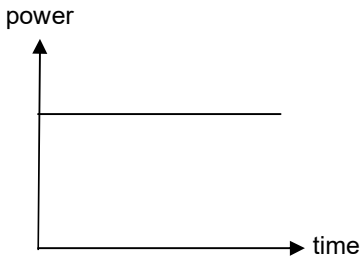
A.



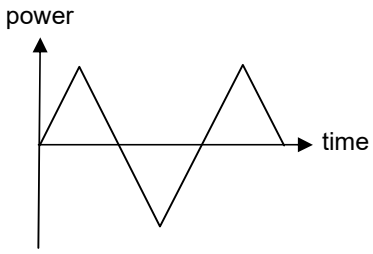
B.



C.



D.

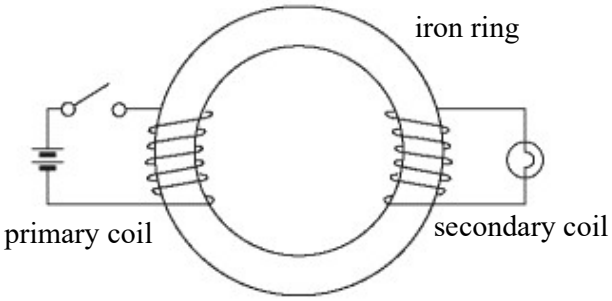


29. In the following nuclear equation, what is particle X ?

$$ {}_{1}^{2}H + {}_{1}^{3}H \rightarrow {}_{2}^{4}He + X + \text{energy} $$

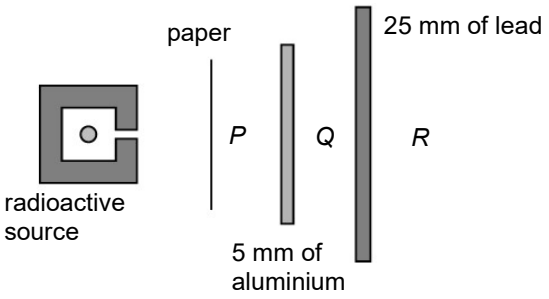
A. neutron
B. proton
C. electron
D. helium nucleus

*30. In the following figure, two coils are wound on an iron ring. The primary coil is connected to a battery and a switch, and the secondary coil is connected to a lamp. When the switch is closed, what would happen to the lamp in the secondary coil ?



A. It lights up with gradually increasing brightness.
B. It flashes at a constant frequency.
C. It gives a flash of light.
D. It does not light up.

31. In the following figure, a radioactive source emitting α, β and γ radiation is placed in front of a sheet of paper, 5 mm of aluminum and 25 mm of lead. Which type(s) of radiation will be detected in regions *P*, *Q* and *R* respectively ?

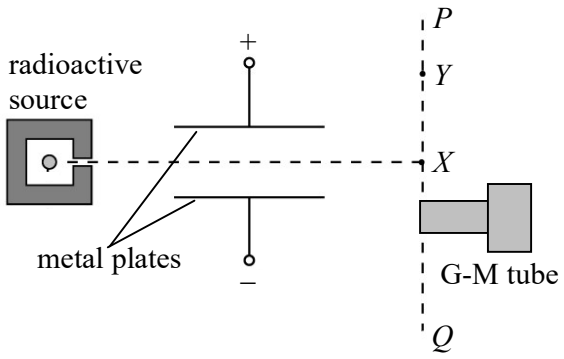


	P	***Q***	***R***
A.	α radiation	β radiation	γ radiation
B.	β and γ radiation	γ radiation	no radiation
C.	β and γ radiation	γ radiation	γ radiation
D.	α, β and γ radiation	β and γ radiation	γ radiation

32. The activity of a radioactive source *X* drops from 4000 units to 250 units in 12 hours. Find the half-life of *X*.

A. 2 hours.
B. 3 hours
C. 4 hours
D. 6 hours

33. In the following figure, a G-M tube is moved along dotted line *PQ*. The readings of the counter are significant only when the G-M tube is at *X* and *Y*. Which of the following statements must be correct ?



(1) α particles are emitted from the source.
(2) γ rays are emitted from the source.
(3) The reading of the counter at *Y* is higher than that at *X*.

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

END OF SECTION A

List of data, formulae and relationships

Data

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

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

$U = -\frac{GMm}{r}$	gravitational potential energy
$P = \sigma A T^4$	Stefan's law
$\left\|\frac{\Delta f}{f_0}\right\| \approx \frac{v}{c} \approx \left\|\frac{\Delta\lambda}{\lambda_0}\right\|$	Doppler effect

Energy and Use of Energy

$E = \frac{\Phi}{A}$	illuminance
$\frac{Q}{t} = \kappa\frac{A(T_H - T_C)}{d}$	rate of energy transfer by conduction
$U = \frac{\kappa}{d}$	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
$E_n = -\frac{1}{n^2}\left\{\frac{m_e e^4}{8h^2\varepsilon_0^2}\right\} = -\frac{13.6}{n^2}\text{eV}$	energy level equation for hydrogen atom
$\lambda = \frac{h}{p} = \frac{h}{mv}$	de Broglie formula
$\theta \approx \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)

Medical Physics

$\theta \approx \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)
$\text{power} = \frac{1}{f}$	power of a lens
$L = 10\log\frac{I}{I_0}$	intensity level (dB)
$Z = \rho c$	acoustic impedance
$\alpha = \frac{I_r}{I_0} = \frac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$	intensity reflection coefficient
$I = I_0 e^{-\mu x}$	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.	$P = Fv$	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.	$E = \frac{V}{d}$	electric field between parallel plates (numerically)
D4.	$R = \frac{\rho l}{A}$	resistance and resistivity
D5.	$R = R_1 + R_2$	resistors in series
D6.	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	resistors in parallel
D7.	$P = IV = I^2R$	power in a circuit
D8.	$F = BQv\sin\theta$	force on a moving charge in a magnetic field
D9.	$F = BIl\sin\theta$	force on a current-carrying conductor in a magnetic field
D10.	$B = \frac{\mu_0 I}{2\pi r}$	magnetic field due to a long straight wire
D11.	$B = \frac{\mu_0 NI}{l}$	magnetic field inside a long solenoid
D12.	$\varepsilon = N\frac{\Delta\Phi}{\Delta t}$	induced e.m.f.
D13.	$\frac{V_s}{V_p} \approx \frac{N_s}{N_p}$	ratio of secondary voltage to primary voltage in a transformer
E1.	$N = N_0e^{-kt}$	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.	$\Delta E = \Delta mc^2$	mass-energy relationship

B

SACRED HEART CANOSSIAN COLLEGE
17 – 18 S6 MOCK EXAMINATION

PHYSICS PAPER 1

Section B: Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write your name, class, class number and block number in the spaces provided on Page 1 and other odd numbered pages.

(2) Refer to the general instructions on the cover of the Question Paper for Section A.

(3) Answer **ALL** questions.

(4) Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Graph paper and supplementary answer sheets will be provided on request. Write your name, class, class number, and mark the question number box on each sheet.

(6) No extra time will be given to candidates for filling in the question number boxes after the 'Time is up' announcement.

Name: _____

Class & No.: _____( )

Block: _____

Question No.	Marks	For markers' use
1	**6**	
2	**8**	
3	**13**	
4	**9**	
5	**9**	
6	**8**	
7	**10**	
8	**11**	
9	**5**	
10	**5**	
TOTAL	**84**	

Answer **ALL** questions. Parts marked with "*" involve knowledge of the extension component. Write your answers in the spaces provided.

1. In a marathon, P and Q are running at uniform speed of 3 m s^{-1} as shown in Figure 1.1. At some instance, P suddenly slows down to 1.4 m s^{-1} at uniform deceleration. When Q notices that, she slows down to the same speed as well. In Figure 1.2, the velocity-time graph of P is shown as solid line and that of Q as dotted line.

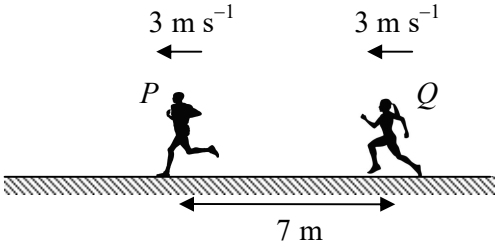


Figure 1.1

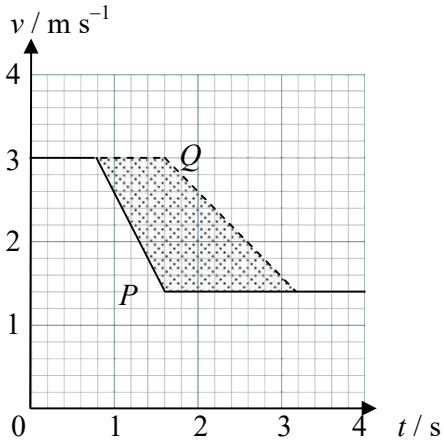


Figure 1.2

(a) What is the reaction time of Q ? (1 mark)

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(b) Find the deceleration of P when he starts to slow down. (2 marks)

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(c) (i) What is the physical meaning of the shaded area in Figure 1.2 ? (1 mark)

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Answers written in the margins will not be marked.

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(ii) If the initial separation between P and Q is 7 m, how far would they separate when they come to the same speed of 1.4 m s^{-1} ? (2 marks)

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*2. Some air is pumped into a swimming ring as shown in the figure below. When the ring is inflated, its volume remains unchanged at 8×10^{-3} m^3. You may assume air behaves like an ideal gas.

(a) If the air pressure in the inflated swimming ring is 1.5 atm at 20°C, find the number of moles of the air particles inside the ring. (Take 1 atm = 100 kPa.) (2 marks)

(b) If 20% more air particles are injected in the swimming ring, calculate the new air pressure in the swimming ring. Assume the temperature in the ring remains the same. (2 marks)

(c) (i) Using the kinetic theory of gases, briefly explain why the pressure in the ring drops when it is put into sea water at 10°C. (2 marks)

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Answers written in the margins will not be marked.

(ii) Estimate the percentage change in the air pressure in the ring when the ring is put into sea water at 10°C. (2 marks)

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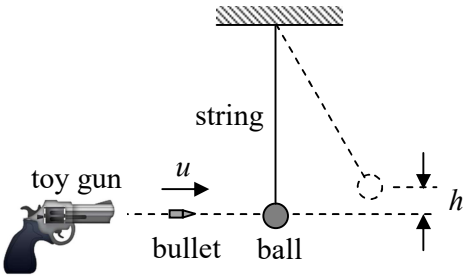
3. As shown in the figure below, a bullet of 5 g is fired from a toy gun at speed u = 20 m s^{-1} horizontally and then hits a suspended ball of 100 g at rest. The bullet embeds in the ball and both of them move upward to reach a maximum height of h. Assume the air resistance is negligible.



(a) Find the speed of the bullet right after it hits the ball. (2 marks)

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(b) Hence, find the value of h. (2 marks)

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(c) Find the work done by the tension on the ball by the string during the rise of the ball. (1 mark)

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(d) Find the loss in the kinetic energy during the hit. Mainly in what form of energy is it lost ? (3 marks)

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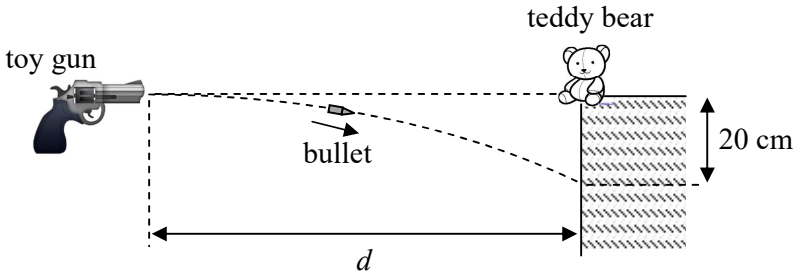
*(e) The same toy gun now targets horizontally at a teddy bear placed on the edge of a table as shown below. The separation between the gun and the bear is d. Due to gravity, the bullet hits the table 20 cm below the bear.



(i) Find the value of d. (3 marks)

(ii) If the bear is pushed off the table horizontally at the moment when the bullet is being fired, the bullet would hit the bear for whatever value of d. Explain briefly. (2 marks)

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4. In Figure 4.1, a light beam is directed to a semi-circular block and the angles of incidence (i) and refraction (r) are measured by a protractor. Figure 4.2 shows some data taken in the experiment.

Figure 4.1

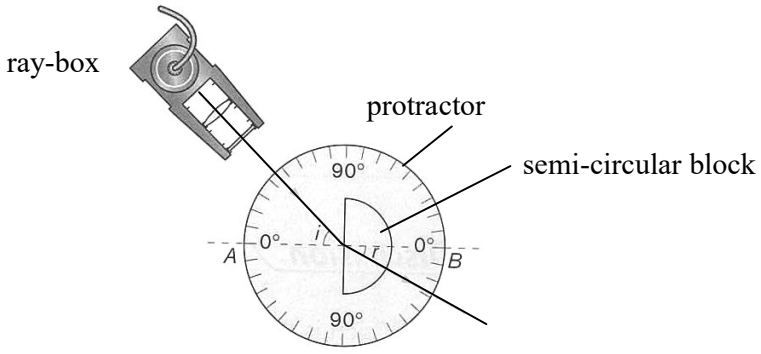

Figure 4.2

i	0°	10°	30°	50°
r	0°	5.5°	16.1°	25.2°
sin i				
sin r				

(a) Except turning off the room lighting, suggest **TWO** precautions we may take in laboratory to improve the accuracy of measuring the values of i and r during the experiment. (2 marks)

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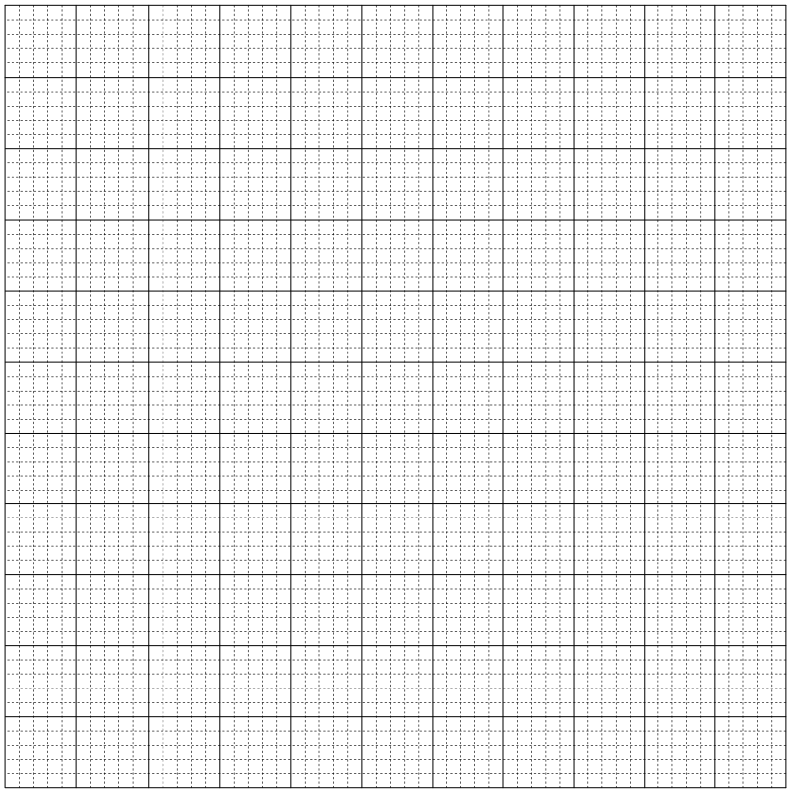
(b) Plot a graph of sin i against sin r on Figure 4.3. (4 marks)

Figure 4.3



(c) From the graph, estimate the critical angle of the block. (2 marks)

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(d) Suggest an application of total internal reflection in daily life. (1 mark)

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5. In a ripple tank, a train of straight water waves passes the two small openings, namely S_1 and S_2, of a barrier at time t = 0 s. Figure 5.1 shows the wave pattern at time t = 1 s. The displacement-time graph of the water particle at S_1 is shown in Figure 5.2.

Figure 5.1

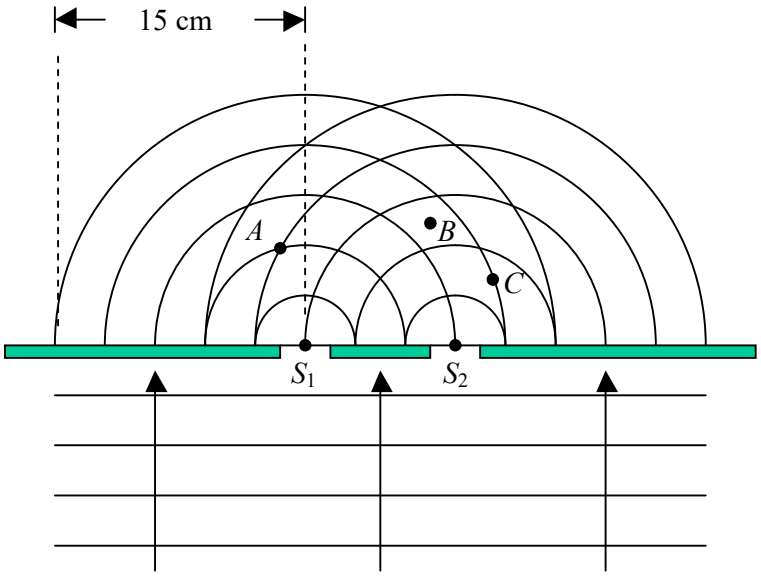
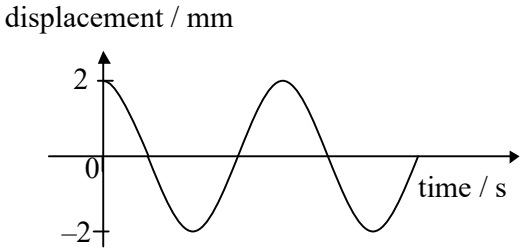


Figure 5.2



(a) From the figures, find

(i) the frequency of the wave, and (1 mark)

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(ii) the speed of the wave. (1 mark)

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(b) On Figure 5.1, sketch two lines to indicate all points P with path difference $|PS_1 - PS_2|$ equals to 0.5λ. (2 marks)

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(c) Express the path difference at B and C respectively in terms of wavelength λ of the water waves. Hence, state at which position does constructive interference occur.

(2 marks)

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(d) How would the answer in (c) change if the frequency of the wave is doubled ? Why ?

(2 marks)

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(e) If the opening at S_2 blocked, suggest any change in the amplitude of the wave at A.

(1 mark)

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6. Figure 6.1 shows part of the circuit in a car. On a cold night, a driver has to switch on the two identical headlights and the rear demister before switching on the starter motor of the car. When the headlights and demister are switched on, the reading of the voltmeter on dashboard drops from 14.6 V to 13.6 V while the current drawn by ***each*** headlight and the demister are 4 A and 2 A respectively.

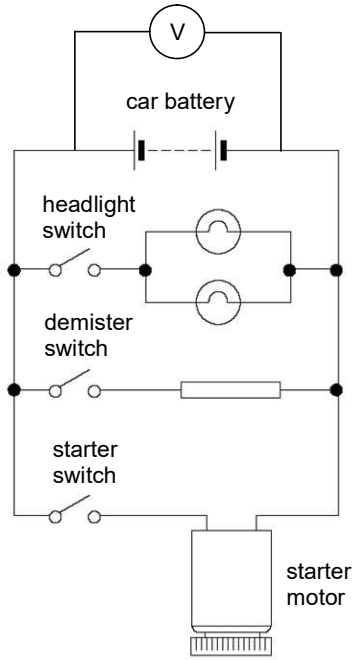

Figure 6.1

(a) What is the resistance of each headlight ? (1 mark)

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(b) What is the power of demister ? (1 mark)

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(c) What is the internal resistance of the battery ? (2 marks)

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(d) When the driver closes the starter switch, describe and explain how the brightness of each headlight would change. (2 marks)

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(e) A car battery is said to have run down if its internal resistance increases to a certain value. Explain the effect of an increased internal resistance of the car battery on the voltage across the starter motor. (2 marks)

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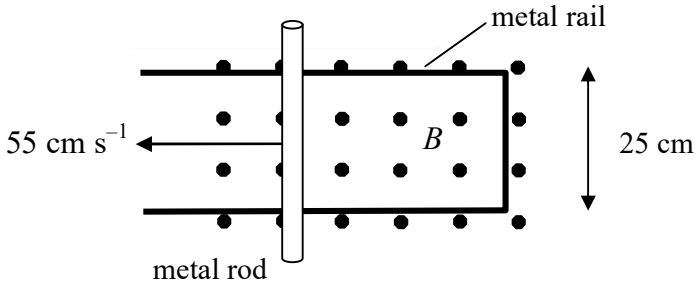
Answers written in the margins will not be marked.

*7. A metal rod is moving at a uniform speed of 55 cm s^{-1} on two parallel metal rails as shown in Figure 7.1. A magnetic field B is pointing out of the paper. The separation between the upper and the lower rails is 25 cm. The resistance of the rod is 18 Ω and that of the metal rails is negligible.

Figure 7.1



(a) The induced current through the rod is 2.6 mA.

(i) Determine the magnitude of the e.m.f. induced in the rod. (2 marks)

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(ii) Indicate in Figure 7.1 the direction of the induced current through the rod. (1 mark)

(b) Find the value of B. (3 marks)

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(c) To keep the rod moving at uniform speed, an external force has to be exerted on the rod.

(i) Explain why an external force is required. (1 mark)

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(ii) What is the direction and magnitude of the external force acting on the rod ?
(3 marks)

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*8. In the reactor of the Daya Bay Nuclear Power Station, the following reaction takes place:

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{142}_{56}\mathrm{Ba} + {}^{91}_{36}\mathrm{Kr} + 3{}^{1}_{0}\mathrm{n} + 2.79 \times 10^{-11}\ \mathrm{J}$$

Given that: mass of $^{91}_{36}\mathrm{Kr}$ = 90.923 445 u
mass of $^{142}_{56}\mathrm{Ba}$ = 141.916 453 u
mass of $^{235}_{92}\mathrm{U}$ = 235.043 930 u

(a) (i) Find the loss in total mass in the above reaction. Express your answer in atomic mass unit correct to 6 decimal places. (2 marks)

(ii) Hence, estimate the mass of a neutron. Express your answer in atomic mass unit correct to 6 decimal places. (2 marks)

(b) The fuel in the reactor contains 10^4 kg of U-235.

(i) Find the number of U-235 atoms in the fuel of the reactor. (2 marks)

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(ii) It is found that 10% of the fuel is used up in two years i.e. 730 days. Find the average output power of the nuclear reactor. (2 marks)

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(c) One of the radioactive products from the nuclear reactor is Iodine-131. Its half-life is 8.02 days. How many days would it take to reduce its activity to 1% of its original activity ? (3 marks)

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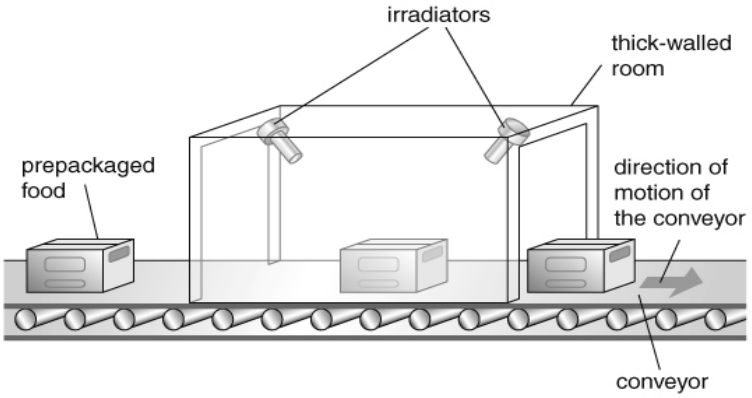
9. Food irradiation is a method of food preservation by irradiating the food with ionizing radiation. During the irradiation process, pre-packaged food is transported by a conveyor system to a thick-walled room that houses the irradiators as shown below.



(a) What is the purpose of exposing the pre-packaged foods to ionizing radiation? (1 mark)

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(b) Which type of radiation (α, β or γ) should be used ? Explain briefly. (2 marks)

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(c) A student suggests that food irradiation should be banned because it produces radioactive foods by leaving radioactive substances inside the food. Do you agree ? Explain briefly. (2 marks)

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10. You are given the following apparatus. Describe an experiment to find the specific latent heat of vaporization of water. (5 marks)

power supply

joulemeter

heater

beaker

electronic balance

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END OF PAPER

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