HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

2018 MOCK EXAMINATION

PHYSICS PAPER 1

8.30 am – 11.00 am (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 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 Answer Sheet, so that wrong marks can be completely erased with a certain 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.

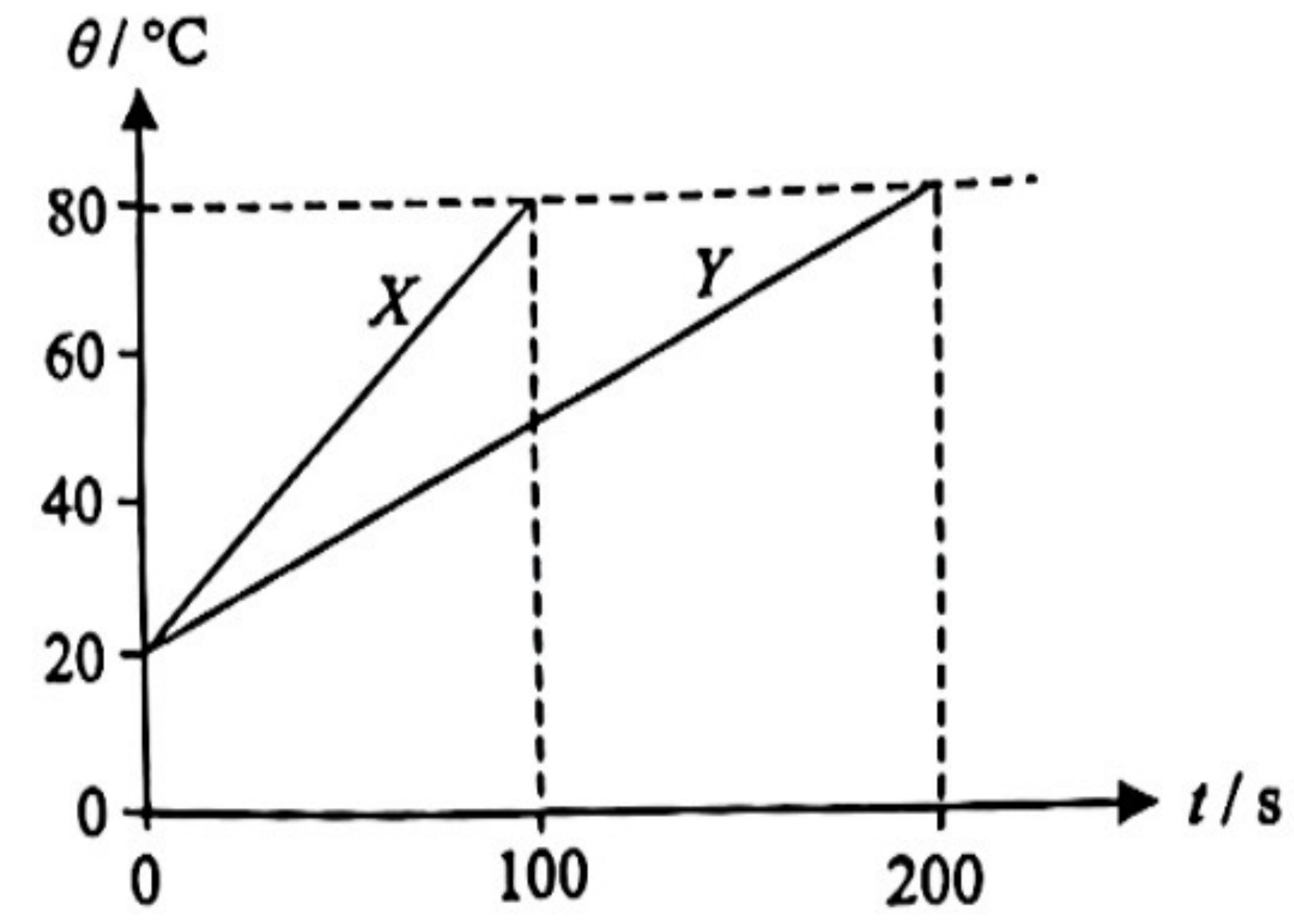
6. No marks will be deducted for wrong answers.

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Section A

There are 33 questions.

1.



Two objects X and Y are heated separately by heaters of the same power. The graph shows the variation of temperature θ o X and Y with time t. If the ratio of mass of X to Y is 3 : 2, what is the ratio of the specific heat capacity of X to that of Y?

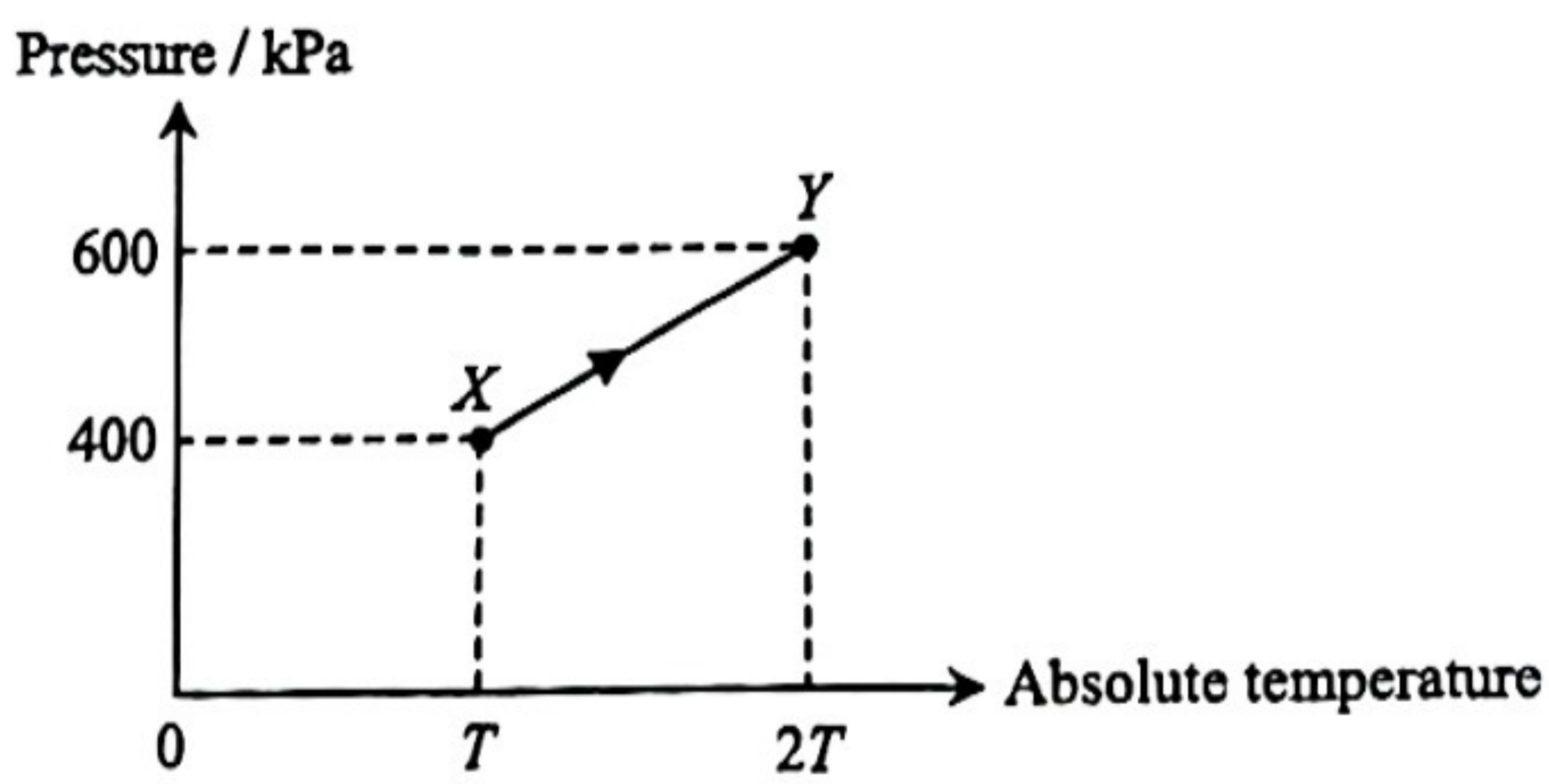
A. 3 : 1
B 1 : 3
C. 2 : 3
D. 4 : 3

2. A fixed mass of an ideal gas is contained in a gas vessel of fixed volume. If the gas inside the gas vessel is heated, which o the following statements is/are correct ?

(1) The average separation of the gas molecules will increase.
(2) The gas molecules hit the walls of the container more violently.
(3) The gas molecules hit the walls of the container less frequently.

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

3.



A fixed amount of an ideal gas is contained in a gas syringe. The gas changes from state X to state Y along the path XY as shown in the above figure. Which of the following statements is/are correct ?

(1) The pressure of the ideal gas is directly proportional to the absolute temperature from state X to state Y.
(2) The internal energy of the ideal gas is double when it changes from state X to state Y.
(3) The ratio of the volume of the ideal gas in state X to that in state Y is 3 : 4.

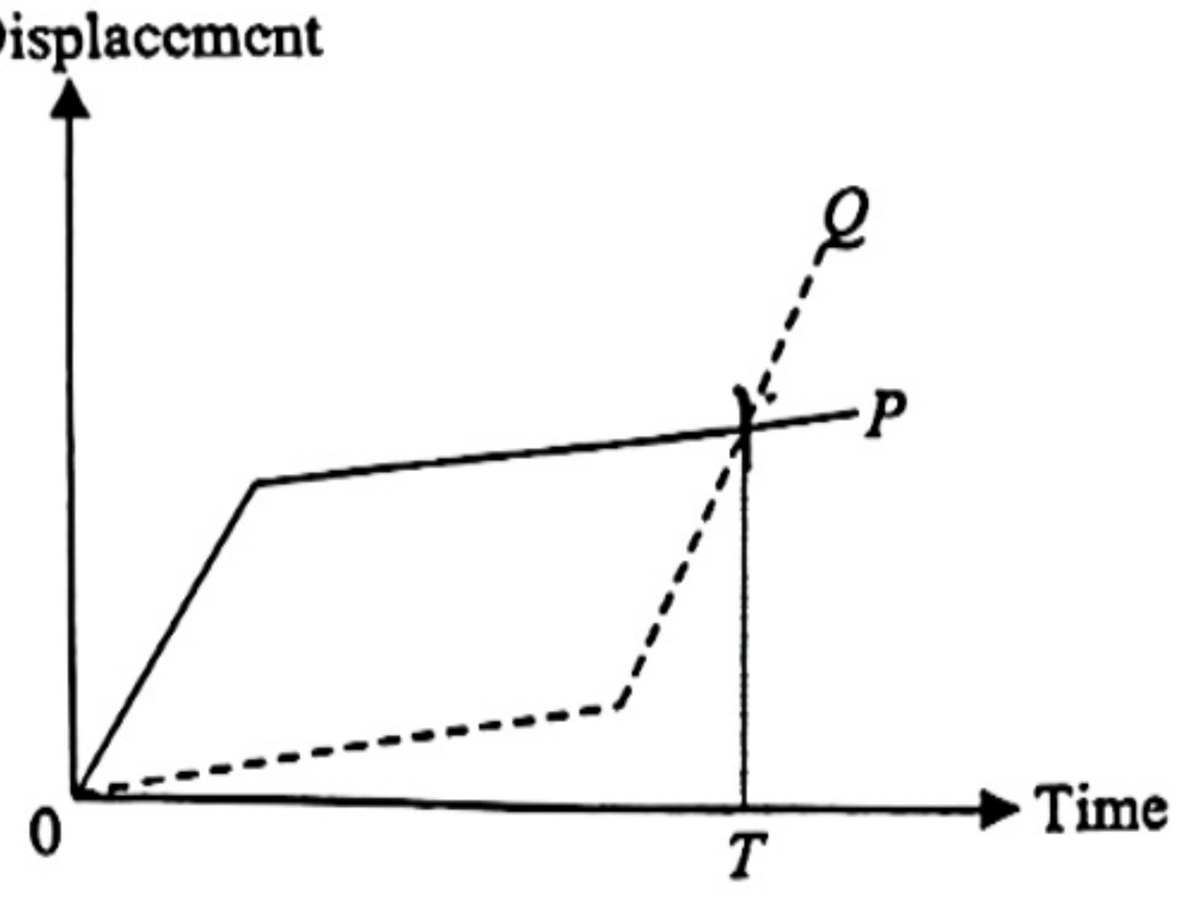
A. (1) only
B. (3) only
C. (1) and (2) only
D (2) and (3) only

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

4. An object of mass m, released from rest at height h above the ground, takes time t to reach the ground. If another object of mass $2m$ is released from rest at height $2h$, how long does it take to reach the ground ? Assume air resistance is negligible.

A. $t/\sqrt{2}$
B. t 2
C. $\sqrt{2}\,t$
D. $2t$

5.



Two cars P and Q start from the same position and travel along the same straight horizontal road. The displacement-time graphs of the two cars are shown in the above figure. Which of the following statements about the motion of the two cars are correct ?

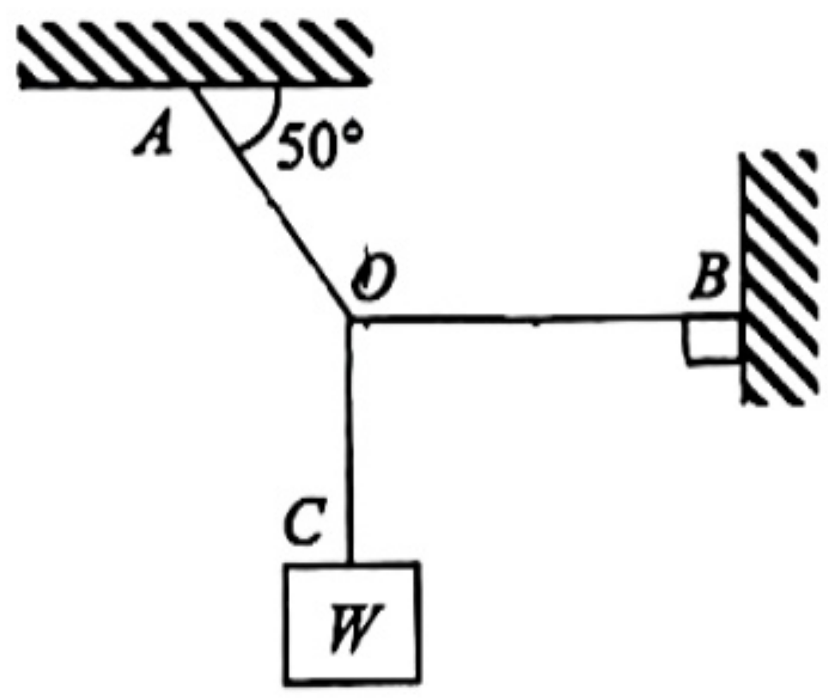
(1) At time T, car Q catches up with car P.
(2) At time T, car Q moves with a greater velocity than car P.
(3) The average velocity of car P from 0 to T is greater than that of car Q.

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

6. A small ball of mass 480 g is thrown vertically upwards in air. At a certain instant, the deceleration of the ball is found to be 12.5 m s^{-2}. What is the air resistance acting on the ball at this instant ?

A. 1.29 N
B. 4.68 N
C. 7.43 N
D. 10.7 N

7.



A body of weight W is suspended by three inextensible light strings OA, OB and OC as shown in the figure. If the tension of the string OB is 20 N, the weight W is

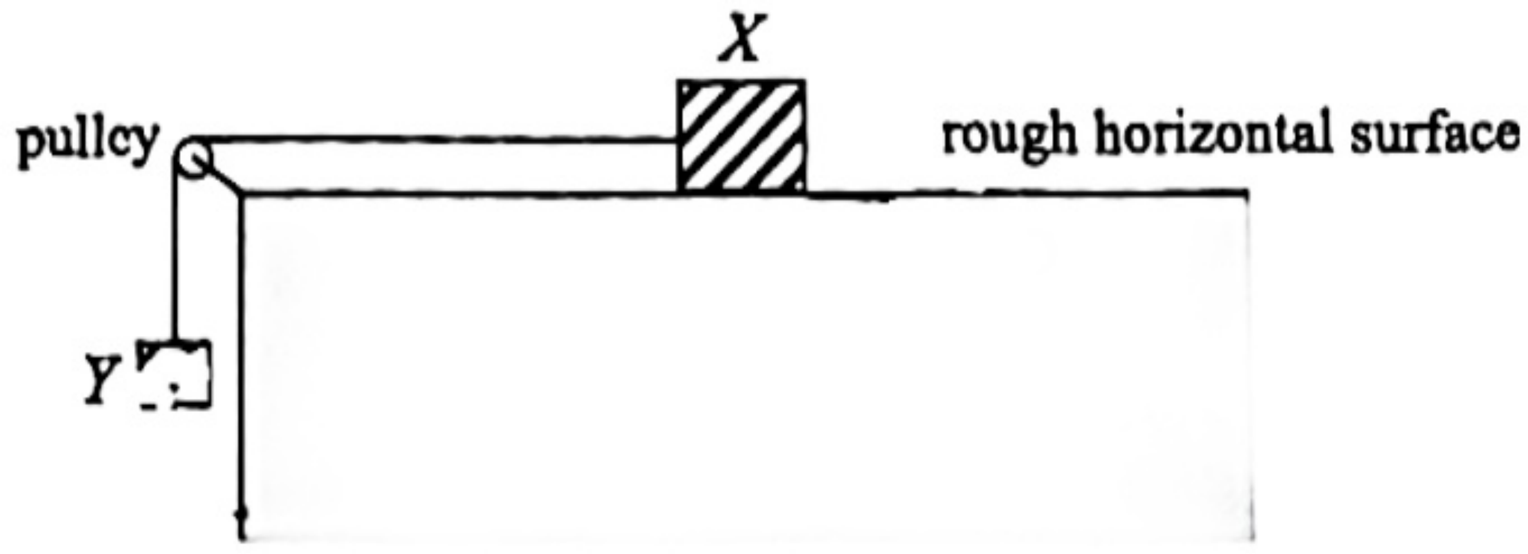
A. 15.3 N
B. 16.8 N
C 23.8 N
D. 26.1 N

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

8. A man of mass 60 kg stands on a compression balance inside a lift. At a cert... g shown by the balance is 510 N. Take g to be 10 m s^{-2}, which of the following statements is **NOT** correct ?

A. The magnitude of the acceleration of the lift is 1.5 m s^{-2}.
B. The lift may be moving upwards with deceleration.
C. The lift may be moving downwards with acceleration.
D. The force acting on the man by the balance and the weight of the man form an action and reaction pair.

9.

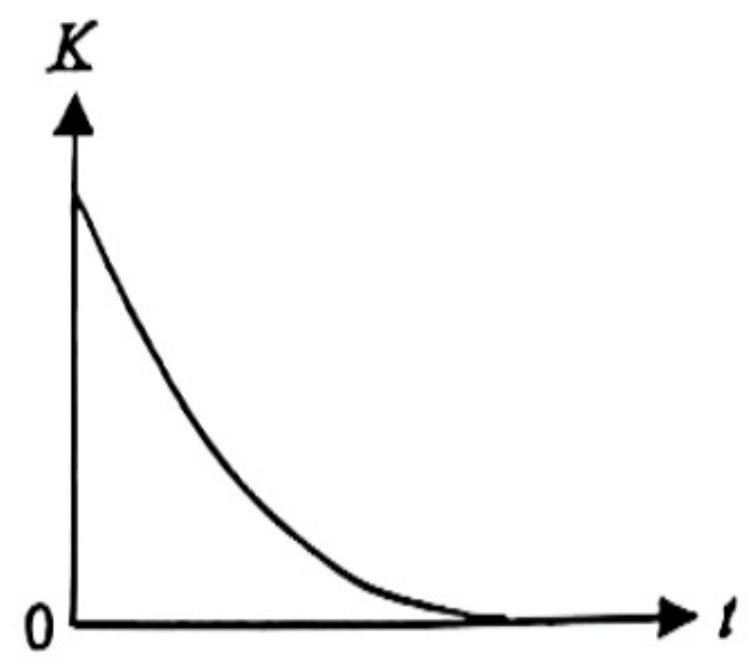


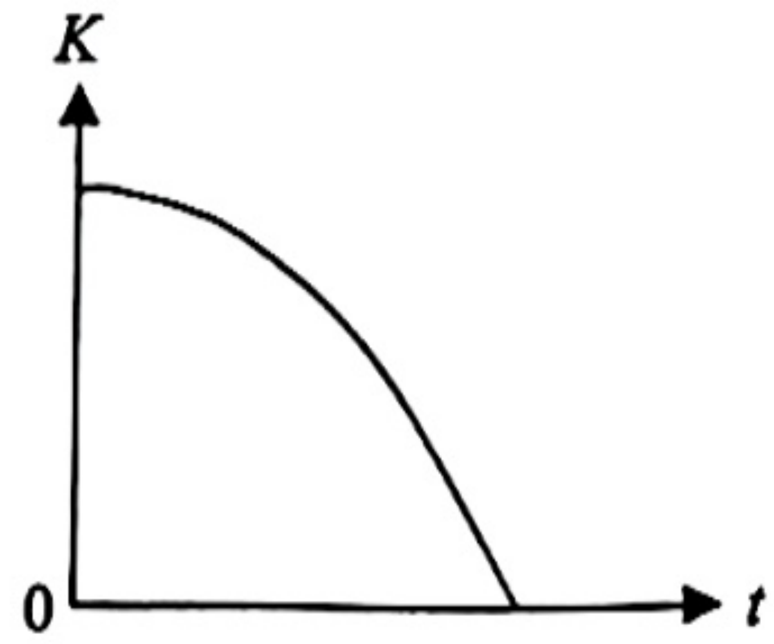
Two blocks X of mass 2.8 kg and Y of mass 1.2 kg are connected by a light string passing over a smooth pulley as shown i the above figure. Block X is placed on a rough horizontal surface. When the two blocks are released, their acceleration found to be 2.25 m s^{-2}. Find the friction acting on X by the surface.

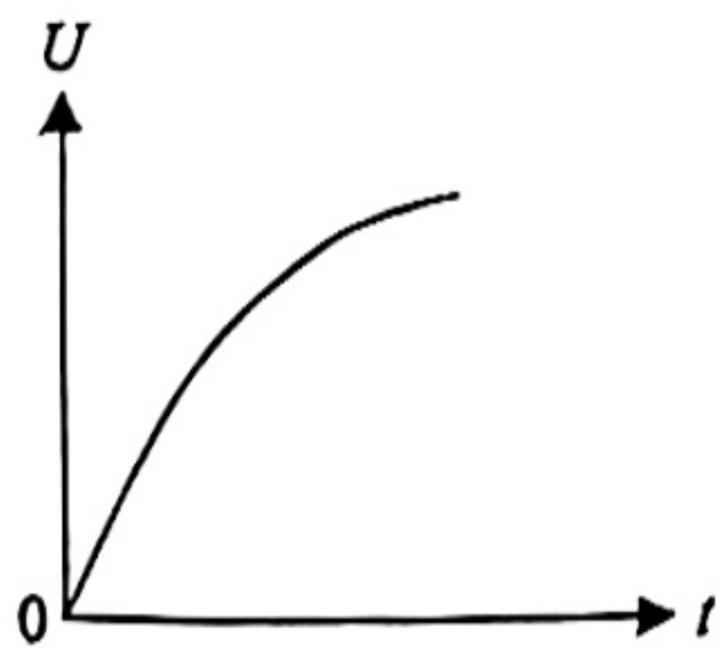
A. 1.84 N
B. 2.25 N
C. 2.77 N
D. 3.63 N

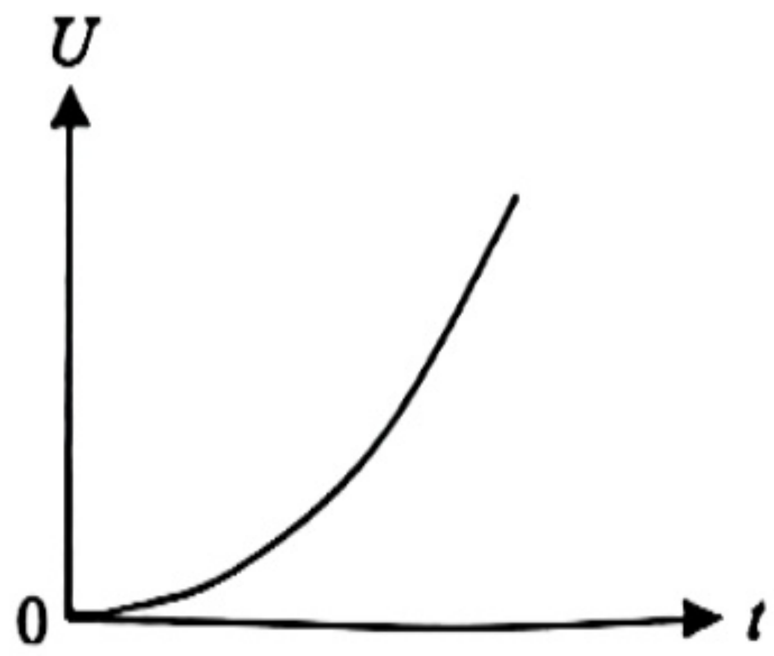
10.

A small block is projected upwards with an initial velocity along a smooth inclined plane as shown. Which of the followin combination correctly shows the time variation of the kinetic energy K and the potential energy U from the time c projection to the maximum height ?

(1)


(2)


(3)


(4)


	Kinetic energy K	Potential energy U
A	(1)	(3)
B.	(1)	(4)
C.	(2)	(3)
D	(2)	(4)

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

11. A water rocket ejecting water at an initial rate of 0.5 kg s^{-1} with a downward velocity of 80 m s^{-1}. If the initial mass of the rocket is 2.5 kg, calculate the initial acceleration of the rocket.

A. 6.19 m s^{-2}
B. 8.24 m s^{-2}
C. 12.5 m s^{-2}
D. 16.0 m s^{-2}

12. A car moves with constant speed travels along a circular horizontal path of radius 48 m. The maximum friction acting on the car by the road surface is 0.6 times of the weight of the car. Calculate the maximum speed of the car without skidding.

A. 12.5 m s^{-1}
B. 16.8 m s^{-1}
C. 21.7 m s^{-1}
D. Cannot be determined since the mass of the car is not given.

13. An artificial satellite revolves in a circular orbit above the Earth's surface at a height equal to the radius of the Earth. What is the orbital speed of the satellite ? Given that the radius of the Earth is 6400 km.

A. 4750 m s^{-1}
B. 5600 m s^{-1}
C. 6200 m s^{-1}
D. 7800 m s^{-1}

14. Figure (a) shows a series of particles at their equilibrium positions. Figure (b) shows their positions at a certain instant. At this instant, particle *e* is moving towards the right.

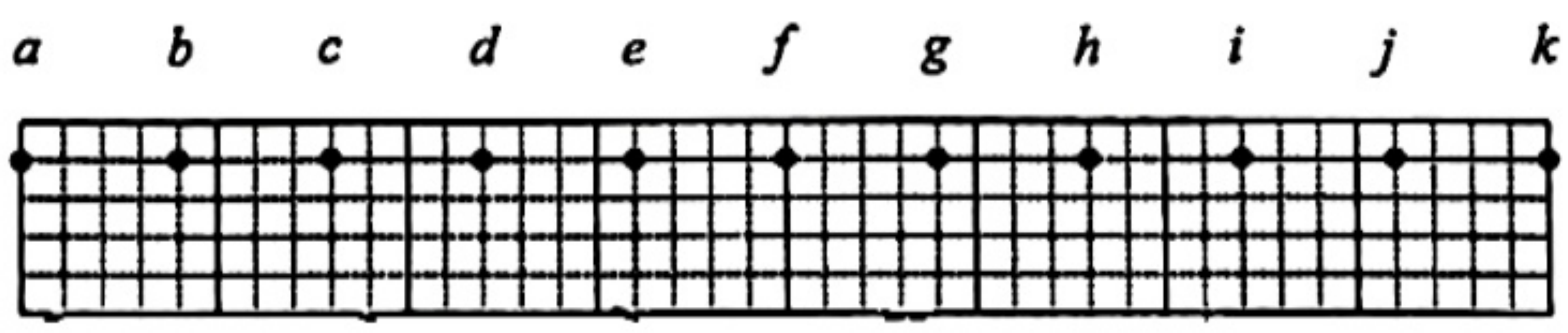


Figure (a)

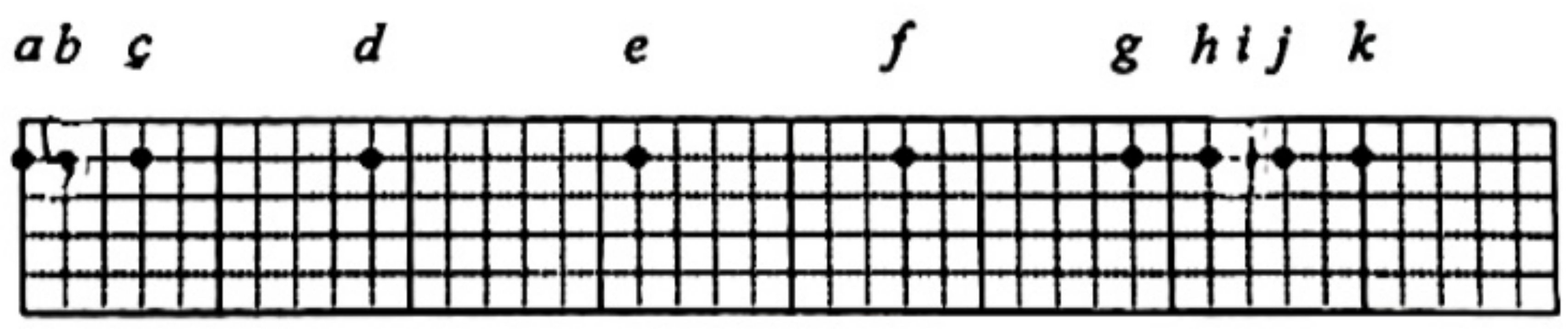


Figure (b)

Which of the following statements concerning the longitudinal wave in Figure (b) is/are correct ?

(1) The longitudinal wave is travelling towards the right.
(2) The distance between particle *b* and particle *j* is equal to one wavelength of the wave.
(3) After a quarter of a period, particle *a* becomes momentarily at rest.

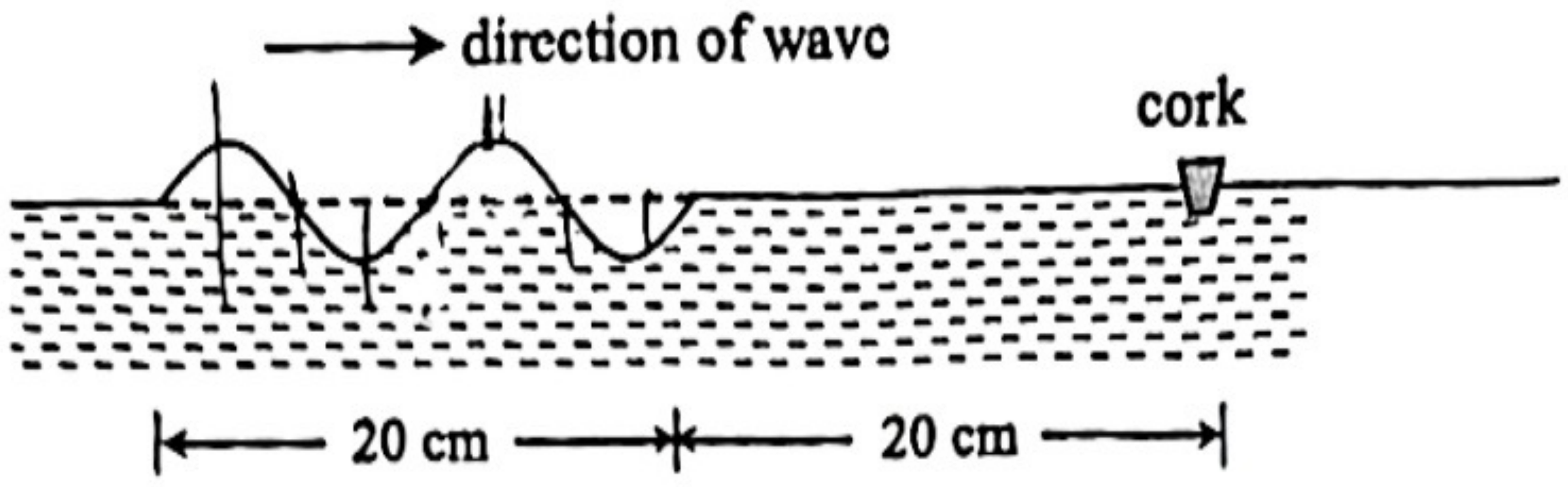
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

15. The refractive indices of water and plastic are 1.33 and 1.65 respectively. Which of the following statements is correct ?

A. When light travels from water to plastic, it bends away from normal.
B. Light travels with a greater speed in plastic than that in water.
C. The frequency of light increases when it travels from water to plastic.
D. The wavelength of light decreases when it travels from water to plastic.

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

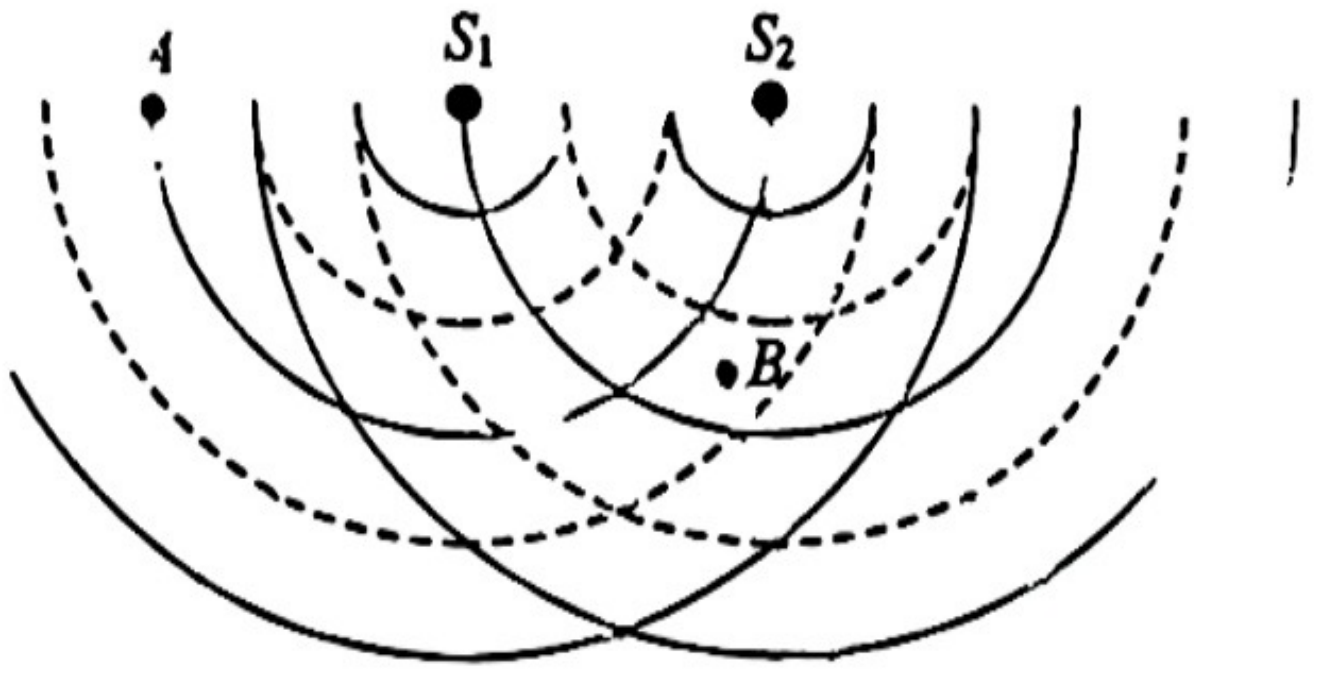
16.



A cork is floating on a water surface and a water wave is propagating towards it. The above figure shows an instant of the wave. It is found that after 2.2 s the cork rises to the highest position for the first time. What is the frequency of the water wave ?

A. 0.80 Hz
B. 1.00 Hz
C. 1.25 Hz
D 1.50 Hz

17.

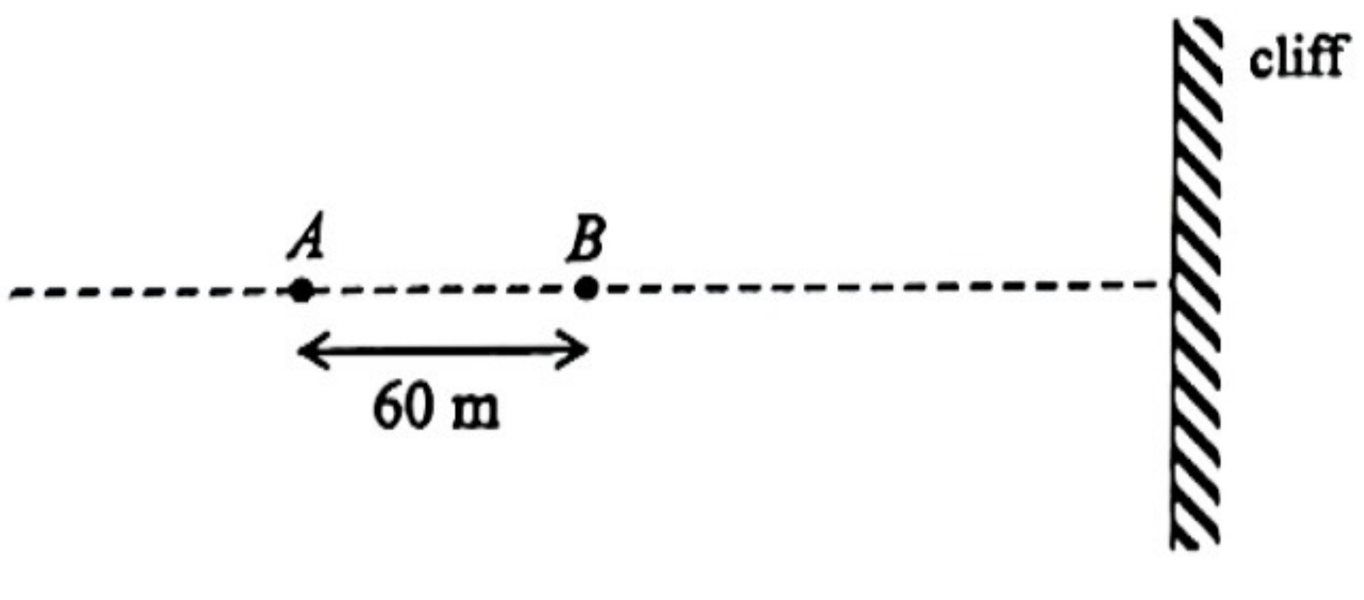


Two point sources S_1 and S_2 produce circular water waves in a ripple tank. The above figure shows the wave pattern at a certain instant. Solid lines represent crests and dotted lines represent troughs. Which of the following statements is/are correct ?

(1) Point A undergoes constructive interference.
(2) Point B is neither constructive nor destructive interference.
(3) There are 3 points on the line between S_1 and S_2 undergoing constructive interference.

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

18.

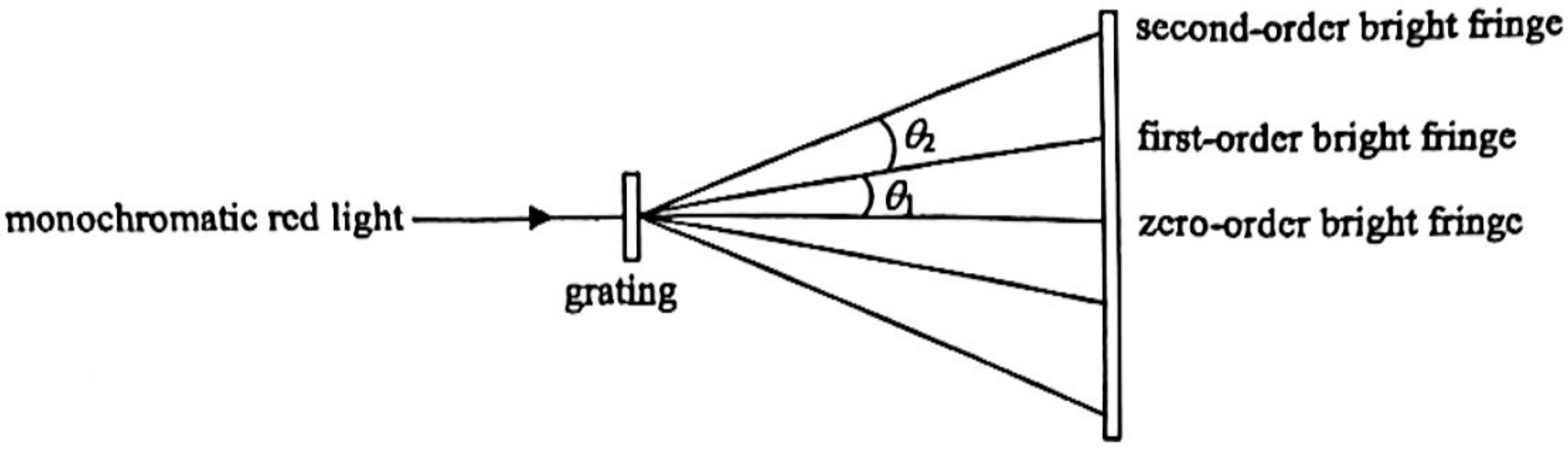


John thinks of a method to determine the speed of sound in air. He stands at a certain position A from a cliff. He then claps his hands and hears the echo after 2.54 s. Afterward, he walks 60 m directly towards the cliff to the position B as shown in the above figure. This time he claps his hand and hears the echo after 2.19 s. What is the speed of sound in air measured by John ?

A. 330 m s^{-1}
B. 333 m s^{-1}
C 340 m s^{-1}
D 343 m s^{-1}

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

9.



The above figure shows some of the diffracted maximum when a monochromatic red light of wavelength 650 nm is directed towards a diffraction grating. The first-order bright fringe is at an angle θ_1 of 15° from the central line. Which of the following statements are correct ?

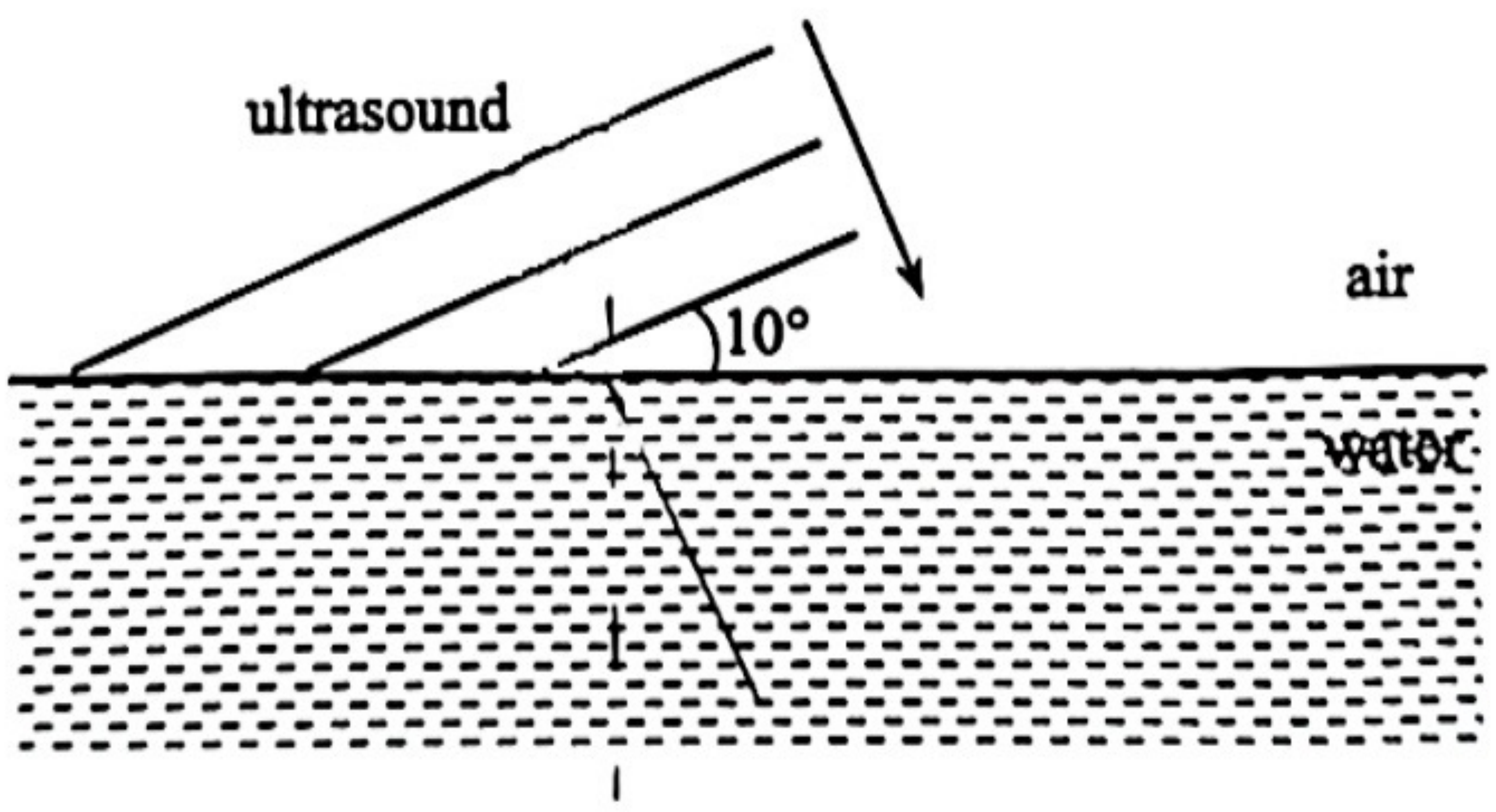
(1) The angle θ_2 indicated in the figure is 16.2°.
(2) There is no 4th order bright fringe formed by this grating.
(3) If another monochromatic blue light of wavelength 450 nm is directed towards this grating, the maximum order of bright fringe is 5.

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

10. In a Young's double slit experiment, a monochromatic light source of wavelength λ is used. The fringe separation formed on the screen is 2.4 mm. If the slit separation is doubled and another monochromatic light source of wavelength 1.5 λ is used, what is the new fringe separation ?

A. 1.2 mm
B 1.8 mm
C. 2.4 mm
D. 3.2 mm

11.



An ultrasound is directed from air to water with an incident angle of 10°. Given that the speed of sound in air and that in water are 340 m s^{-1} and 1500 m s^{-1} respectively. Which of the following statements are correct ?

(1) When ultrasound travels from air to water, the frequency remains unchanged.
(2) The angle of refraction in water is 50°.
(3) If the incident angle of ultrasound in air is increased to 20°, total internal reflection occurs.

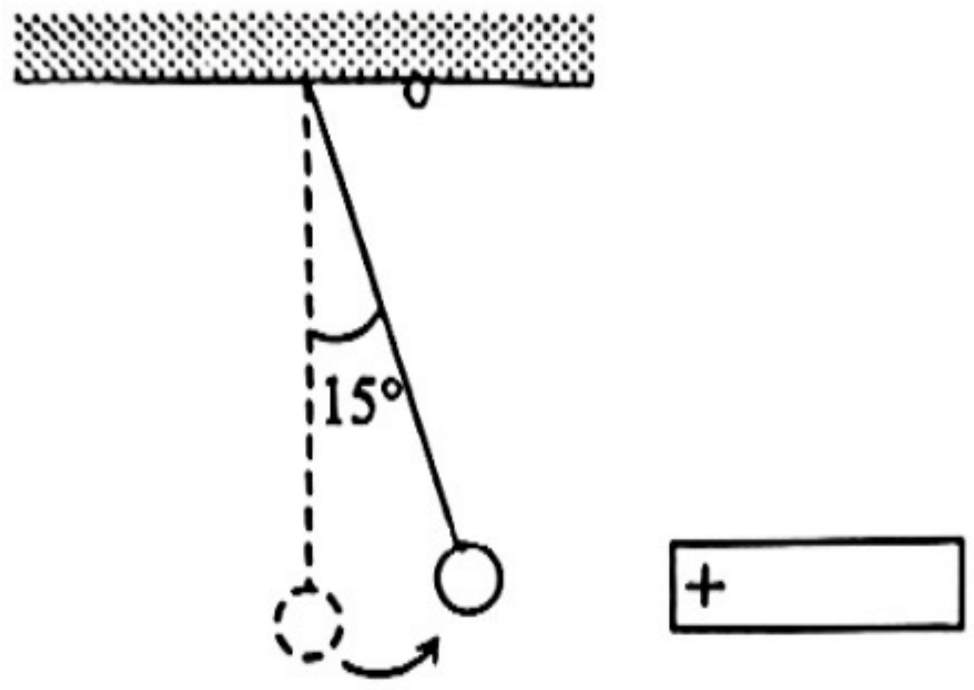
A (1) and (2) only
B (1) and (3) only
C. (2) and (3) only
D (1), (2) and (3)

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

22. A d.c. voltage V is applied to two parallel plates separated at 24 cm. An electron placed inside the two parallel pla... experience an electrostatic force of 7.2×10^{-18} N. Calculate the voltage V.

A. 10.8 V
B. 12.4 V
C. 14.4 V
D. 16.8 V

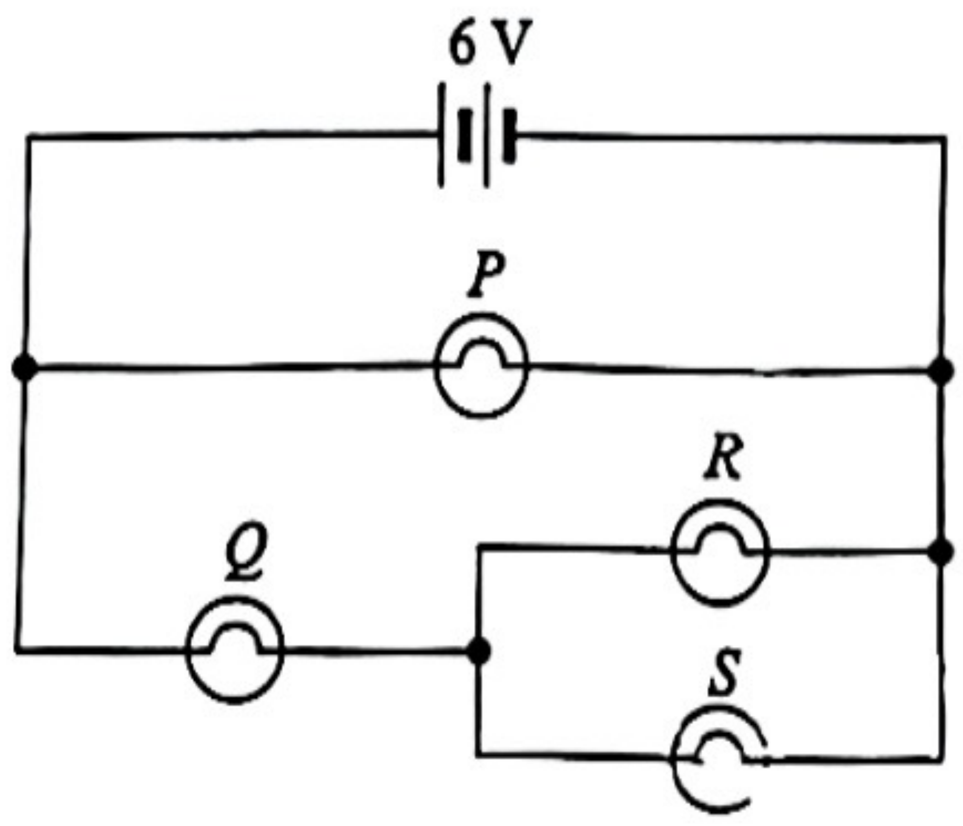
23.



A small conducting sphere of mass 45 g is suspended by an insulated thread. When a positively charged rod is brought nea... the sphere, the sphere is attracted to one side so that the string makes an angle of 15° with the vertical as shown. What i... the electrostatic force acting on the sphere by the rod ? Assume the electrostatic force is horizontal.

A. 0.08 N
B. 0.12 N
C. 0.16 N
D. 0.24 N

24.



In the above circuit, a battery of e.m.f. 6 V with negligible internal resistance is connected to 4 identical light bulbs a... shown. All the light bulbs lit. After a while, light bulb S burns out. Which of the following statement is correct ?

A. The current delivered by the battery remains unchanged.
B. The current flowing through light bulb P decreases.
C. The light bulb Q becomes brighter.
D. The voltage across light bulb S becomes 3 V.

25. Which of the following statements give(s) the correct reason why the switch should be connected on the live wire i... domestic circuit ?

(1) If the switch is connected on the neutral wire, the electrical appliance cannot be switched off.
(2) When the switch is off, the metal case of the electrical appliance can be cut off from high voltage.
(3) When the switch is off, someone touching the heating element of the electrical appliance will not get electric shock.

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

GROUP BEACON® 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

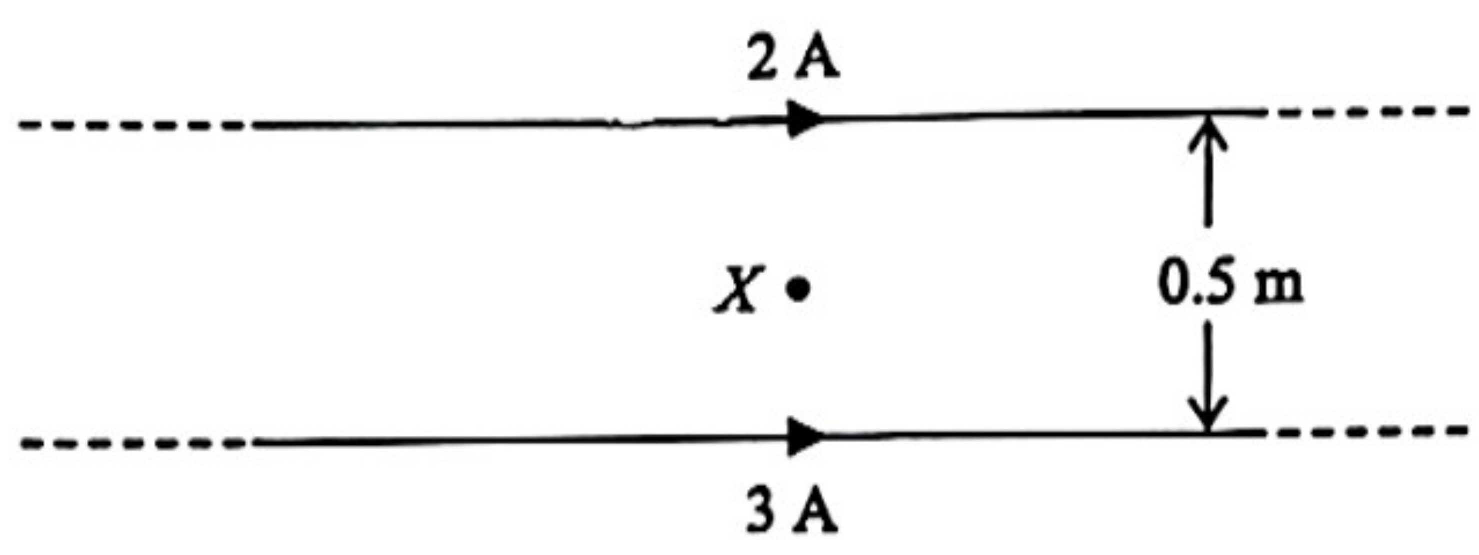
6.

A proton with mass 1.66×10^{-27} kg and charge 1.6×10^{-19} C enters a uniform magnetic field of 1.25 T directed into paper as shown in the figure. The speed of the proton is 2×10^{6} m s^{-1}. Which of the following statements are correct ?

(1) The proton will be deflected upwards.
(2) The radius of curvature of the path of the proton in the magnetic field is 1.66 cm.
(3) The period of the circular motion of the proton in the magnetic field is 2.6×10^{-8} s.

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

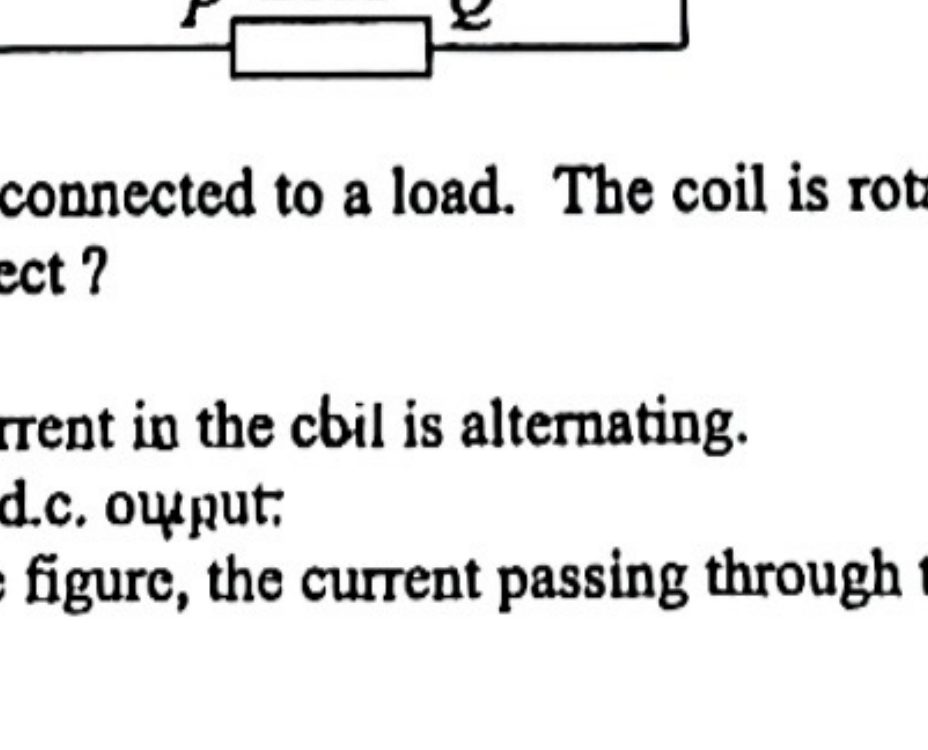
7.



Two long parallel straight wires carrying current of 2 A and 3 A in the same direction are separated by 0.5 m apart as shown. Determine the magnetic field at a point X mid-way between the two wires in both magnitude and direction.

	Magnitude	Direction
A.	4×10^{-7} T	into paper
B.	8×10^{-7} T	into paper
C.	4×10^{-7} T	out of paper
D.	8×10^{-7} T	out of paper

8.



The above figure shows a dynamo connected to a load. The coil is rotating continuously in clockwise direction. Which of the following statements is/are correct ?

(1) The direction of induced current in the coil is alternating.
(2) The dynamo gives a steady d.c. output.
(3) At the position shown in the figure, the current passing through the load is from P to Q.

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

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

29. When a d.c. current of 5 A is supplied to a heater, the power dissipated is P. If now an a.c. current of peak value 10 A is supplied to the same heater, what is the power dissipated by the heater ?

A $\sqrt{2}P$
B. $2P$
C $2\sqrt{2}P$
D $4P$

30. A power station supplies electrical power to the users. The power given out by the station is 2500 kW. After stepping up, the voltage applied to the transmission cable is 20 kV. If the efficiency of power transmission is 98%, calculate the total resistance of the transmission cable.

A. 1.6 Ω
B 3.2 Ω
C. 4.8 Ω
D. 6.4 Ω

31. Po-210 undergoes alpha decay. A sample of Po-210 has an activity of 6.4×10^9 Bq. If the power of the radiation of the sample is 5 mW, what is the kinetic energy of each α particle emitted by Po-210 ? Assume most of the decay energy is carried by the α particles.

A. 4.88 MeV
B. 4.94 MeV
C. 5.00 MeV
D. 5.12 MeV

32. Radioactive nuclide $^{244}_{94}$Pu undergoes a series of decay that emits 9 α-particles, 6 β-particles and 8 gamma radiation. What is the atomic number of the final daughter product ?

A. 80
B. 82
C. 84
D. 86

33. A star radiates energy at a constant rate of 5×10^{26} W by nuclear fusion. What is the decrease of mass of the star after one year ?

A. 1.25×10^{17} kg
B 1.50×10^{17} kg
C 1.75×10^{17} kg
D. 2.25×10^{17} kg

End of Section A

GROUP BEACON• 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

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 :

$$v = u + at$$

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

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

Mathematics

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

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

Astronomy and Space Science

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

Energy and Use of Energy

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

Atomic World

$\dfrac{1}{2}m_e v_{max}^2 = hf - \phi$	Einstein's photoelectric equation
$E_n = -\dfrac{13.6}{n^2}\ \text{eV}$	energy level equation for hydrogen atom
$\lambda = \dfrac{h}{p} = \dfrac{h}{mv}$	de Broglie formula
$\theta \approx \dfrac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)

Medical Physics

$\theta \approx \dfrac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)
$\text{power} = \dfrac{1}{f}$	power of a lens
$L = 10\log\dfrac{I}{I_0}$	intensity level (dB)
$Z = \rho c$	acoustic impedance
$\alpha = \dfrac{I_r}{I_0} = \dfrac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$	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.	$E_p = m\,g\,h$	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.	$E = \frac{V}{d}$	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.	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$	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.	$E = mc^2$	mass-energy relationship

Hong Kong Diploma of Secondary Education Examination

Please stick the barcode label here.

2018

Mock Examination

Candidate Number									

PHYSICS PAPER 1

SECTION B : Question-Answer Book B

This paper must be answered in English

Question No.	Marks
1	6
2	7
3	7
4	9
5	8
6	7
7	8
8	10
9	5
10	10
11	7

INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write you Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided.

(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 candidate number, mark the questions box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this Question-Answer Book.

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

GROUP BEACON 進理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Section B : Answer **ALL** questions. Write your answers in the spaces provided.

1. A heater connected to a low voltage supply of 12 V is put into a polystyrene cup containing 300 g of water at an initial temperature of 24°C. After switching on the supply, the current drawn by the heater is 3.5 A.

Given : specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$

specific latent heat of fusion of ice = 3.34×10^5 J kg^{-1}

(a) Explain why the heater should be placed near the bottom of the polystyrene cup. (1 mark)

....

....

....

(b) The heater is switched on for 5 minutes. Calculate the final temperature of the water in the cup. (2 marks)

....

....

....

....

....

(c) Although no water is splashing out during the heating process, the mass of water is found to decrease slightly after the heating process. Give a reason. (1 mark)

....

....

....

....

(d) After the heater is switched off, a lump of ice of mass 50 g at 0°C is put into the water inside the cup. Assume no heat exchange with the surroundings, what would be the final temperature of the mixture ? (2 marks)

....

....

....

....

....

....

....

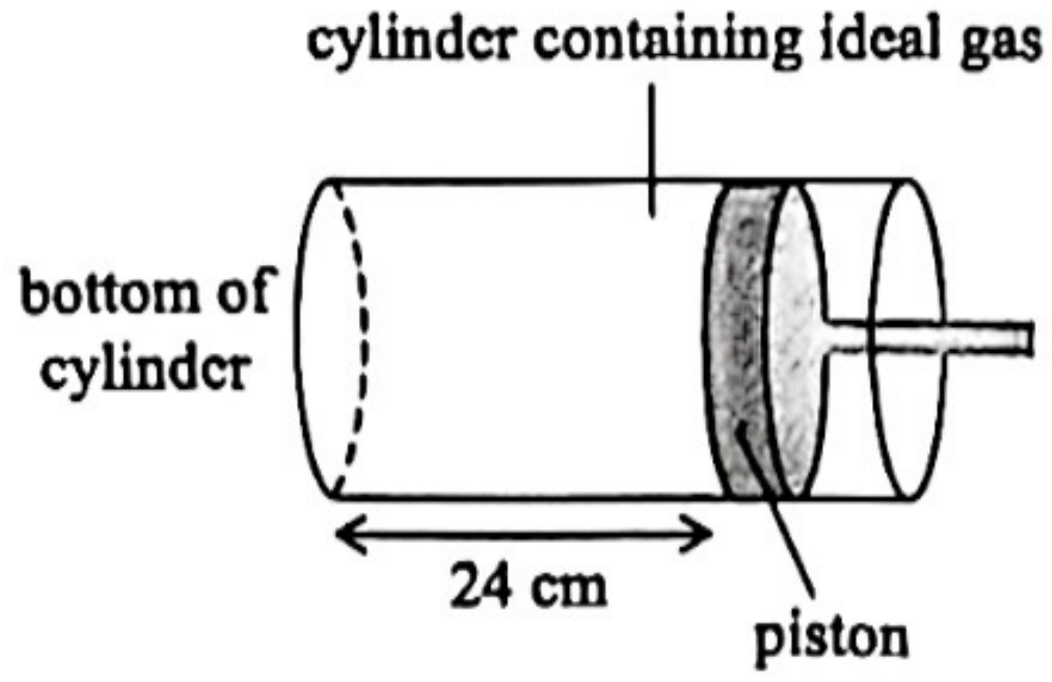
....

....

Answers written in the margins will not be marked.

GROUP BEACON 趨理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

2.



A uniform cylinder fitted with a movable piston contains air. The cross-sectional area of the cylinder is 150 cm^2 and the piston is at a distance of 24 cm from the bottom. The air is at a temperature of 20°C and an atmospheric pressure of 102 kPa. Given that the molar mass of air is 29 g mol^{-1}. Assume that the air is an ideal gas.

(a) Calculate the mass of air inside the cylinder. (2 marks)

....

....

....

....

....

(b) Calculate the root-mean-square speed of air molecules inside the cylinder. (2 marks)

....

....

....

....

(c) A student argues that since air is a mixture of different gases with different molecular mass, they should have different average kinetic energy inside the cylinder. Comment. (1 mark)

....

....

....

....

(d) If now the gas is heated to a temperature of 60°C and the piston is pushed in so that the piston is at a distance of 16 cm from the bottom of the cylinder. Calculate the new pressure of the air inside the cylinder. (2 marks)

....

....

....

....

....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 燈理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

3.

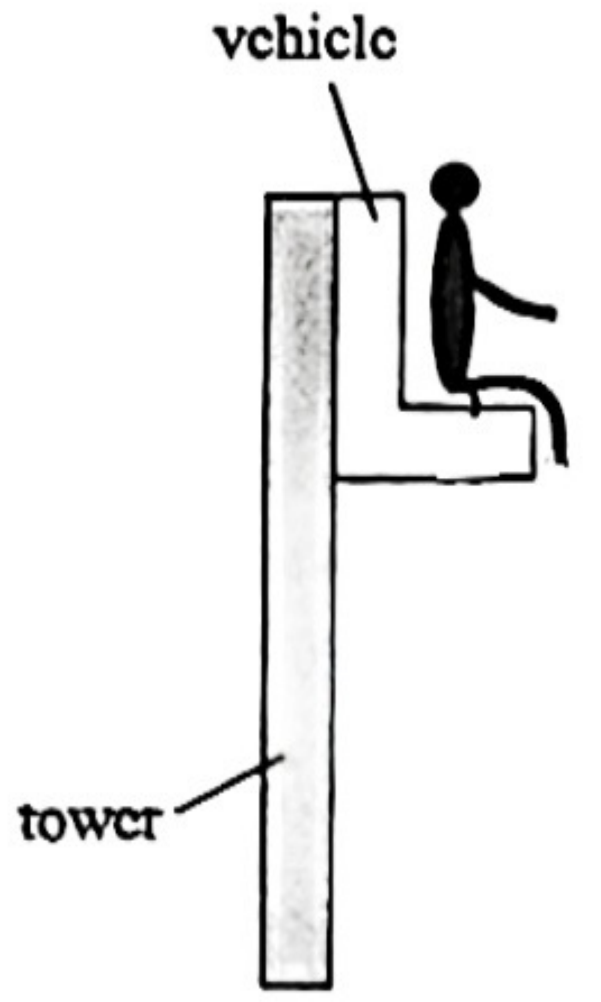


Figure (a)

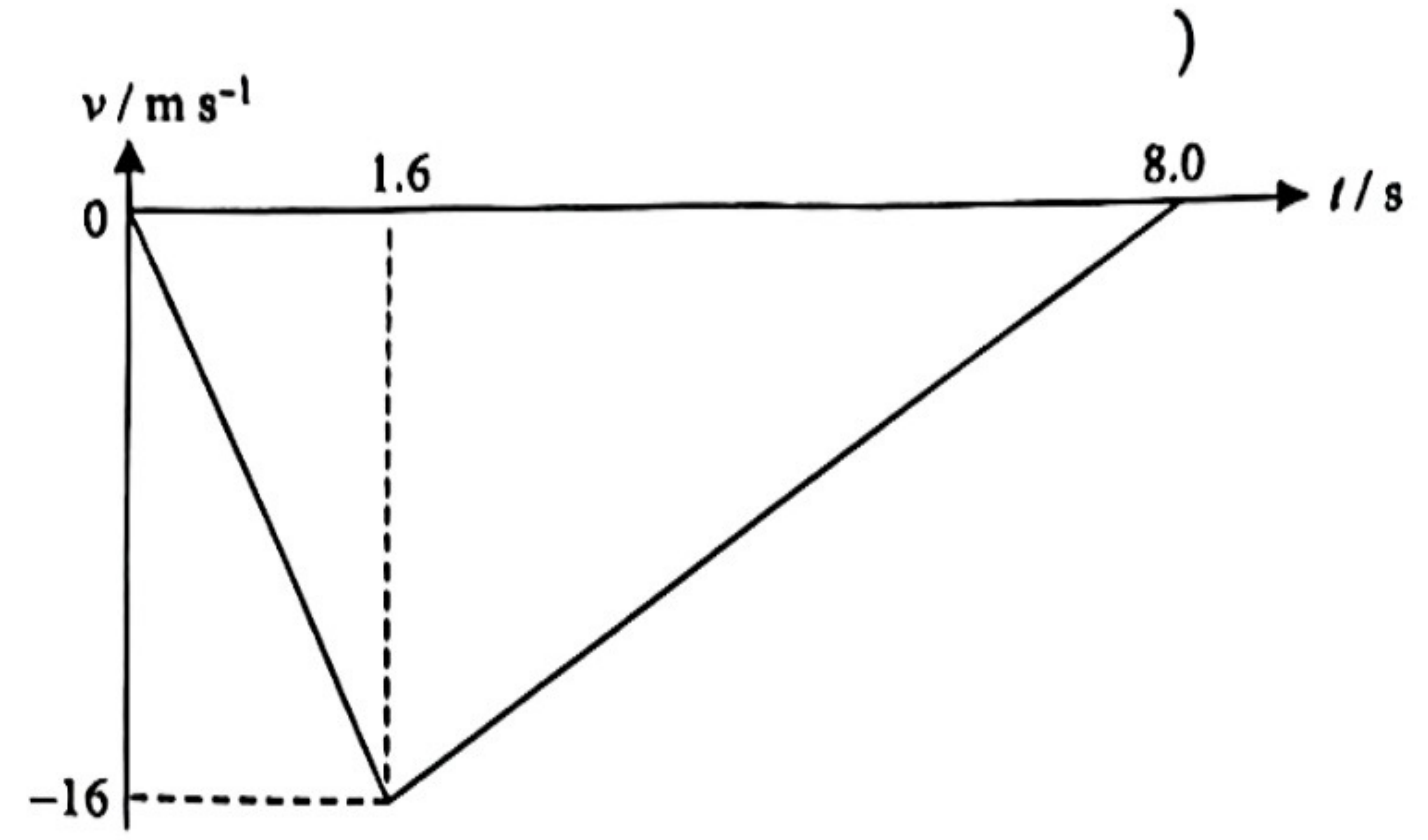


Figure (b)

Figure (a) shows a Mega Drop in an amusement park. The vehicle carrying a passenger of mass 60 kg is lifted up to the top of the tower. The vehicle then released from rest and falls down under gravity. When the vehicle gets close to the ground, it decelerates and finally stops at 8.0 s and reaches the bottom of the tower. The time variation of the velocity of the vehicle is shown in Figure (b). Upward direction is taken as positive. Take the acceleration due to gravity be 10 m s^{-2}.

(a) From the time $t = 0$ to $t = 1.6$ s, the passenger experiences weightlessness. Explain the reason. (1 mark)

....

....

(b) Calculate the height of the tower. (2 marks)

....

....

....

(c) Calculate the magnitude of deceleration of the passenger from $t = 1.6$ s to $t = 8.0$ s. (1 mark)

....

....

....

(d) Determine the normal reaction force acting on the passenger from $t = 1.6$ s to $t = 8.0$ s. (2 marks)

....

....

....

....

(e) State a safety measure for the passenger. (1 mark)

....

....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

4.

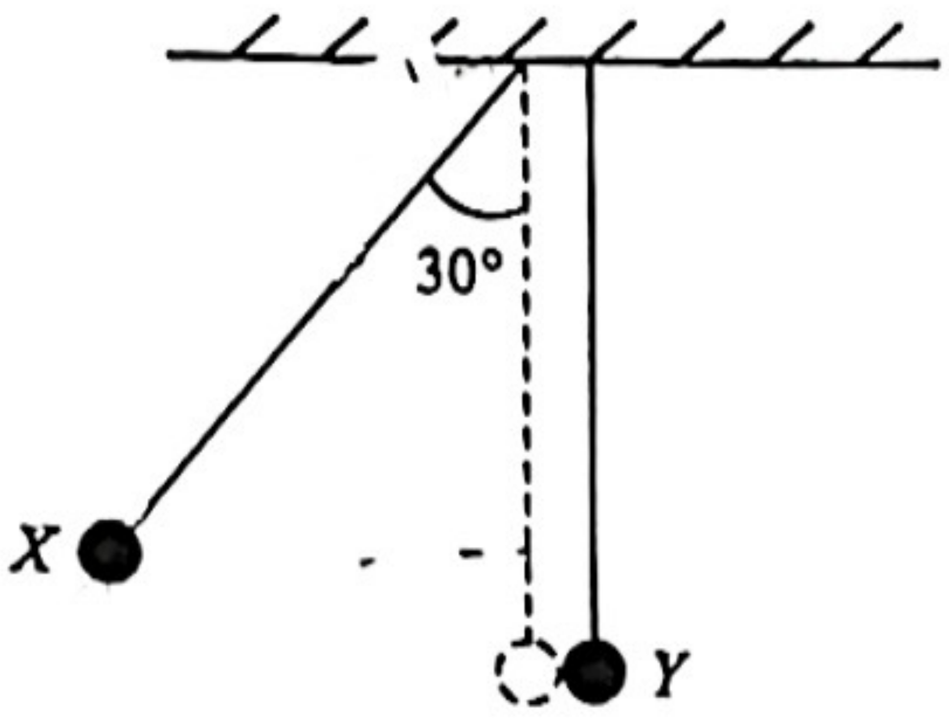


Figure (a)

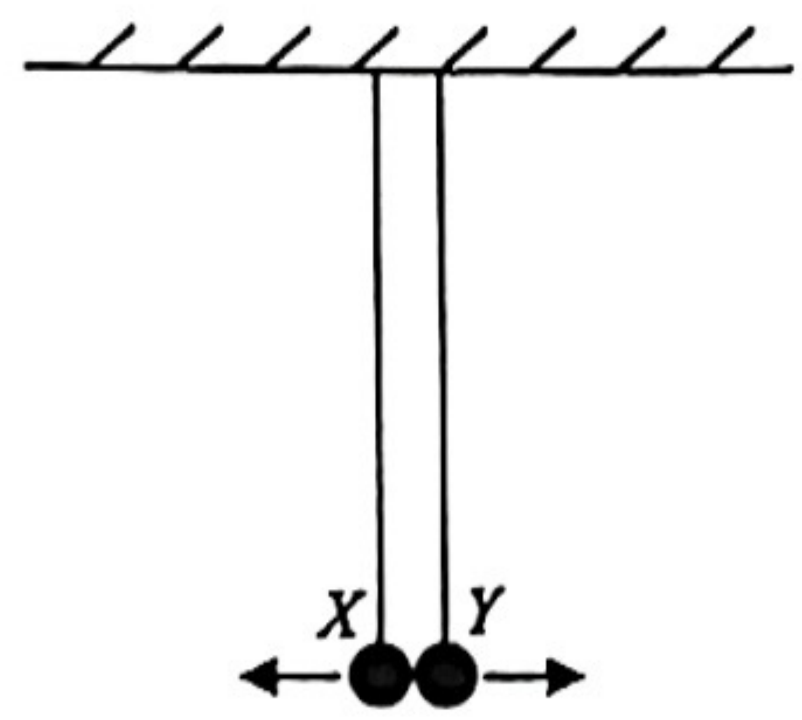


Figure (b)

Two metal balls X and Y of mass 0.45 kg and 0.75 kg respectively are suspended by light inextensible strings of length 1.2 m. Ball X is pulled to one side so that the string makes an angle of 30° with the vertical, and it is then released as shown in Figure (a). After colliding with ball Y, the two balls move away in opposite directions as shown in Figure (b).

(a) Calculate the speed of ball X just before it collides with ball Y. (2 marks)

(b) Calculate the tension in the string attaching ball X just before ball X hits ball Y. (2 marks)

(c) After colliding with ball Y, ball X moves away with a speed of 0.32 m s^{-1}. Calculate the speed of ball Y just after the collision. (2 marks)

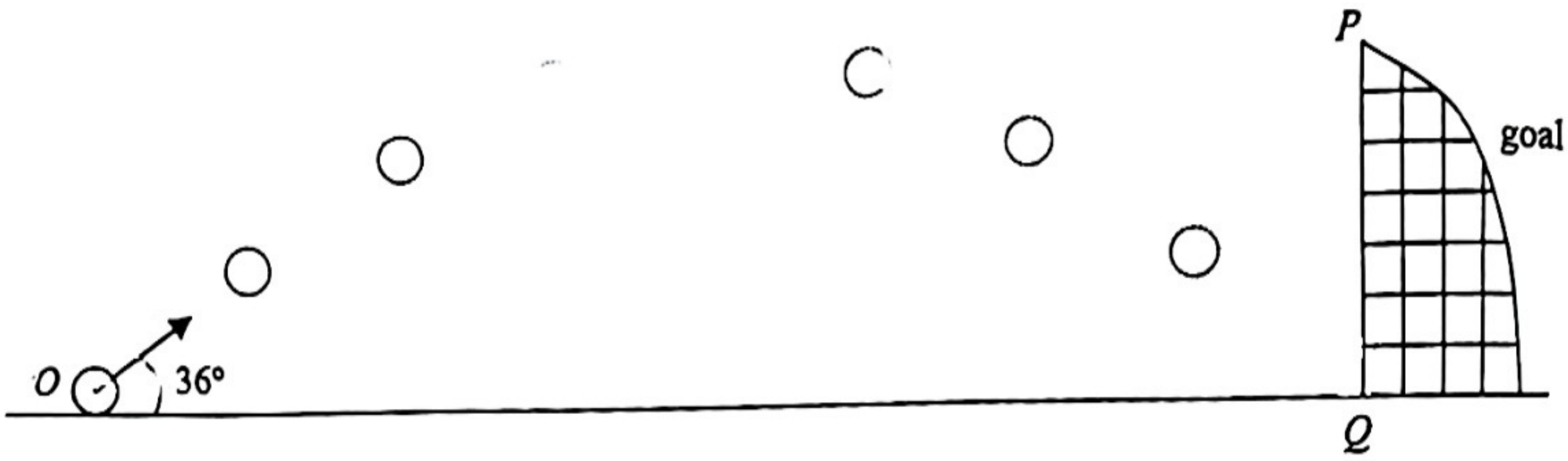
(d) Explain whether the collision is elastic or not. Show your calculation. (3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 樂理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

5.



A ball of mass 420 g is kicked to move with an initial velocity u, making an angle of 36° with the horizontal. After reaching the highest point, the ball hits the ground at point Q, just at the edge of the goal as shown in the above figure. At the highest point, the kinetic energy of the ball is 14.9 J. Neglect air resistance and size of the ball.

(a) Calculate the initial velocity u of the ball at the starting point O. (2 marks)

....

....

....

....

(b) Calculate the maximum height H reached by the ball. (2 marks)

....

....

....

....

(c) Calculate the distance between the starting point O and the final point Q. (2 marks)

....

....

....

....

....

(d) If the ball is kicked with another initial velocity of 15 m s^{-1} at a suitable angle from point O, it will hit the top of the goal P with a velocity of 13.5 m s^{-1}. Find the height of the top P above the ground. (2 marks)

....

....

....

....

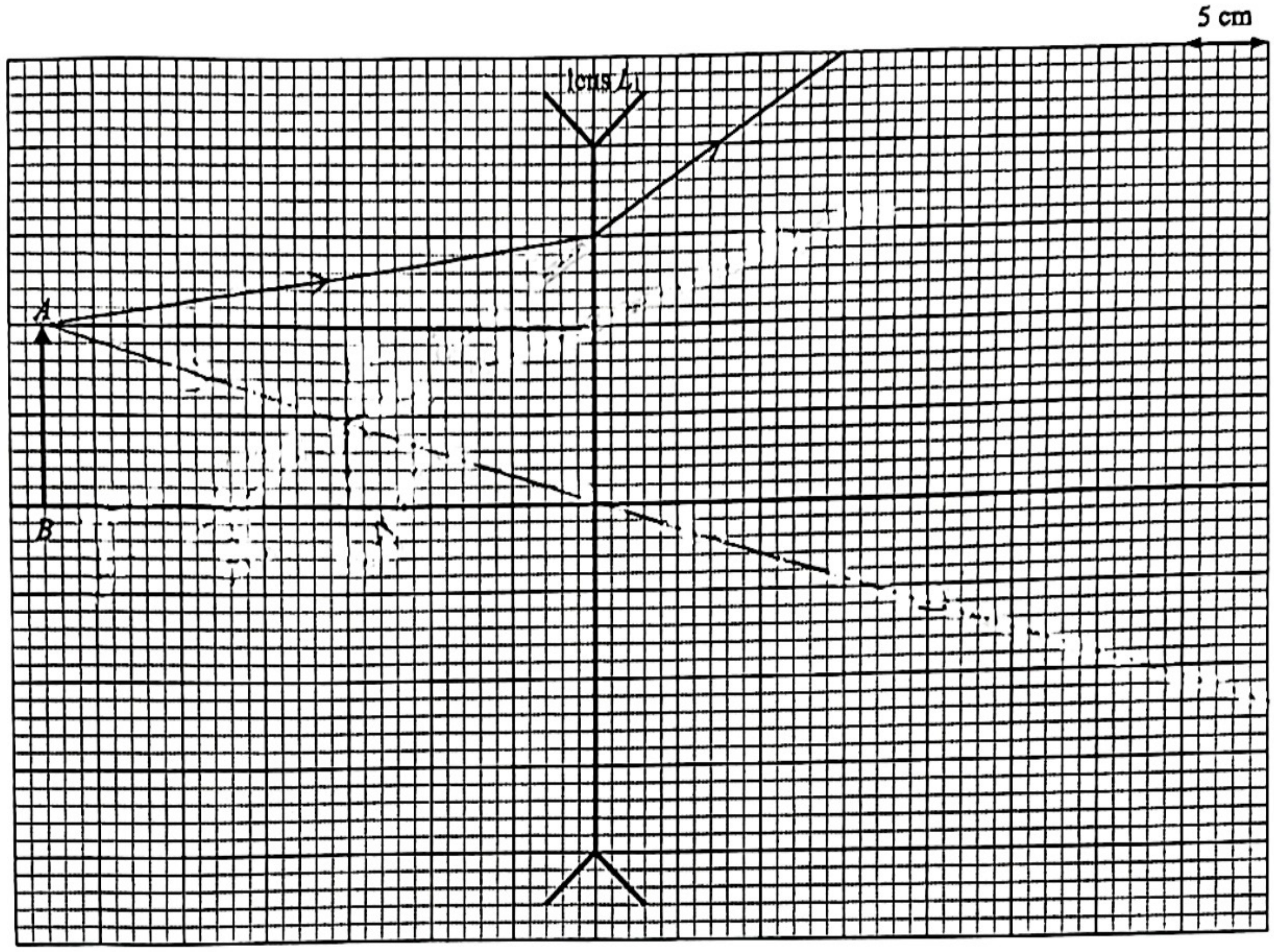
....

Answers written in the margins will not be marked

Answers written in the margins will not be marked.

GROUP BEACON® 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

6.



An object AB is placed in front of a concave lens L_1. A light ray emitted from A is refracted as shown in the figure.

(a) By drawing a suitable light ray, draw the image $A'B'$ in the above figure. (2 marks)

(b) By adding a suitable light ray, indicate the position of the principal focus F of the concave lens in the above figure. (1 mark)

(c) State the direction of movement of the lens so that a larger image can be observed by the lens. (1 mark)

....

(d) Concave lens is used in the peep-hole of the main door. State the reason of using a concave lens in such an application. (1 mark)

....

....

(e) If the above concave lens L_1 is replaced by another convex lens L_2 at the same position, calculate the focal length of L_2 so that an erect image with linear magnification of 2.5 can be obtained. (2 marks)

....

....

....

....

....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

7.

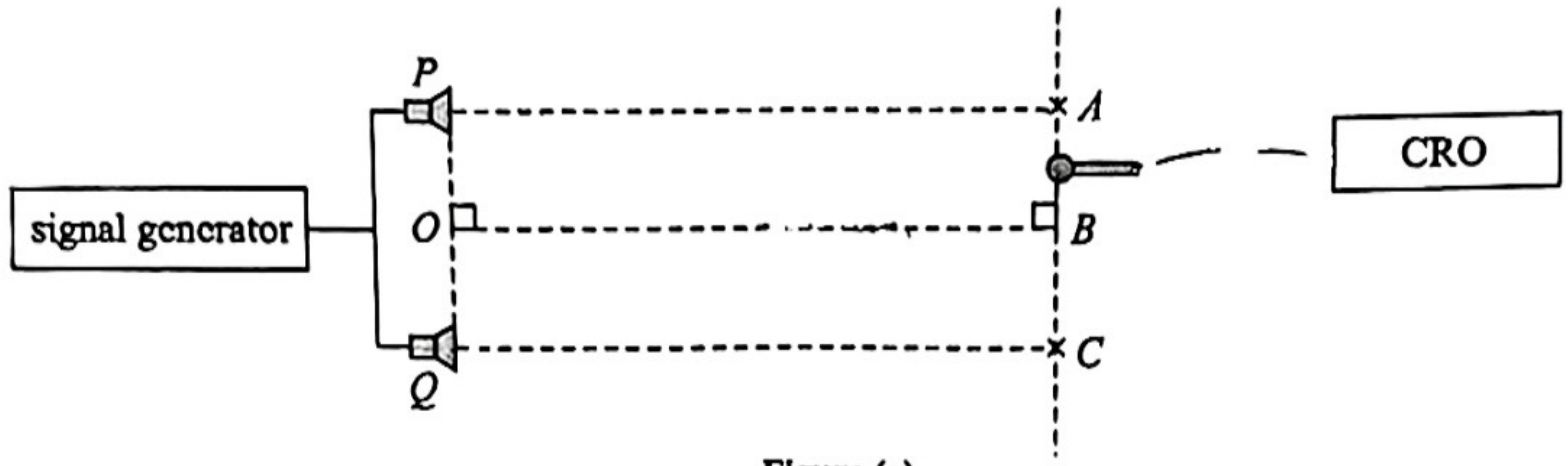


Figure (a)

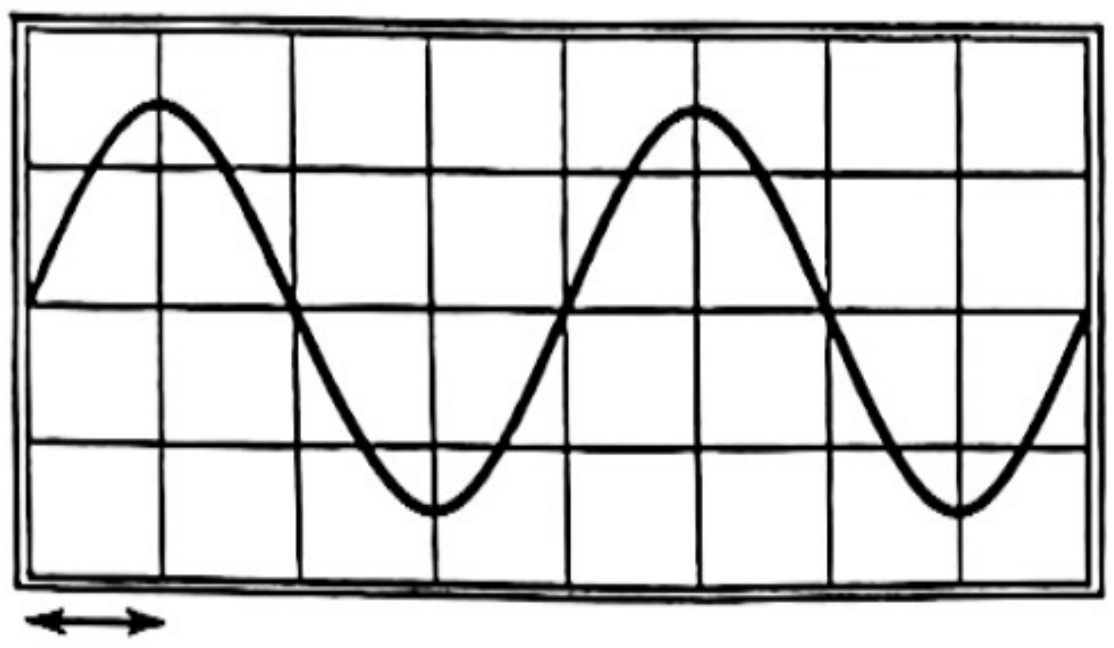


Figure (b)

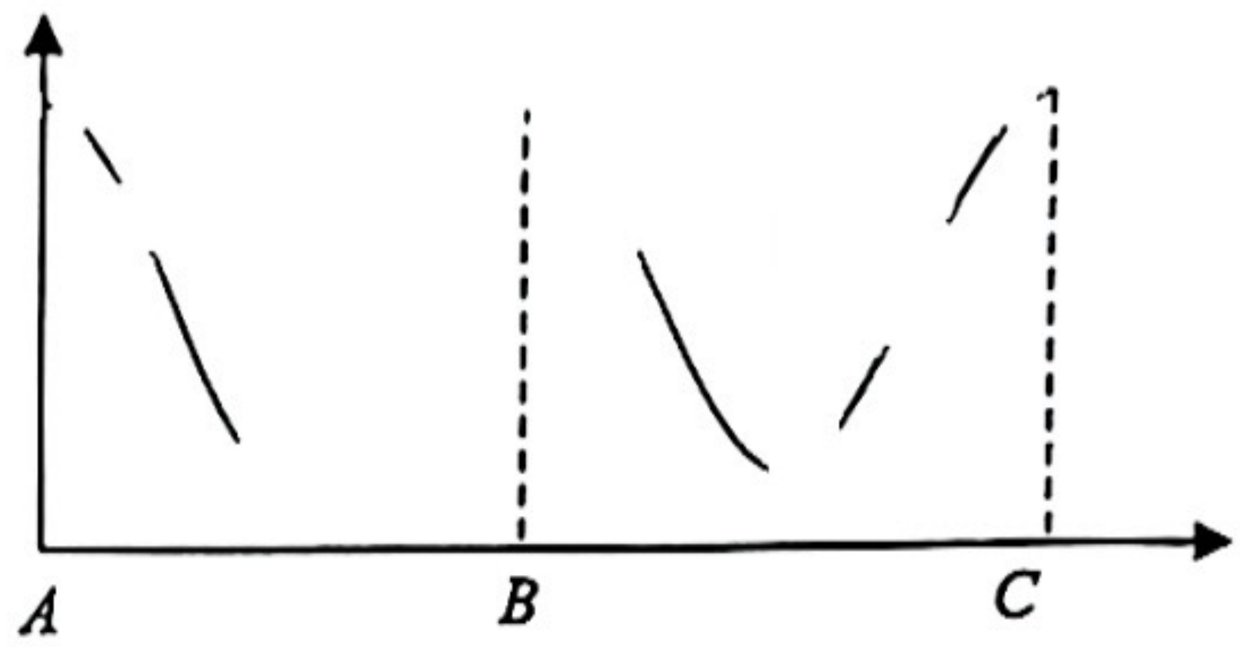


Figure (c)

Two identical loudspeakers P and Q are connected to a signal generator as shown in Figure (a). A microphone connected to a CRO is moves along ABC to measure the loudness of the sound. At position A, the trace of CRO is shown in Figure (b). The time-base scale of the CRO is 0.2 ms div^{-1}. The loudness along ABC is shown in Figure (c). The distance PA and QA are 1.06 m and 1.32 m respectively.

(a) Calculate the frequency of the sound emitted by the signal generator. (2 marks)

....

....

(b) Determine the wavelength of the sound wave. (1 mark)

....

....

(c) Calculate the speed of sound wave in air. (2 marks)

....

....

(d) If the microphone is moved along OB, describe and explain the loudness observed. (2 marks)

....

....

....

(e) Other than background noise, state ONE more reason that the loudness is not zero at points of destructive interference. (1 mark)

....

....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

8.

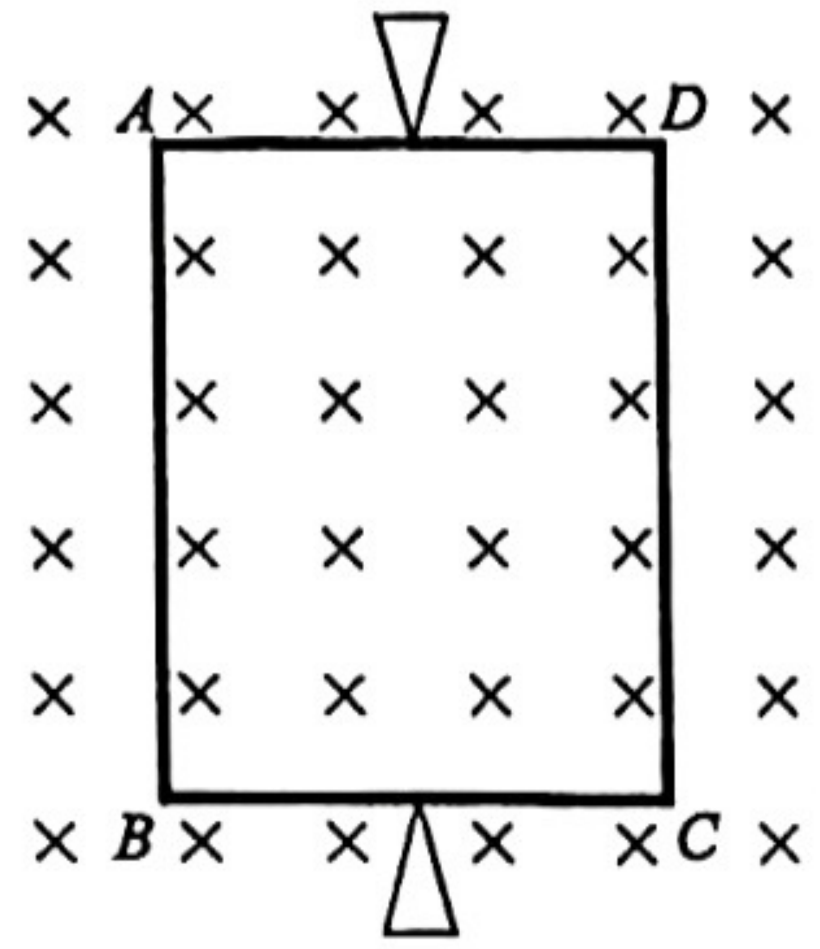


Figure (a)

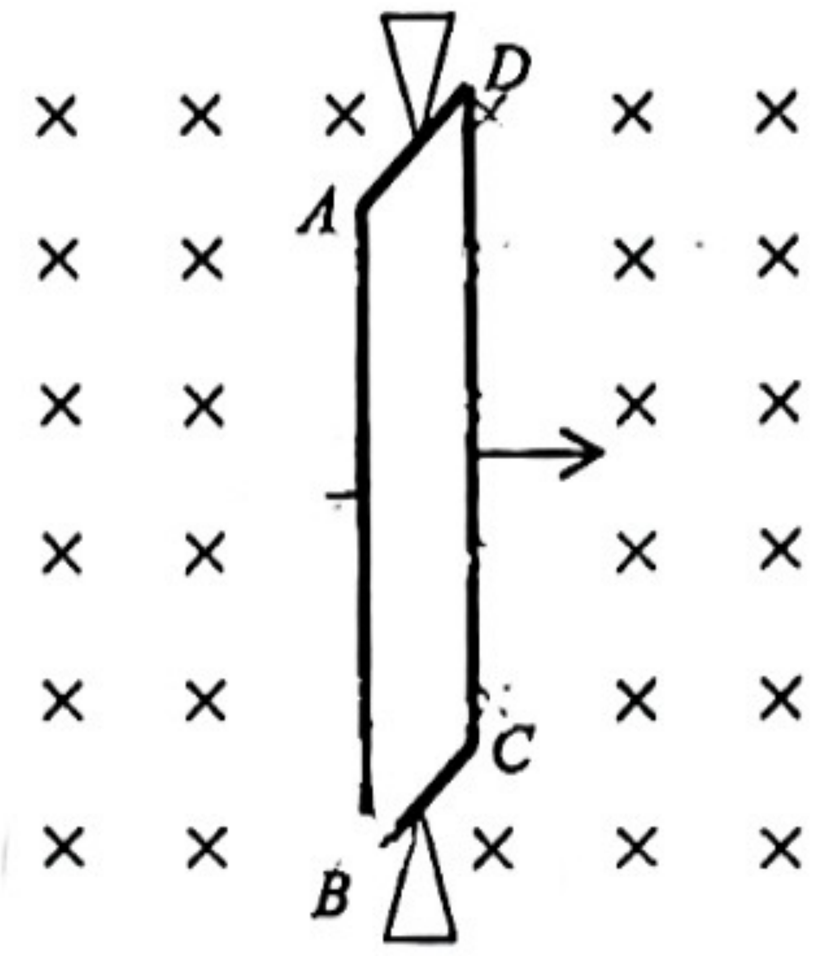


Figure (b)

A rectangular loop of one single turn is pivoted by two smooth vertical supports as shown in Figure (a). The length of the side *AB* is 20 cm and length *BC* is 16 cm. It is placed in a region with uniform field of 0.24 T pointing into paper. The resistance of the coil is 4 Ω.

(a) Calculate the magnetic flux through the loop in the above figure. (2 marks)

....

....

....

(b) If the strength of the magnetic field gradually decreases to zero within 1.5 s, calculate the magnitude of the average induced current in the loop in this period. State the direction of the induced current. (3 marks)

....

....

....

....

(c) Suppose now a student rotates the loop continuously with a constant angular speed of 3.6 rad s^{-1} about an axis through the two supports. At a certain instant, the position of the loop is perpendicular to the direction of the magnetic field as shown in Figure (b). At this instant, side *AB* is moving leftwards and side *CD* is moving rightwards.

(i) Find the induced e.m.f. at the side *AB*. State which point (*A* or *B*) is at a higher potential. (3 marks)

....

....

....

(ii) State the direction of magnetic force acting on side *AB* at this instant. (1 mark)

....

(iii) State the source of electrical energy of the induced current in the loop. (1 mark)

....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 遊理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

9. You are given the following apparatus :

① a bottle of iron filings

② a bar magnet

③ a piece of transparent cardboard

(a) Describe the experimental procedure that have to be followed so as to observe the magnetic field pattern produced by a bar magnet. (3 marks)

(b) Sketch the magnetic field pattern around a bar magnet. Indicate the direction of the magnetic field lines. (2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON® 燈理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

10. (a) A light bulb has rating values of '220 V, 100 W'. When it is used in foreign countries with a.c. mains supply of 120 V, a transformer *X* is used to give normal operation of the light bulb. The primary coil of the transformer *X* has 5280 turns and its efficiency is 80%.

(i) Find the number of turns in the secondary coil of the transformer *X*. (1 mark)

....

....

....

....

(ii) Calculate the operation resistance of the light bulb. (2 marks)

....

....

....

....

(iii) Find the primary current of the transformer *X*. (2 marks)

....

....

....

....

(iv) If another transformer *Y* that has higher efficiency than *X* is now used to give normal operation of the light bulb, state the change of the power input and power output compared with the transformer *X*. (2 marks)

....

....

(b) Explain why a.c and high voltages are used for long distance power transmission. (3 marks)

....

....

....

....

....

....

....

....

....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

11. In a hospital, radioactive waste produced by iodine-125 is stored in a special room before final disposal. The half-life of iodine-125 is 60 days and it emits β radiation. Suppose a batch of waste with activity 4.5×10^6 Bq is deposited into the room. Given that the molar mass of iodine-125 is 125 g mol^{-1}.

(a) After the deposition, calculate the number of β particles emitted by the batch in one hour. (1 mark)

(b) Calculate the mass of iodine-125 inside the batch when it is just put into the room. (3 marks)

(c) The batch has to be stored until the activity drops to 450 Bq before final disposal. Calculate the number of days that the batch has to be stored inside the room. (2 marks)

(d) State one application that radioactive substance can be used in hospital. (1 mark)

END OF PAPER

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Hong Kong Diploma of Secondary Education Examination

2018

Mock Examination

PHYSICS PAPER 2

Question-Answer Book

(1 hour)

This paper must be answered in English

Please stick the barcode label here.

Candidate Number									

INSTRUCTIONS

(1) After the announcement of the start of the examination, you should first write you Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided.

(2) This paper consists of **FOUR** sections, Section A, B, C and D. Each section contains eight multiple-choice questions and one structured question which carries 10 marks. Attempt **ALL** question in any **TWO** sections.

(3) Write your answers to the structured questions in the **ANSWER Book** provided. For multiple-choice questions, blacken the appropriate circle with an HB pencil. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

(4) Graph paper and supplementary answer sheets will be provided on request. Write your candidate number, mark the questions box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this Question-Answer Book.

(5) The Question-Answer Book and Answer Book will be collected **SEPARATELY** at the end of the examination.

(6) The diagrams in this paper are **NOT** necessarily drawn to scale.

(7) The last two pages of this Question-Answer Book contain a list of data, formulae and relationship which you may find useful.

(8) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

GROUP BEACON* 導理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Section A : Astronomy and Space Science

Q.1 : Multiple-choice questions

1.1 Venus is said to be a morning and evening star. Which of the following statements is/are correct ?

(1) Venus can never be seen in the mid night from the Earth.
(2) The reason that Venus is a morning and evening star can only be explained by Copernican's heliocentric model but not by Ptolemy's geocentric model.
(3) Throughout the year, Venus can be seen in the morning and in the evening.

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

A B C D

1.2 Which of the following ideas are proposed by Kepler ?

(1) The orbits of planets around the Sun are elliptical.
(2) The planets move around the Sun with varying speed.
(3) The period of a planet around the Sun is proportional to the average radius of the planet from the Sun.

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

A B C D

1.3 A satellite orbits around the Earth at a height of 5000 km with a period T. What is the period of another satellite orbiting the Earth at a height of 10000 km ? Given that the radius of the Earth is 6400 km.

A. 1.4 T
B. 1.7 T
C. 2.2 T
D. 2.8 T

A B C D

1.4 The gravitational potential energy of a mass 5 kg at the surface of a planet is -5×10^7 J relative to infinity. What is the speed of escape at the surface of this planet ?

A. 3160 m s^{-1}
B. 3850 m s^{-1}
C. 4260 m s^{-1}
D. 4470 m s^{-1}

A B C D

1.5 The luminosity of a star is 6.8×10^{26} W. The brightness of the star observed on the Earth is 3.63×10^{-10} W m^{-2}. What is the parallax of the star ?

A. 0.02 arcsecond
B. 0.04 arcsecond
C. 0.06 arcsecond
D. 0.08 arcsecond

A B C D

GROUP BEACON 燈理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

1.6 The table below shows the apparent magnitudes and absolute magnitudes of three stars.

star	apparent magnitude	absolute magnitude
X	−1.2	2.4
Y	4.8	0.2
Z	1.4	−3.5

Which of the following statements is/are correct ?

(1) The distance of star X from the Earth is less than 10 pc.
(2) Star Y has the smallest parallax among the three stars.
(3) Star Z has the highest surface temperature among the three stars.

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

A B C D

O O O O

1.7 A star has a surface temperature of 8500 K. It is at a distance of 75 pc from the Earth. The brightness of the star observed on the Earth is 25×10^{-8} W m^{-2}. Determine the radius of the star.

A. 4.12×10^{10} m
B. 5.38×10^{10} m
C. 6.74×10^{10} m
D. 8.26×10^{10} m

A B C D

O O O O

1.8 In the Milky Way Galaxy, the Sun rotates around the Galactic centre with a rotational radius of 8 kpc and a rotational speed of 2.2×10^8 years. Assume most of the mass of the Galaxy is concentrated at its centre, which of the following deductions is/are correct ?

(1) The rotational speed of the Sun around the centre of the Galaxy is 224 km s^{-1}.
(2) The mass of the Galaxy is estimated to be about 2×10^{41} kg.
(3) For those stars further away from the centre of the Galaxy than the Sun, their rotational speeds are rather constant.

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

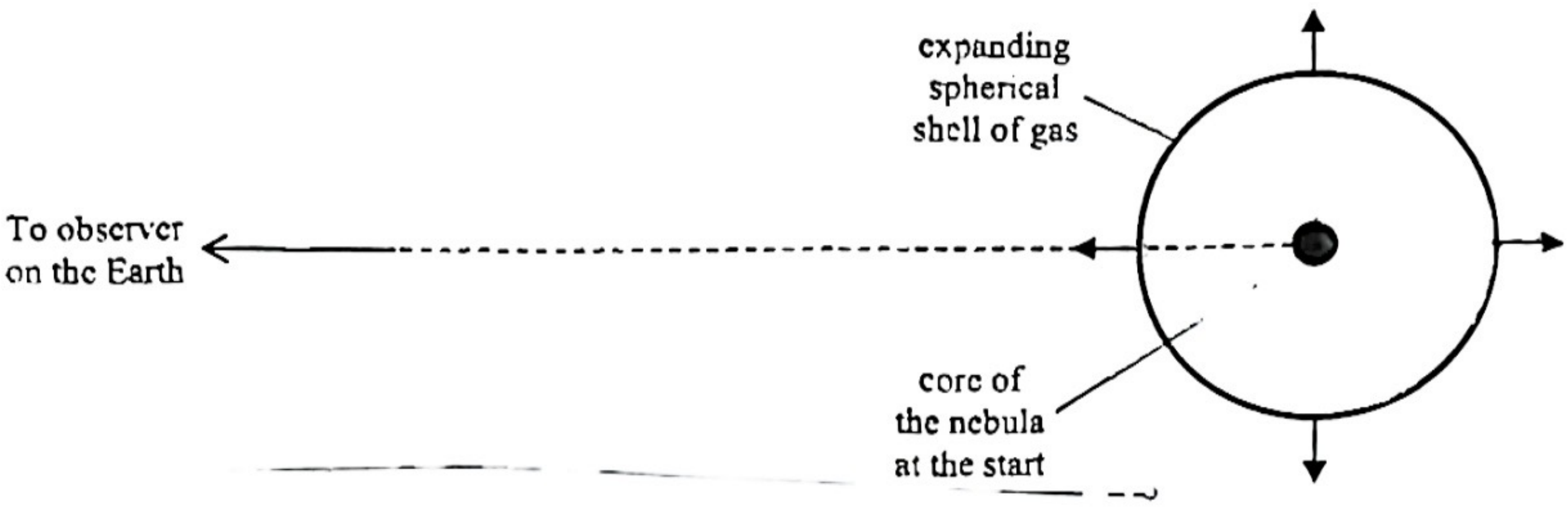
A B C D

O O O O

GROUP BEACON* 港理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Q.1 : Structural question

(a) A nebula X is an expanding spherical shell of gas in the Milky Way Galaxy. It is at a distance of 850 pc from the Earth. The velocity of the nebula relative to the Earth is assumed negligible. In the year 2000 A.D., the nebula is observed to have a diameter of 1.5 light year and the surface is expanding with a velocity of 500 km s^{-1}.



(i) Calculate the apparent angular size of the nebula observed from the Earth. Express the answer in arcminute. (2 marks)

(ii) The light spectrum emitted by the expanding gas of the nebula consists of a spectral line L. The spectral line L observed in the laboratory has a wavelength of 572.36 nm. What should be the apparent wavelength observed in the spectrum of the nebula ? (3 marks)

(iii) The Nebula was formed by the explosion of a star whose size was negligible compared with the present size of the nebula. Assume the expansion speed of the gas remains constant throughout the history of the nebula, determine the year that the nebula was formed. (2 marks)

(b) A star has angular shift of 0.48 arcsecond when it is observed from the two opposite extremes of the Earth's orbit.

(i) What is the distance of this star from the Earth ? (1 mark)

(ii) Describe a method to estimate the surface temperature of this star. (2 marks)

GROUP BEACON 滙理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA

Section B : Atomic World

Q.2 : Multiple-choice questions

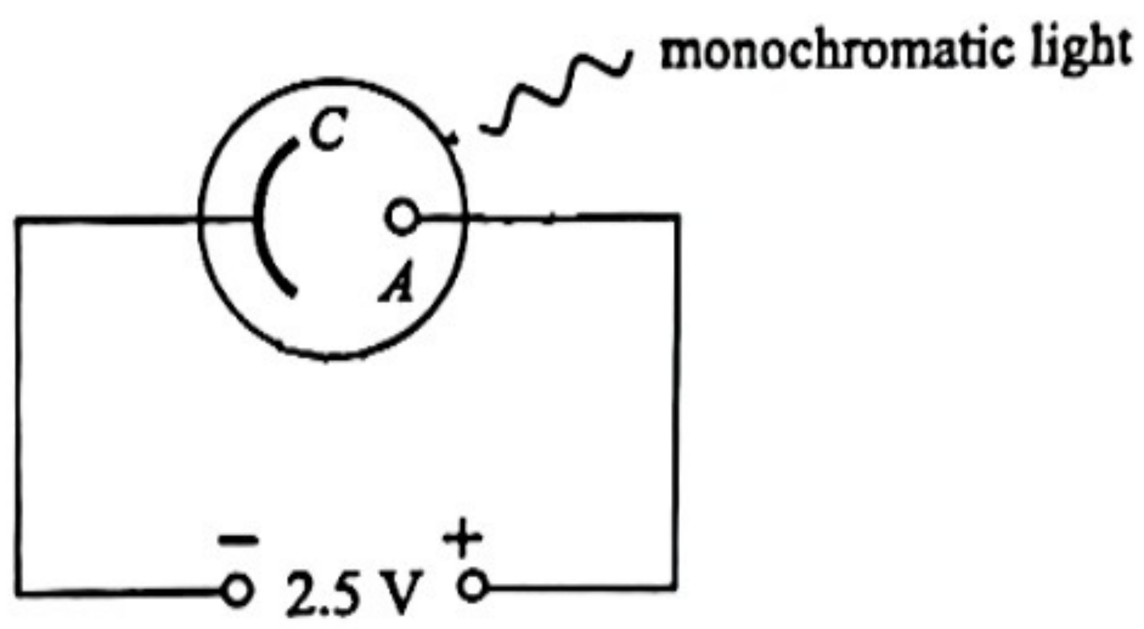
2.1 Which of the following statements concerning the nuclear model of atom proposed by Rutherford is/are **NOT** correct ?

(1) The protons and neutrons are inside the nucleus.
(2) The electrons can only stay in certain orbits without radiation of energy.
(3) Inside the atom, most of the space is empty.

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

A B C D

2.2



A photocell is connected to a 2.5 V d.c. supply as shown in the above figure. A monochromatic light beam with wavelength 450 nm is incident onto the cathode *C*. The maximum kinetic energy of the photoelectrons reaching anode *A* is 4 eV. What is the longest wavelength of incident radiation that can cause photoelectrons to be emitted from cathode *C* ?

A. 6.64×10^{-7} m
B. 7.85×10^{-7} m
C. 8.25×10^{-7} m
D. 9.85×10^{-7} m

A B C D

2.3 Given that the orbital radius r_n of the electron in a hydrogen atom from the Bohr model is equal $5.3 \times 10^{-11} n^2$ m, where n is the quantum number. Calculate the momentum of the electron in the first excited state ($n = 2$).

A. 6.66×10^{-25} N s
B. 7.89×10^{-25} N s
C. 8.82×10^{-25} N s
D. 9.95×10^{-25} N s

A B C D

2.4 A hydrogen atom is at the ground state. A photon of energy 15 eV hits the atom. Which of the following may happen ?

(1) An inelastic collision occurs for the hydrogen atom and the photon.
(2) The photon is absorbed by the hydrogen atom.
(3) The hydrogen atom is excited to a higher energy level.
(4) The hydrogen atom is ionized.

A. (1) and (3) only
B. (1) and (4) only
C. (2) and (3) only
D. (2) and (4) only

A B C D

GROUP BEACON• 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

2.5 In a Transmission Electron Microscope, electrons with de Broglie wavelength of 4×10^{-11} m are used to give image of the sample. What should be the voltage of the anode relative to the cathode in the microscope ?

A. 603 V
B. 720 V
C. 837 V
D. 943 V

A B C D

2.6 A magnifying glass is used to observe small objects. Which of the following can increase the resolving power of the magnifying glass ?

(1) Increase the diameter of the magnifying glass.
(2) Increase the distance of the object from the magnifying glass.
(3) Increase the magnifying power of the magnifying glass.

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

A B C D

2.7 In hydrogen atom, a series of infra-red radiation is emitted when the excited atom transits from higher energy level to the second excited state. Calculate the shortest wavelength of this series of radiation.

A. 7.82×10^{-7} m
B. 8.23×10^{-7} m
C. 8.56×10^{-7} m
D. 8.94×10^{-7} m

A B C D

2.8 Lotus leaves are covered with nanoscale waxy bumps that give rise to the Lotus effect. Which of the following statements is/are correct ?

(1) The waxy bumps can be observe by using high power optical microscope.
(2) The waxy bumps attract water molecules to adhere onto the surface of the leaves.
(3) Application of Lotus effect on the cloth surface gives self-cleaning effect.

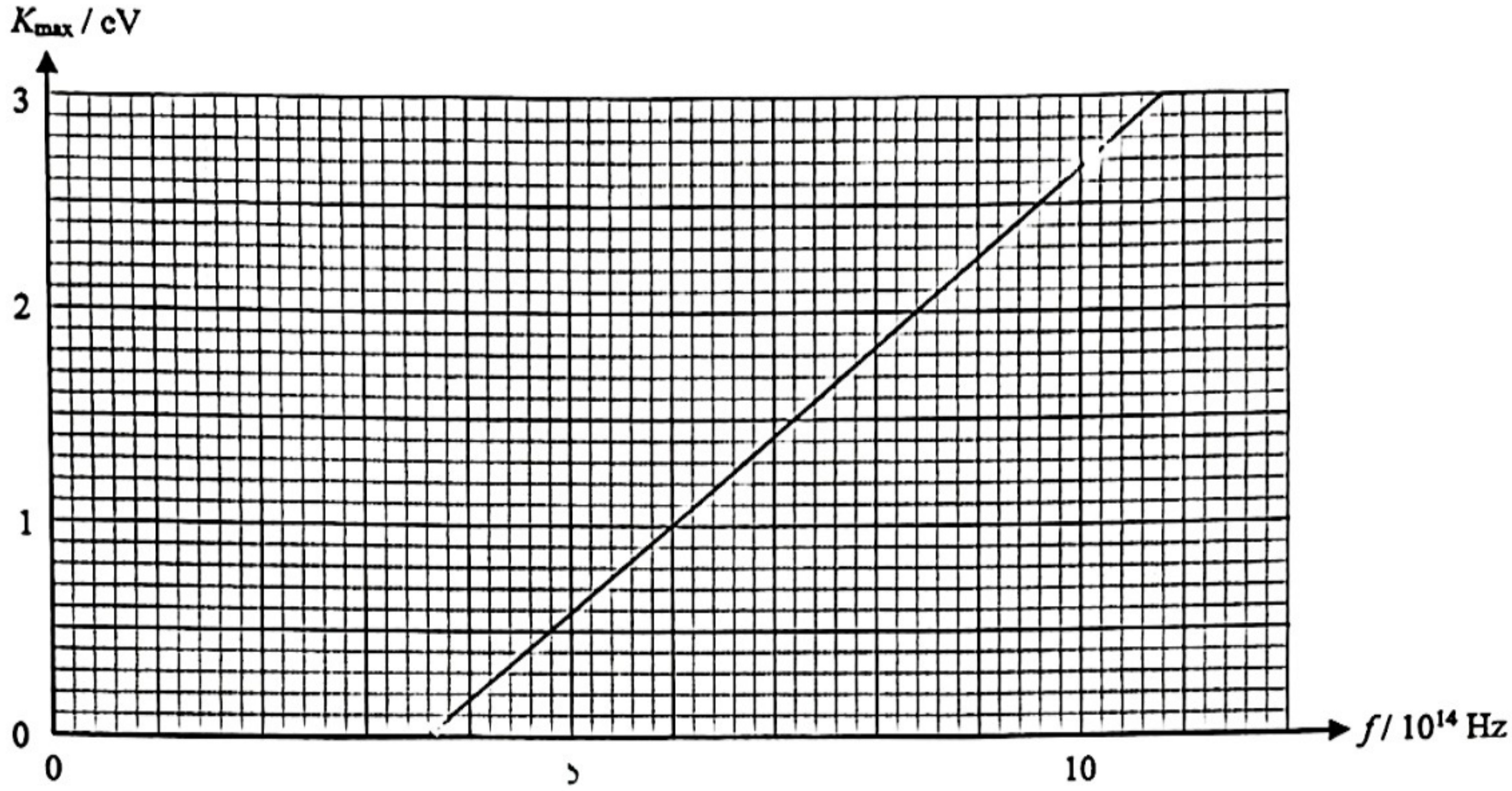
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

A B C D

GROUP BEACON 境理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA

Q.2 : Structural question

The graph below shows the variation of the maximum kinetic energy K_{max} of photoelectrons emitted from the surface of the cathode metal X with the frequency f of the incident radiation in a photocell.



(a) Calculate the work function of the metal X, expressed the answer in eV. (1 mark)

(b) Explain what is represented by the slope of the graph. (1 mark)

(c) Suppose a beam of incident light with intensity 1.25 W m^{-2} and wavelength 417 nm is incident onto the cathode metal X in a photocell. The area of the cathode is 18 cm^2.

(i) From the above graph, determine the stopping potential V_S. (2 marks)

(ii) Calculate the number of photons incident onto the cathode surface in one second. (2 marks)

(iii) Assume 5% of the incident photons can cause the emission of electrons from the cathode surface, determine the saturation current of the photocell. (2 marks)

(d) Suppose another beam of incident light with double intensity but the same wavelength as that in part (c) is incident onto the cathode metal X.

(i) State the change of the maximum kinetic energy of the photoelectrons. (1 mark)

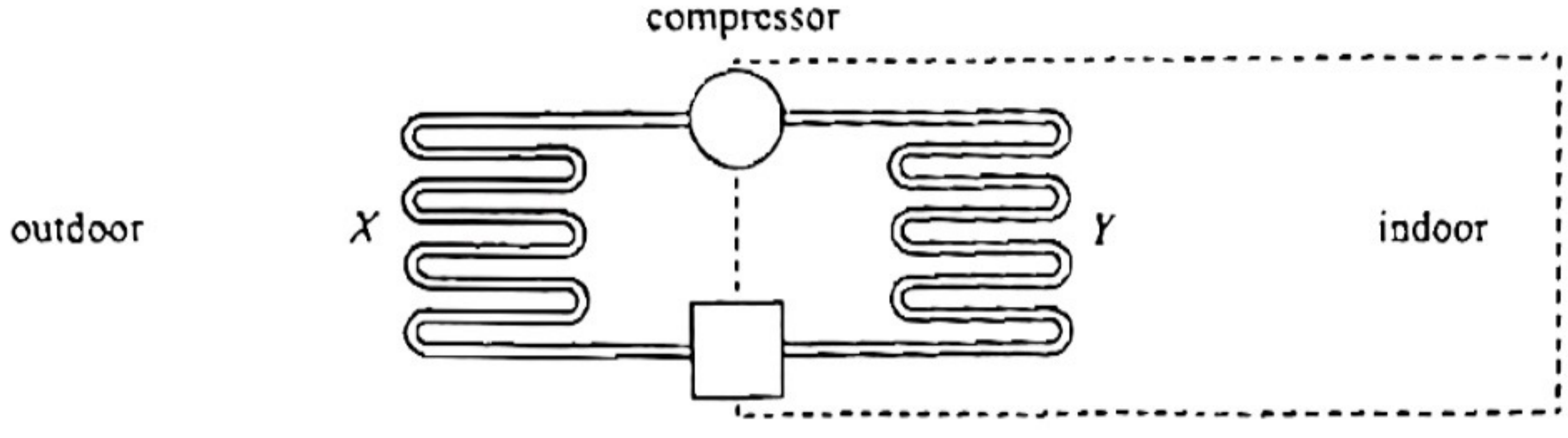
(ii) Explain why the above observation contradicts with the wave theory of light. (1 mark)

GROUP BEACON• 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Section C : Energy and Use of Energy

Q.3 : Multiple-choice questions

3.1



The above figure shows a simplified schematic diagram of an air-conditioner. Which of the following statements concerning its working is **NOT** correct ?

A. The flow of refrigerant through the compressor is from X to Y.
B. Component X is the condenser.
C. The refrigerant changes from liquid to vapour in component Y.
D. The lowest temperature of the refrigerant is at the component Y.

A B C D
○ ○ ○ ○

3.2 A small lamp is installed inside a room as the only light source. At a point 2.6 m directly below the lamp, the illuminance is 20 lux. If the current drawn from the mains supply of 220 V is 114 mA, find the efficacy of the lamp.

A. 64 lm W^{-1}
B. 68 lm W^{-1}
C. 72 lm W^{-1}
D. 76 lm W^{-1}

A B C D
○ ○ ○ ○

3.3 The table below shows the data of a house.

	Windows	Walls
U-value / W m^{-2} K^{-1}	4.5	1.8
Total area / m^2	120	480

If the average temperature difference between the indoor and outdoor of the house is 8°C, calculate the Overall Thermal Transfer Value of the house.

A. 14.5 W m^{-2}
B. 16.2 W m^{-2}
C. 18.7 W m^{-2}
D. 19.8 W m^{-2}

A B C D
○ ○ ○ ○

3.4 A simple LED consists of a PN-junction. Which of the following statements concerning the operation of the LED is **NOT** correct ?

A. A monochromatic light is given out due to the fixed energy levels of the p-layer and n-layer.
B. The electric field inside the junction directs from the p-layer to n-layer.
C. A light photon is given out when an electron-hole pair is created.
D. The LED requires a d.c. supply for operation.

A B C D
○ ○ ○ ○

GROUP BEACON 保理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA

3.5 Given that the mass of a proton is 1.0073 u and that of a neutron is 1.0087 u. If the average binding energy per nucleon of a $^{235}_{92}U$ nucleus is 7.50 MeV/nucleon, calculate the mass of a $^{235}_{92}U$ nucleus.

A. 235.0226 u
B. 235.0842 u
C. 235.1426 u
D. 235.1834 u

A B C D
○ ○ ○ ○

3.6 Which of the following statements concerning a nuclear fission reactor that generates electricity is/are correct ?

(1) The fuel rod should consist of pure uranium-235.
(2) The moderator is used to increase the speed of the fission neutrons so as to increase the chance of neutron-capture by the uranium nuclei.
(3) The control rods are used to absorb excess fission neutrons so that on average only one neutron is released in each fission.

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

A B C D
○ ○ ○ ○

3.7 A wind farm installs 30 wind turbines to generate electrical energy. Each turbine has 2 blades with each blade 25 m long. The overall efficiency of the turbines is 35%. If the total electrical power generated by the wind farm is 30 MW, what is the wind speed blowing normally towards the turbines ? Assume air has a constant density of 1.2 kg m^{-3}.

A. 12.3 m s^{-1}
B. 13.4 m s^{-1}
C. 14.8 m s^{-1}
D. 15.2 m s^{-1}

A B C D
○ ○ ○ ○

3.8 A power plant gives out a steady electrical power output of 500 MW throughout a day of 24 hours. A pump storage system is built near the power plant. The height between the upper reservoir and the lower reservoir is 120 m. During the low demand period, the average demand of power is only 320 MW. The excess power is used to pump water from the lower reservoir to the upper reservoir. If the efficiency of the pump storage system is 72%, calculate the average mass flow rate of the pumping water. Given that the density of water is 1000 kg m^{-3}.

A. 1.1×10^5 kg s^{-1}
B. 1.5×10^5 kg s^{-1}
C. 2.4×10^5 kg s^{-1}
D. 3.2×10^5 kg s^{-1}

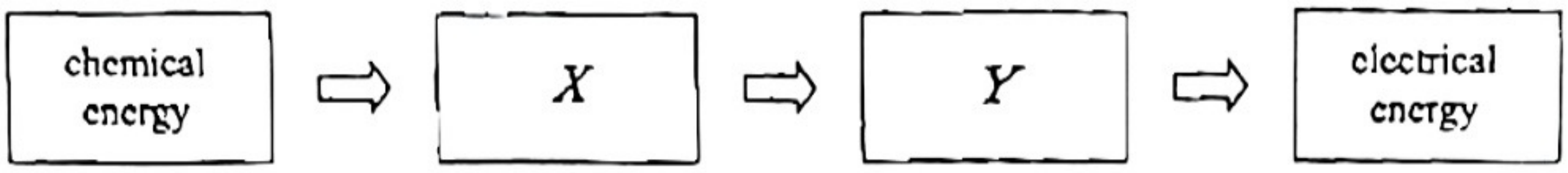
A B C D
○ ○ ○ ○

GROUP BEACON 燈理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Q.3 : Structured question

(a) (i) Briefly explain the origin of fossil fuel. (1 mark)

(ii) The following block diagram shows the conversion of energy in a coal-fired power plant.



The chemical energy of coal is used to heat water into hot steam that drives turbine coupling to generator for the generation of electricity. State the types of energy that represent X and Y. (1 mark)

(iii) The percentage loss of energy during the generation process of electricity in the power plant is 60%. During the power transmission from the power plant to the consumer, there is 25% power loss. Calculate the overall efficiency of energy conversion that is obtained by consumers. (1 mark)

(b) A hybrid car has a petrol engine with a full power of 50 kW and a motor with a full power of 35 kW. The mass of the hybrid car is 950 kg. A regenerative braking system is also installed in the hybrid car.

(i) When the regenerative braking system is applied, state the conversion of energy that occurs. (1 mark)

(ii) The battery in a hybrid car does not require plug-in charging. Other than charging during braking, state another condition that the battery can be charged. (1 mark)

(iii) When the hybrid car accelerates from rest, the engine and motor works together to give full power. If the efficiency of energy conversion is 73%, find the time taken for the car to reach the speed of 100 km h^{-1}. (2 marks)

(iv) The hybrid car installs an air-conditioner system with COP 2.8. When the air-conditioner is in full operation, it can lower the temperature of air inside the car from 40°C to 25°C within 1.2 minutes. Given that the heat capacity of air inside the car is 1850 J $°C^{-1}$. Calculate the power rating of the air-conditioner. (2 marks)

(v) The time of cooling should be longer in actual situation. State ONE reason. (1 mark)

GROUP BEACON® 思理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA

Section D : Medical Physics

Q.4 : Multiple-choice questions

4.1 John is a youngster. He wears spectacles with power + 2.75 D to correct his eye defect so that he can view clearly near object at 25 cm. Which of the following statements concerning his eye defect are correct ?

(1) John is suffering from long sight.
(2) John's eye-lens is too thick.
(3) The near point of John's eye is at 80 cm.

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

A B C D
○ ○ ○ ○

4.2 Candy finds that she can just resolve two point objects at a small separation of 1.5 mm at a distance of 5.9 m. Assume that the average wavelength of visible light is 550 nm. Calculate the diameter of the pupils of Candy's eyes.

A. 2.6 mm
B. 2.8 mm
C. 3.0 mm
D. 3.2 mm

A B C D
○ ○ ○ ○

4.3 A small sound source gives out sound in all direction. At a distance of 4 m from the source, the sound intensity level is measured as 65 dB. Ignore the background noise, find the sound intensity level at a distance of 6 m from the sound source.

A. 58.5 dB
B. 60.4 dB
C. 61.5 dB
D. 63.2 dB

A B C D
○ ○ ○ ○

4.4 Which of the following statements about a fibre optic endoscope is **NOT** correct ?

A. A small tool can be used to cut tissue sample and transmitted through the tool channel.
B. All the light entering an optical fibre can be transmitted to the other end of the fibre.
C. The coherent bundle fibres can transmit the original colour of image to the observer.
D. A coherent bundle consists of finer fibres can transmit image with better resolution.

A B C D
○ ○ ○ ○

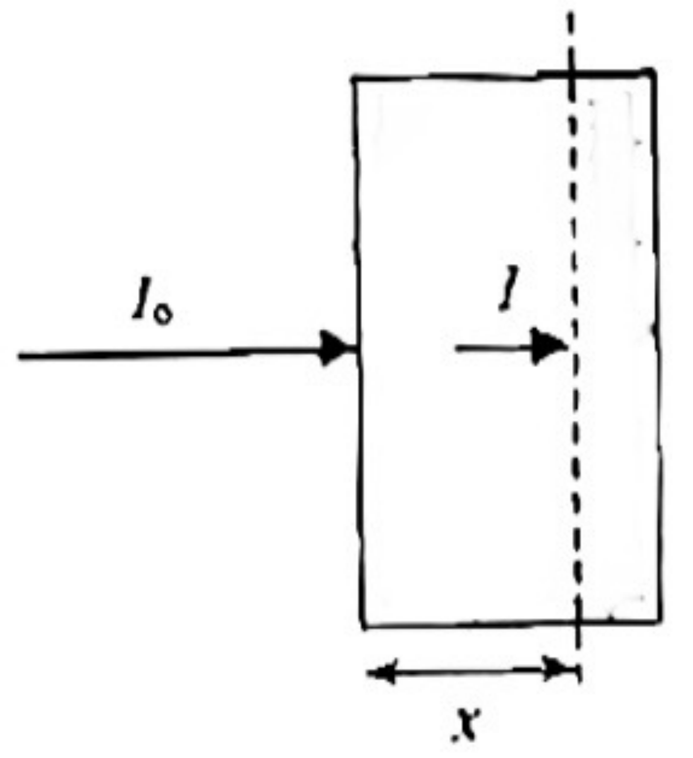
4.5 After taking radiographic imaging, the chest X-ray picture shows that there is a mass outside the lung of a patient. The doctor suspects that the mass is a lung cancer. To confirm the diagnosis, which of the following medical treatment is the most suitable to follow ?

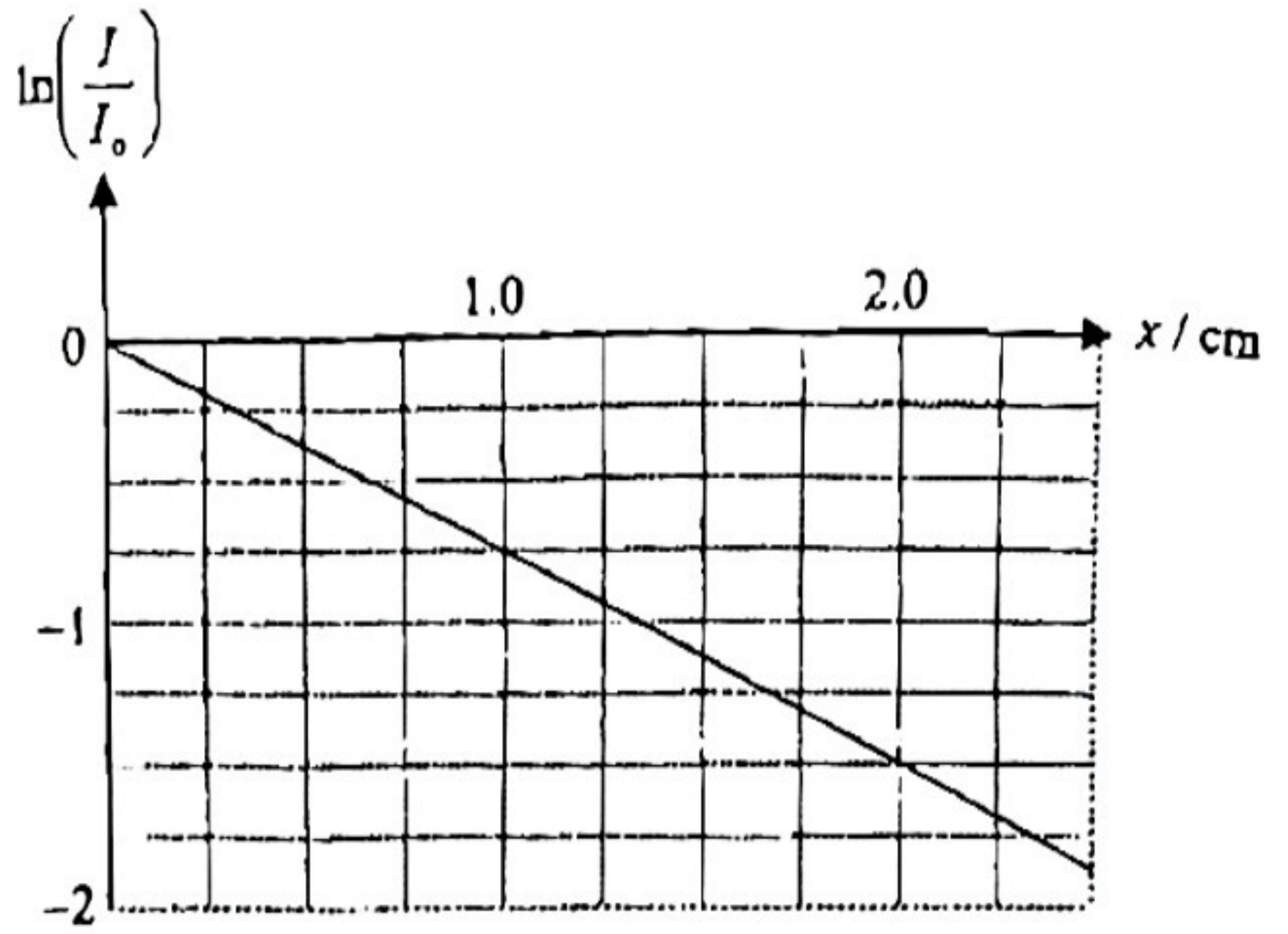
A. Ultrasound scanning
B. Optic endoscopy
C. Computed tomography
D. Radionuclide imaging

A B C D
○ ○ ○ ○

GROUP BEACON 燈塔 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

4.6





An X-ray beam of intensity I_o is incident on a medium. After travelling a distance x in that medium as shown, the intensity of the beam becomes I. A graph of $\ln(I / I_o)$ is plotted against x. From the graph, determine the half-value thickness of the medium.

A. 0.785 cm
B. 0.850 cm
C. 0.924 cm
D. 0.985 cm

A B C D
○ ○ ○ ○

4.7 A medical tracer X has a physical half-life of 6 hours. A small amount of tracer X with activity 2500 Bq is injected into the bloodstream of a patient. If the biological half-life of the patient is 9 hours, calculate the activity of tracer X inside the body of the patient after 3 hours.

A. 1400 Bq
B. 1770 Bq
C. 1980 Bq
D. 2150 Bq

A B C D
○ ○ ○ ○

4.8 Which of the following statements concerning radionuclide imaging is correct ?

A. The gamma camera can capture the gamma radiation emitted from the target organ to give a clear image of the organ.
B. The image shows variation of brightness in different regions due to the attenuation of gamma rays in the target organ.
C. A hot spot in the image of an organ shows that the organ has inflammation.
D. A cold spot in the image of an organ shows that region cannot function properly.

A B C D
○ ○ ○ ○

GROUP BEACON 遵理 All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA

Q.4 : Structured question

The following table shows the acoustic impedance and speed of sound in 3 different media.

Medium	Acoustic impedance / kg m^{-2} s^{-1}	Speed of sound / m s^{-1}
air	430	330
tissue	1.65×10^6	1620
bone	4.23×10^6	2850

(a) From the above table, calculate the density of the bone. (1 mark)

(b) (i) Determine the intensity reflection coefficient when ultrasound entering tissue from air. (2 marks)

(ii) Comment on the result when a beam of ultrasound is directed into the body tissue from air. (1 mark)

(iii) Explain how an ultrasound scan can be successfully applied to the human body. (1 mark)

(c) A pulse of ultrasound is emitted from a transducer placed on a patient's skin. The pulse is reflected by the kidney and is received back at the transducer after 75 μs. Assume there is only tissue in the path of the ultrasound, determine the distance between the kidney and the transducer. (1 mark)

(d) To scan the kidney, a low frequency ultrasound is used. State the reason behind. What is the disadvantage of using of a low frequency ultrasound for scanning. (2 marks)

(e) State **TWO** differences between A-scan and B-scan. (2 marks)

END OF PAPER

GROUP BEACON All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

Section A

Answers

1. B	6. A	11. A	16. C	21. D	26. A	31. A
2. B	7. C	12. B	17. B	22. A	27. D	32. B
3. D	8. D	13. B	18. D	23. B	28. A	33. C
4. C	9. C	14. D	19. D	24. D	29. B	
5. A	10. A	15. D	20. B	25. B	30. B	

Solution

1. B

By $P\,t = m\,c\,\Delta T$ $\quad\therefore$ slope of the graph $= \dfrac{P}{m\,c} \propto \dfrac{1}{m\,c}$

$$\frac{\text{slope of } X}{\text{slope of } Y} = \frac{m_Y}{m_X} \times \frac{c_Y}{c_X}$$

$$\therefore \frac{(60/100)}{(60/200)} = \frac{2}{3} \times \frac{c_Y}{c_X} \qquad \therefore c_X : c_Y = 1:3$$

2. B

× (1) Since the volume is fixed, the average separation of the gas molecules remain unchanged.

✓ (2) As the temperature of the gas increases, the average kinetic energy of gas molecules increases. Gas molecules move faster and hit the walls of container with greater momentum, thus more violently.

× (3) Since the gas molecules move faster and the volume is fixed, they hit the walls more frequently.

3. D

× (1) When temperature is double from X to Y, pressure is not double. Thus, the pressure is not proportional to the absolute temperature.

(2) Internal energy depends on the number of mole and absolute temperature. The number of mole remains unchanged. As the absolute temperature is double, the internal energy is also double.

(3) By the use of $P\,V = n\,R\,T$

For X: $(400)\,V_X = n\,R\,(T)$

For Y: $(600)\,V_Y = n\,R\,(2T)$

$\therefore V_X : V_Y = 3:4$

All rights [redacted] public exam questions, if any, are licen[redacted]

4 C

The acceleration due to gravity g is independent of mass

By $s = \frac{1}{2} g t^2$ $\therefore s \propto t^2$

$\frac{s_2}{s_1} = \left(\frac{t_2}{t_1}\right)^2$ $\frac{2h}{h} = \left(\frac{t_2}{t}\right)^2$ $\therefore t_2 = \sqrt{2}\, t$

5. A

✓ (1) Initially, car P leads car Q. At time T, they have same displacement, thus Q catches up with P.

✓ (2) At time T, the slope of the graph represents the velocity of the car. Since car Q has greater slope, car Q has greater (instantaneous) velocity.

✗ (3) Since the two cars have the same displacement in time T, they should have the same average velocity.

6 A

Since the ball is moving upwards, the air resistance R acting on the ball is in downward direction.

By Newton's second law : $m g + R = m a$

$(0.480)(9.81) + R = (0.480)(12.5)$

$\therefore R = 1.29$ N

C

$T_A \sin\theta = T_C = W$

$T_A \cos\theta = T_B = 20$

$\therefore \tan 50° = \frac{W}{20}$ $\therefore W = 23.8$ N

8 D

✓ A. Since the reading of the balance is smaller than the weight, the direction of acceleration is downwards.
By $m g - R = m a$ $\therefore (60 \times 10) - (510) = (60)\, a$ $\therefore a = 1.5$ m s^{-2}

✓ B. Since the direction of a is downwards, the lift may be ascending with deceleration.

✓ C. Since the direction of a is downwards, the lift may be descending with acceleration.

✗ D. Both the force acting on the man by the balance and the weight act on the same body, they cannot be action and reaction pair.
Moreover, the force acting on the man by the balance is normal reaction force.
Normal reaction and weight are two different types of force, they cannot be action and reaction pair.

9 C

Consider X : $T - f = m_X a$

Consider Y : $m_Y g - T = m_Y a$

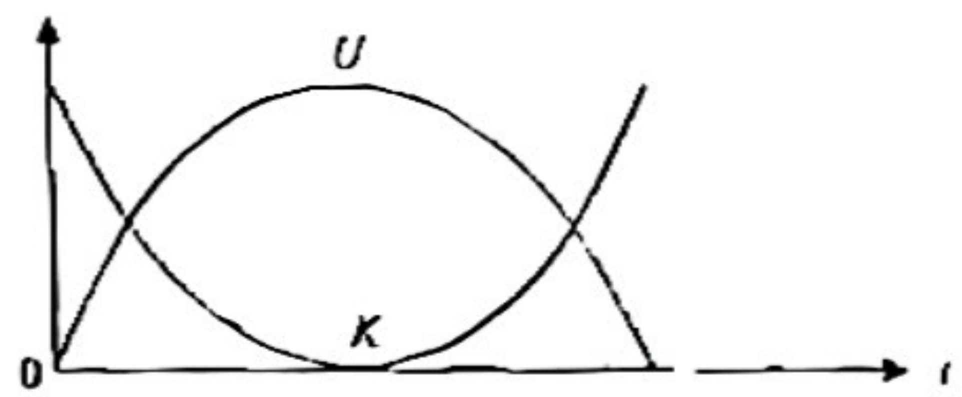
Combine the two equations : $m_Y g - f = (m_X + m_Y)\, a$

$\therefore (1.2 \times 9.81) - f = (2.8 + 1.2) \times (2.25)$ $\therefore f = 2.77$ N

All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

10. A

When an object is thrown upwards to reach and highest point and returns to the original position, the time variation of kinetic energy K and potential energy U are shown below :



Graph in option (1) is the kinetic energy K in the upward motion.

Graph in option (3) is the potential energy U in the upward motion.

11 A

$F = \frac{m}{t}(v - u) = (0.5)(80 - 0) = 40$ N

$F - m g = m a$ $\therefore (40) - (2.5 \times 9.81) = (2.5)\, a$ $\therefore a = 6.19$ m s^{-2}

12 B

Maximum friction acting on the car : $f = 0.6\, mg$

Since the friction provides the centripetal force : $f = \frac{m v^2}{r}$

$\therefore 0.6\, m g = \frac{m v^2}{r}$

$\therefore v = \sqrt{0.6\, g\, r} = \sqrt{0.6 \times 9.81 \times 48} = 16.8$ m s^{-1}

13 B

By $g \propto \frac{1}{r^2}$ $\therefore \frac{g_2}{g_1} = \left(\frac{r_1}{r_2}\right)^2$ $\therefore \frac{g_2}{(g)} = \left(\frac{R}{R + R}\right)^2$ $\therefore g_2 = \frac{1}{4} g$

By $mg = \frac{mv^2}{r}$

$\therefore v = \sqrt{g\, r} = \sqrt{(\frac{1}{4} \times 9.81)(2 \times 6400 \times 10^3)} = 5600$ m s^{-1}

14 D

✗ (1) Particle e is at the centre of rarefaction, it must move in the opposite direction of the direction of travel of the wave, thus, the wave should move towards the left.

✓ (2) Both particles a and i are at the centre of compression.
Distance between a and i is equal to one wavelength.
Thus, the next particles, b and j are separated at one wavelength.

(3) Since particle a is at the centre of compression, it is at the equilibrium position.
After one quarter of a period, a would be at the extreme position and becomes momentarily at rest.

All rights reserved by Beacon College Ltd. except that all public exam questions, if any, are licensed by copyright owner HKEAA.

15 D

✗ A When light travels from water to plastic, refractive index increases, thus the refracted angle decreases. Therefore, the light should bend towards the normal.

✗ B. Since plastic has greater refractive index, light travels with smaller speed in plastic

✗ C When light travels from water to plastic, frequency should remain unchanged.

✓ D Since plastic has greater refractive index, light has smaller wavelength in plastic.

16. C

The distance between the closet crest and the cork $= 10 \times \frac{3}{4} + 20 = 27.5$ cm

Speed of the wave : $v = \frac{d}{t} = \frac{27.5}{2.2} = 12.5\ \text{cm s}^{-1}$

By $v = f\lambda$ $\quad (12.5) = f(10)$ $\quad \therefore f = 1.25$ Hz

17. B

✗ (1) The separation between the two sources a is equal to 1.5 λ.
Thus, the path difference at A is 1.5 λ.
Therefore, point A should undergo destructive interference

✗ (2) From the figure, $S_1B = 1.75\lambda$ and $S_2B = 1.25\lambda$.
Path difference at $B = 0.5\lambda$.
Therefore, B should undergo destructive interference.

✓ (3) Between S_1 and S_2, there is 1 point that has path difference = 0 λ,
and there is two points that have path difference = 1 λ.
Therefore, there are 3 points that have constructive interference

18 D

When John walks a distance 60 m towards the cliff, the echo is heard with a difference of time (2.54 − 2.19) s

$$v = \frac{2d}{\Delta t} = \frac{2\times(60)}{(2.54-2.19)} = 343\ \text{m s}^{-1}$$

19 D

✓ (1) ① $d\sin 15° = 1\lambda$
② $d\sin(15° + \theta_2) = 2\lambda$
$\therefore \theta_2 = 16.2°$

(2) ① $d\sin 15° = 1\lambda$
② $d\sin 90° = n\lambda$
$\therefore n = 3.86$
Thus the maximum order is 3. There is no 4th order

(3) ① $d\sin 15° = 1 \times 650$
② $d\sin 90° = n \times 450$
$\therefore n = 5.58$
Thus, the maximum order is 5 for blue light

20. B

By $\Delta y = \frac{\lambda D}{a}$

① $(2.4) = \frac{(\lambda)D}{a}$ ② $\Delta y = \frac{(1.5\lambda)D}{(2a)}$

Combine ① and ② : $\Delta y = 1.8$ mm

21. D

✓ (1) During refraction, frequency of wave must remain unchanged.

✓ (2) Since $\sin\theta \propto v$ $\quad \frac{\sin 10°}{\sin r} = \frac{340}{1500}$ $\quad \therefore r = 50°$

✓ (3) By $\frac{\sin 20°}{\sin r} = \frac{340}{1500}$ $\quad \therefore \sin r = 1.5 > 1$ $\quad \therefore$ refracted angle does not exist
Since no refraction can occur, thus, total internal reflection occurs.

22 A

By $F = qE$

$\therefore (7.2\times10^{-18}) = (1.6\times10^{-19})E$ $\quad \therefore E = 45\ \text{V m}^{-1}$

By $E = \frac{V}{d}$

$\therefore V = Ed = 45 \times 0.24 = 10.8$ V

23. B

There are 3 forces acting on the sphere.

① Tension T ② Weight mg ③ Electrostatic force F

Resolving the tension T

$T\sin\theta = F$

$T\cos\theta = mg$

$\therefore \tan\theta = \frac{F}{mg}$

$\therefore F = mg\tan\theta = (0.045)(9.81)\tan 15° = 0.12$ N

24 D

✗ A After S burns out, the equivalent resistance of R and S increases
Thus, the equivalent resistance of the whole circuit increases.
Therefore, the current given out by the battery should decrease.

✗ B Since the voltage across P remains unchanged, the current flowing through P should remain unchanged.

✗ C Since the equivalent resistance of R and S increases, the voltage across them increases,
thus, the voltage across Q decreases, therefore, Q should become dimmer

✓ D After S burns out, voltage across Q and voltage across R should be both equal to 3 V.
Thus, voltage across S is also 3 V.

... except that all public exam questions, if any, are licensed by copyright owner HKEAA.

25. B

- ✗ (1) The electrical appliance can be switched off no matter the switch is on live or neutral
- ✗ (2) The metal case is connected to earth wire and is always at zero voltage.
- ✓ (3) When switch is off, the heating element can be cut off from the live of high voltage, thus, someone touching the heating element will not get electric shock

26. A

- ✓ (1) By Left-hand rule, direction of magnetic force on the particle is upward
- ✓ (2) By $BQv = \frac{mv^2}{r}$ $\therefore (1.25)(1.6\times10^{-19}) = \frac{(1.66\times10^{-27})(2\times10^{5})}{r}$ $r = 0.0166$ m
- ✗ (3) By $T = \frac{2\pi m}{BQ} = \frac{2\pi(1.66\times10^{-27})}{(1.25)(1.6\times10^{-19})} = 5.2\times10^{-8}$ s

27. D

By Right-hand screw rule :

At X, the B-field by the upper wire is into paper and that by the lower wire is out of paper.

Since the field due to the lower wire is greater, thus the resultant B-field is out of paper.

$$B = \frac{\mu_0 I_2}{2\pi r} - \frac{\mu_0 I_1}{2\pi r} = \frac{(4\pi\times10^{-7})}{2\pi}\left(\frac{3}{0.25} - \frac{2}{0.25}\right) = 8\times10^{-7}\text{ T}$$

28. A

- ✓ (1) In a dynamo, the induced current must always be in alternating direction when the coil rotates.
- ✗ (2) The dynamo gives an unsteady d.c. output.
- ✗ (3) By using Right hand rule and consider the right wire, direction of B-field is towards the right, motion is downwards, thus the induced current at the right wire is out of paper. Therefore, the current flowing through the load should be from Q to P.

29. B

By $P = I^2R$

For the d.c. current : $P = (5)^2R = 25R$

For the a.c. current $P' = (10/\sqrt{2})^2R = 50R = 2P$

30. B

By $P = VI$

$\therefore (2500\times10^3) = (20\times10^3)I$ $\quad I = 125$ A

Power loss in the cable $= 2500\times10^3\times(1-98\%) = 50\,000$ W

By $P_{loss} = I^2R$

$\therefore (50\,000) = (125)^2R$

$R = 3.2\ \Omega$

All rights reserved by Beacon College …

31. A

By $P = EA$

$(5\times10^{-3}) = E(6.4\times10^{9})$

$\therefore E = 7.8125\times10^{-13}\text{ J} = 7.8125\times10^{-13}\times\frac{1}{1.6\times10^{-19}}\text{ eV} = 4.88\times10^{6}\text{ eV} = 4.88\text{ MeV}$

32. B

Atomic number of the final daughter product $= 94 - 2\times9 + 6\times1 = 82$

33. C

By $E = Pt = (5\times10^{26})\times(365\times24\times3600) = 1.5768\times10^{34}$ J

By $E = mc^2$ $\quad (1.5768\times10^{34}) = m(3\times10^{8})^2$ $\quad \therefore m = 1.75\times10^{17}$ kg

… copyright owner HKEAA

Section B

1. (a) To give convection of water so that heat can transfer faster to other part of water [1]

OR

To give convection of water so that temperature of water in the cup will be quicker to become uniform. [1]

(b) $P t = V I t = m c \Delta T$

$\therefore (12)(3.5)(5 \times 60) = (0.3)(4200)(\theta - 24)$ [1]

$\therefore \theta = 34°C$ [1]

(c) There is evaporation of water during the heating process. [1]

(d) $m_i \ell + m_i c \Delta T_i = m_w c \Delta T_w$

$0.05 \times 3.34 \times 10^5 + 0.05 \times 4200 \times \theta = 0.3 \times 4200 \times (34 - \theta)$ [1]

$\therefore \theta = 17.8°C$ [1]

2. (a) By $P V = n R T = \frac{M}{M_m} R T$

$\therefore (102 \times 10^3)(24 \times 150 \times 10^{-6}) = \frac{M}{(0.029)} \times (8.31)(20 + 273)$ [1]

$\therefore M = 4.37 \times 10^{-3}$ kg < accept 4.37 g > [1]

(b) By $P V = \frac{1}{3} N m c^2 = \frac{1}{3} M c^2$

$(102 \times 10^3)(24 \times 150 \times 10^{-6}) = \frac{1}{3}(4.37 \times 10^{-3}) c^2$ [1]

$c = 502$ m s^{-1} [1]

OR

By $c = \sqrt{\frac{3RT}{M_m}}$

$\therefore c = \sqrt{\frac{3 \times (8.31)(20 + 273)}{(0.029)}}$ [1]

$\therefore c = 502$ m s^{-1} [1]

(c) The student is not correct since average kinetic energy of gas depends on (absolute) temperature only, different gases have the same average kinetic energy at the same temperature [1]

(d) By $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$\frac{(102 \times 10^3)(24)}{(20 + 273)} = \frac{P (16)}{(60 + 273)}$ [1]

$P = 1.74 \times 10^5$ Pa < accept 174 kPa > [1]

All rights reserved by Beacon College Ltd. except that all public e...

3. (a) Since the acceleration of the passenger is equal to g, there is no normal reaction force acting on him, thus he experiences weightlessness [1]

(b) Height = area of the graph

$= \frac{1}{2} \times (16) \times (8.0)$ [1]

$= 64$ m [1]

(c) Deceleration = slope of the graph

$= \frac{16 - 0}{8.0 - 1.6}$

$= 2.5$ m s^{-2} < negative value is not accepted for magnitude > [1]

(d) By $R - mg = m a$

$R - (60 \times 10) = (60) \times (2.5)$ [1]

$\therefore R = 750$ N [1]

(e) The passenger should have a seat-belt. [1]

4. (a) By $m g h = \frac{1}{2} m v^2$

$(9.81)(1.2 - 1.2 \cos 30°) = \frac{1}{2} v^2$ [1]

$\therefore v = 1.78$ m s^{-1} [1]

(b) By $T - mg = \frac{m v^2}{r}$

$\therefore T - (0.45 \times 9.81) = \frac{(0.45)(1.78)^2}{(1.2)}$ [1]

$\therefore T = 5.60$ N [1]

(c) By $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$

$\therefore (0.45)(1.78) = (0.45)(-0.32) + (0.75) v_2$ [1]

$\therefore v_2 = 1.26$ m s^{-1} [1]

(d) Initial kinetic energy $= \frac{1}{2}(0.45)(1.78)^2 = 0.713$ J [1]

Final kinetic energy $= \frac{1}{2}(0.45)(0.32)^2 + \frac{1}{2}(0.75)(1.26)^2 = 0.618$ J [1]

Since the kinetic energy is not conserved, the collision is not elastic [1]

5. (a) At the highest point, the velocity is horizontal

$\therefore KE = \frac{1}{2} m (u \cos \theta)^2$

$(14.9) = \frac{1}{2}(0.42)(u \cos 36°)^2$ [1]

$u = 10.4$ m s^{-1} [1]

... public exam questions, if any, are licensed by copyright owner HKEAA

5. (b) By $v_y^2 = u_y^2 + 2ay$

$\therefore (0) = (10.4 \sin 36°)^2 + 2(-9.81)H$ [1]

$\therefore H = 1.90$ m < accept 1.91 m > [1]

(c) By $y = u_y t + \frac{1}{2}at^2$

$\therefore (0) = (10.4 \sin 36°)t + \frac{1}{2} \times (-9.81)t^2$

$\therefore t = 1.246$ s [1]

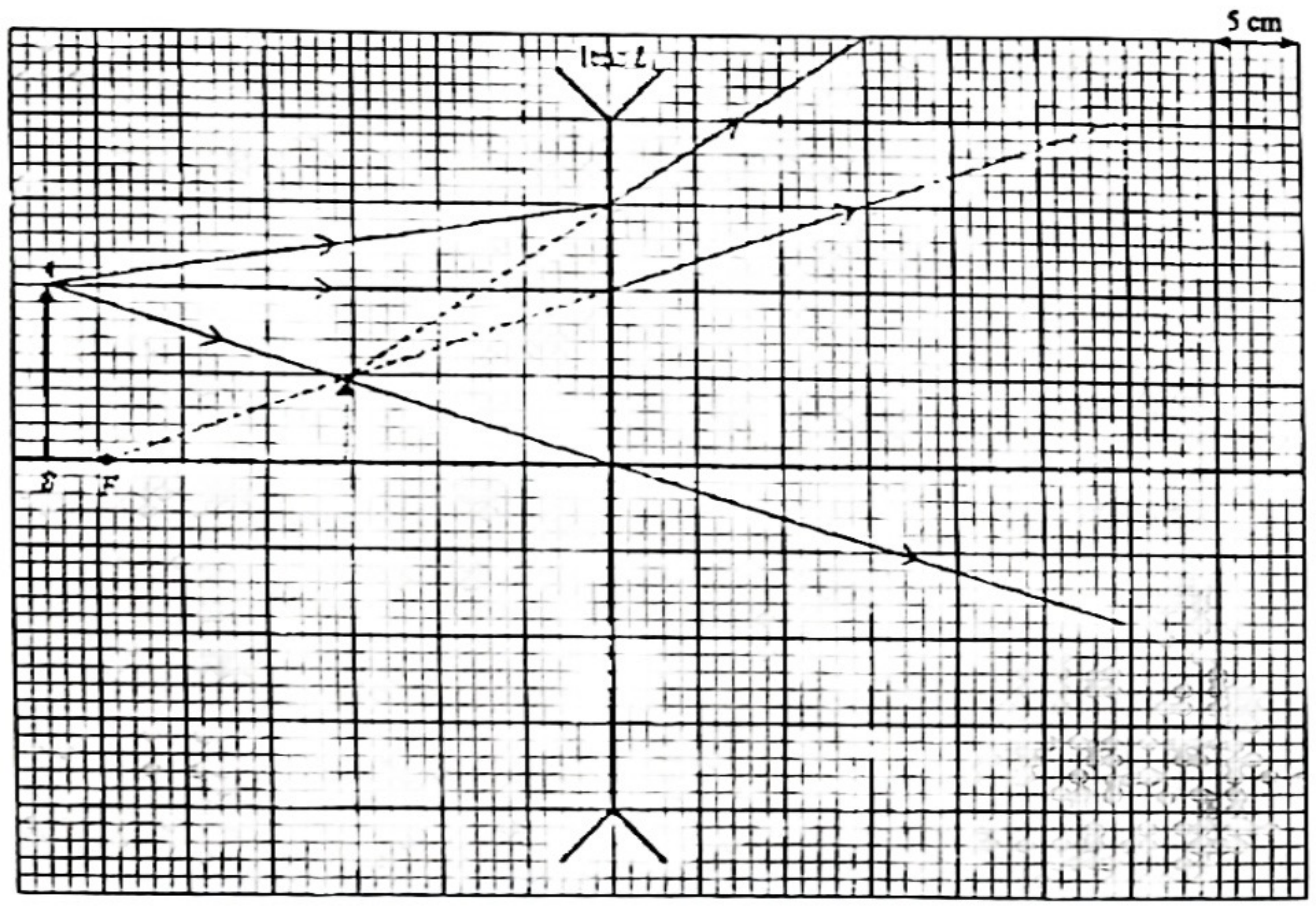
Horizontal distance $x = u_x t = (10.4 \cos 36°) \times (1.246) = 10.5$ m [1]

(d) By $\frac{1}{2}mu^2 = \frac{1}{2}mv^2 + mgh$

$\therefore \frac{1}{2}(15)^2 = \frac{1}{2}(13.5)^2 + (9.81)h$ [1]

$\therefore h = 2.18$ m [1]

6.



(a) < a light ray emitting from A passes through the optical centre is drawn > [1]

< the refracted ray is extended backwards, and the image $A'B'$ is drawn > [1]

[deduct 1 mark if no arrow in solid line or put arrow in dotted line]

(b) < a horizontal light ray emitted from A is drawn and extended to pass A', focus F is marked > [1]

(c) The lens should be moved towards the object. OR The lens should be moved towards the left. [1]

[Move the object towards the lens is not accepted]

All rights reserved by Beacon College Ltd. except that all public exam questions

6 (d) To give a larger field of view. [To give a diminished image is not accepted] [1]

(e) From the above figure, object distance : $u = 33$ cm

Image distance : $v = mu = (2.5) \times (33) = 82.5$ cm [1]

By $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\therefore \frac{1}{f} = \frac{1}{(33)} + \frac{1}{(-82.5)}$ < since the image is erect, it is virtual >

$\therefore f = 55$ cm [1]

7. (a) From Figure (b), period : $T = 4$ div $\times$ 0.2 ms div^{-1} = 0.8 ms [1]

Frequency : $f = \frac{1}{T} = \frac{1}{0.8 \times 10^{-3}} = 1250$ Hz [1]

(b) From Figure (c), point A is at the first maximum.

Path difference at A = 1.32 − 1.06 = 1 λ

$\therefore \lambda = 0.26$ m [1]

(c) $v = f\lambda$

$= (1250) \times (0.26)$ [1]

$= 325$ m s^{-1} [1]

(d) Since the path difference along OB is always equal to zero, constructive interference always occurs. [1]

Thus the loudness along OB remains large.

However, as sound intensity decreases with distance, the loudness gradually decreases from O to B. [1]

(e) Any ONE of the following : [1]

* There is reflection from the surrounding walls.
* The cancellation is not complete due to difference path lengths.

8. (a) $\Phi = BA$

$= (0.24) \times (0.20 \times 0.16)$ [1]

$= 7.68 \times 10^{-3}$ Wb [1]

(b) Induced e.m.f. : $\varepsilon = \frac{\Delta\Phi}{\Delta t}$

$= \frac{7.68 \times 10^{-3}}{1.5}$ [1]

$= 5.12 \times 10^{-3}$ V (5.12 mV)

Induced current : $I = \frac{5.12 \times 10^{-3}}{4} = 1.28 \times 10^{-3}$ A (1.28 mA) [1]

The induced current is in clockwise direction. [1]

8. (c) (i) Speed of side AB : $v = r\omega = (0.08)\times(3.6) = 0.288\ \text{m s}^{-1}$

Induced e.m.f. : $\varepsilon = Bvl$

$= (0.24)(0.288)(0.2)$ [1]

$= 0.0138\ \text{V}$ [1]

Point B is at a higher potential than A [1]

(ii) Direction of magnetic force acting on AB is rightwards [1]

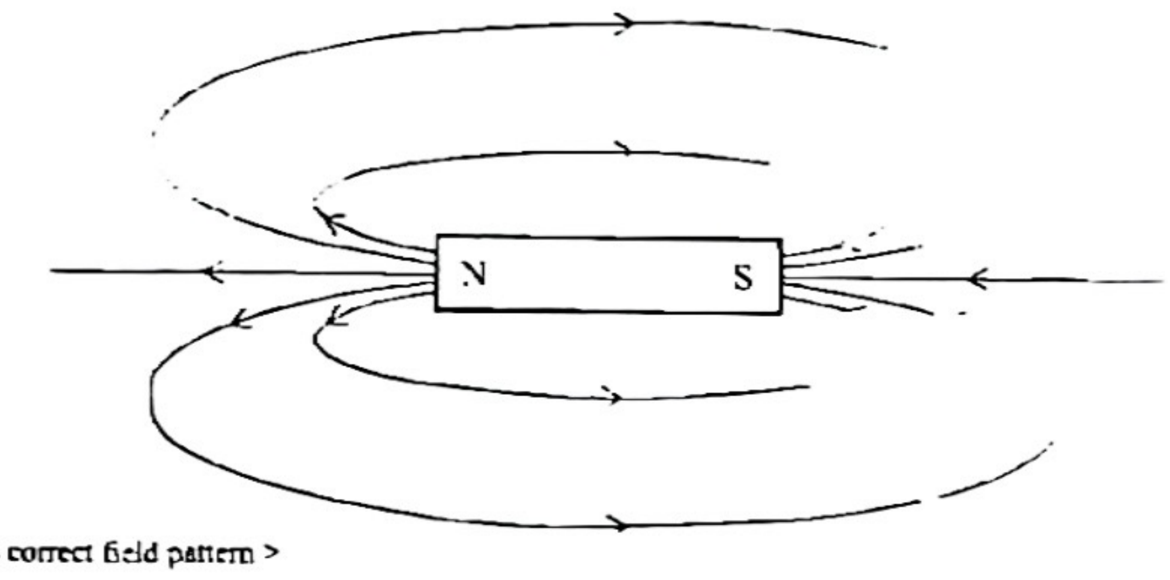
(iii) Electrical energy comes from the work done by the student. [1]

9. (a) Place the bar magnet under the cardboard. [1]

Sprinkle some iron filings onto the cardboard. [1]

Slightly tap the cardboard so that the iron filings show the magnetic field pattern [1]

(b)



< correct field pattern > [1]

< correct direction of field lines > [1]

10. (a) (i) By $\frac{V_P}{V_S} = \frac{N_P}{N_S}$ $\quad \frac{120}{220} = \frac{5280}{N_S}$ $\quad \therefore N_S = 9680$ [1]

(ii) $P = \frac{V^2}{R}$ [1]

$\therefore (100) = \frac{(220)^2}{R}$

$\therefore R = 484\ \Omega$ [1]

(iii) Efficiency $= \frac{\text{Output power}}{\text{Input power}}\times 100\%$ [1]

$\therefore (80\%) = \frac{(100)}{(120)I_P}\times 100\%$

$I_P = 1.04\ \text{A}$ [1]

All rights reserved by Beacon College Ltd ...

10. (a) (iv) Output power remains unchanged [1]

Input power decreases [1]

(b) An a.c. voltage is used because it can be stepped up or down by transformers efficiently [1]

Stepping up to high voltage can reduce the current passing through the cables [1]

This can reduce the power loss in the cables [OR This can increase the efficiency of power transmission] [1]

11. (a) $\Delta N = A\,\Delta t = (4.5\times 10^6)\times(1\times 3600) = 1.62\times 10^{10}$ [1]

(b) $k = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{(60\times 24\times 3600)} = 1.34\times 10^{-7}\ \text{s}^{-1}$ [1]

By $A = kN$ $\quad \therefore (4.5\times 10^6) = (1.34\times 10^{-7})N$ $\quad \therefore N = 3.36\times 10^{13}$ [1]

$M = \frac{N}{N_A}M_m = \frac{3.36\times 10^{13}}{6.02\times 10^{23}}\times 0.125 = 6.98\times 10^{-12}\ \text{kg}$ < accept 6.99×10^{-12} kg > [1]

(c) $A = A_0\left(\frac{1}{2}\right)^{t/60}$

$\therefore (450) = (4.5\times 10^6)\left(\frac{1}{2}\right)^{t/60}$ [1]

$\therefore t = 797$ days < not accept other units since the question asks for number of days > [1]

OR

$A = A_0 e^{-kt}$

$\therefore (450) = (4.5\times 10^6)\, e^{-\frac{\ln 2}{(60)}t}$ [1]

$\therefore t = 797$ days [1]

(d) Any ONE of the followings : [1]

- medical tracer
- radiotherapy

Section A : Astronomy and Space Science

1.1 A

✓ (1) Venus is at an orbit closer to the Sun
In the mid night, the observer is at the opposite side of the Sun
Thus, the observer can never observe Venus.

✗ (2) Both of the two models can give an explanation for the morning and evening star of Venus

✗ (3) Venus can either be seen in the morning or in the evening,
and even in some days, Venus cannot be seen at any time

1.2 A

✓ (1) Kepler's first law states that each planet travels on an elliptical orbit around the Sun.

✓ (2) Kepler's second law states that the line joining the Sun
and the moving planet sweeps equal areas in equal times.
Thus, if the planet is nearer to the Sun, it will move faster with greater speed, and vice versa.

✗ (3) Kepler's third law states that the squares of the orbital periods of the planets
are directly proportional to the cubes of the average radius of their orbits

1.3 B

By Kepler's third law, $T^2 \propto r^3$

$\therefore (\frac{T_2}{T_1})^2 = (\frac{r_2}{r_1})^3$

$\therefore (\frac{T_I}{T})^2 = (\frac{6400+10000}{6400+5000})^3 \qquad \therefore T_I = 1.7\,T$

1.4 D

At the surface of the planet with radius R, gravitational potential energy $\therefore U = -\frac{GMm}{R}$

$\therefore (-5\times10^7) = -\frac{GM(5)}{R} \qquad \frac{GM}{R} = 10^7$

Speed of escape : $v_e = \sqrt{\frac{2GM}{R}} = \sqrt{2(10^7)} = 4470\ \text{m s}^{-1}$

1.5 D

By $b = \frac{L}{4\pi d^2}$

$\therefore (3.63\times10^{-10}) = \frac{6.8\times10^{26}}{4\pi d^2}$

$d = 3.86\times10^{17}\ \text{m} = 12.5\ \text{pc}$

$p = \frac{1}{d} = \frac{1}{12.5} = 0.08''$

All rights reserved by Beacon College Ltd ...

1.6 A

✓ (1) For star X: $m - M = (-1.2) - (2.4) = -3.6 < 0$
Thus, the distance of star X is less than 10 pc from the Earth

✗ (2) Among the three stars, star Z has the greatest value of $(m - M)$,
thus it is at the greatest distance from the Earth
By $p = 1/d$, star Z should have the smallest parallax p

✗ (3) The absolute magnitude indicates the luminosity of the star
However, luminosity has no direct relation with the surface temperature of a star

1.7 C

By $b = \frac{L}{4\pi d^2}$

$\therefore (25\times10^{-9}) = \frac{L}{4\pi(75\times3.09\times10^{16})^2}$

$\therefore L = 1.69\times10^{31}\ \text{W}$

By $L = 4\pi R^2\sigma T^4$

$\therefore (1.69\times10^{31}) = 4\pi R^2(5.67\times10^{-8})(8500)^4$

$R = 6.74\times10^{10}\ \text{m}$

1.8 C

✓ (1) $v = \frac{2\pi r}{T} = \frac{2\pi(8\times10^3\times3.09\times10^{16})}{(2.2\times10^8\times365\times24\times3600)} = 2.24\times10^5\ \text{m s}^{-1} = 224\ \text{km s}^{-1}$

(2) By $\frac{GMm}{r^2} = \frac{mv^2}{r}$

$\therefore M = \frac{v^2 r}{G} = \frac{(224\times10^3)^2(8\times10^3\times3.09\times10^{16})}{(6.67\times10^{-11})} = 1.86\times10^{41}\ \text{kg} \approx 2\times10^{41}\ \text{kg}$

(3) By $\frac{GMm}{r^2} = \frac{mv^2}{r} \qquad v = \sqrt{\frac{GM}{r}} \qquad \therefore v \propto \frac{1}{\sqrt{r}}$

$\therefore$ Rotational speed v should decrease with the distance r, but not constant.

Q1. (a) (i) Apparent angular size :

$$\theta = \frac{D}{d} = \frac{1.5 \times 9.46 \times 10^{15}}{850 \times 3.09 \times 10^{16}} = 5.40 \times 10^{-4} \text{ rad} \quad [1]$$

$$= 5.40 \times 10^{-4} \times \frac{180^\circ}{\pi} = 0.03095^\circ = 1.86 \text{ arcminute} \quad [1]$$

(ii) By $\frac{v_r}{c} = \frac{\Delta\lambda}{\lambda_0}$

$$\frac{(500 \times 10^3)}{(3 \times 10^8)} = \frac{\Delta\lambda}{572.36} \quad [1]$$

$\Delta\lambda = 0.95$ nm [1]

Since the gas is expanding and moving towards the Earth, it shows blue shift.

∴ apparent wavelength : $\lambda' = 572.36 - 0.95 = 571.41$ nm [1]

(iii) By $R = vT$

$$\therefore 1.5 \times 9.46 \times 10^{15} \times \frac{1}{2} = (500 \times 10^3)\, T \quad [1]$$

∴ $T = 1.419 \times 10^{10}$ s = 450 years

Year = 2000 − 450 = 1550

The nebula is formed in 1550 A.D [1]

(b) (i) Parallax , $p = 0.48 / 2 = 0.24''$

$$d = \frac{1}{p} = \frac{1}{0.24} = 4.17 \text{ pc} \quad [1]$$

< accept the distance in other units >

(ii) Observe the radiation from the star and assumed the star is a black body radiator [1]

From the radiation curve, the peak wavelength is related to its surface temperature [1]

OR

The radiation spectrum gives the intensity emitted by the star and is related to its surface temperature. [1]

Section B : Atomic World

2.1 C

✗ (1) Protons and neutrons are not discovered when Rutherford proposed his atomic model.

✗ (2) The energy levels that electrons can stay without radiation is proposed by Bohr, not by Rutherford

✓ (3) Outside the nucleus, most of the space of the atom is empty.

2.2 D

Since the anode is positive, photoelectrons accelerate in moving from cathode to anode.

∴ Maximum KE of photoelectrons emitted from cathode $C = 4 - 2.5 = 1.5$ eV

By Einstein's Photoelectric equation : $E = \phi + K_{max}$

$$\therefore h\frac{c}{\lambda} = h \cdot \frac{c}{\lambda_0} + K_{max}$$

$$\therefore (6.63 \times 10^{-34}) \cdot \frac{(3 \times 10^8)}{(450 \times 10^{-9})} = (6.63 \times 10^{-34}) \cdot \frac{(3 \times 10^8)}{\lambda_0} + (1.5 \times 1.6 \times 10^{-19})$$

$\therefore \lambda_0 = 9.85 \times 10^{-7}$ m

2.3 D

Orbital radius of electron in the second excited state : $r_3 = 5.3 \times 10^{-11} \times 2^2 = 2.12 \times 10^{-10}$ m

Angular momentum of electron is quantized : $mvr = n\frac{h}{2\pi}$

$$\therefore mv \times (2.12 \times 10^{-10}) = (2)\frac{(6.63 \times 10^{-34})}{2\pi}$$

∴ Momentum : $p = mv = 9.95 \times 10^{-25}$ N s

OR

By $2\pi r = n\lambda$

$\therefore 2\pi \times 2.12 \times 10^{-10} = (2)\,\lambda$

$\therefore \lambda = 6.66 \times 10^{-10}$ m

By de Broglie relation :

$$p = \frac{h}{\lambda} = \frac{(6.63 \times 10^{-34})}{(6.66 \times 10^{-10})} = 9.95 \times 10^{-25} \text{ N s}$$

2.4 D

✓ (2) The ionization energy of hydrogen atom is 13.6 eV.
Since the energy of the photon is greater than the ionization energy, the photon is absorbed.

(4) After absorbing the photon, the electron at the ground level gains an energy of 15 eV and transits to the free state with a kinetic energy of 1.4 eV, and the atom is ionized.

< Note that inelastic collision only occurs for electrons hitting atoms with a loss of kinetic energy >

2.5 D

The de Broglie wavelength of the electron is given by : $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE_k}} = \frac{h}{\sqrt{2meV}}$

$\therefore (4 \times 10^{-11}) = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 9.11 \times 10^{-31} \times 1.60 \times 10^{-19} \times V}}$

$\therefore V = 943$ V

2.6 A

(1) By Rayleigh criterion, resolving power : $\theta = 1.22 \frac{\lambda}{d}$

Resolving power depends on λ or d.

Increase the diameter d of the magnifying glass gives smaller θ, thus increase the resolving power.

× (2) The resolving power is not affected by increase the distance of the object from the magnifying glass

× (3) The resolving power is not affected by the magnifying power of an instrument.

2.7 B

The shortest wavelength is due to the transition of electron from the free state to the second excited state.

$\therefore (0) - (-\frac{E_1}{3^2}) = \frac{hc}{\lambda}$

$\frac{(13.6 \times 1.6 \times 10^{-19})}{3^2} = \frac{(6.63 \times 10^{-34}) \times (3 \times 10^8)}{\lambda}$

$\lambda = 8.23 \times 10^{-7}$ m

2.8 B

× (1) Since the waxy bumps are nanoscale, they cannot be observed by optical microscope, but can only be observed by electron microscope

× (2) The waxy bumps prevent water molecules from adhering to the surface.

(3) Lotus effect is the super-hydrophobic effect that helps self-cleaning

All rights

Q2. (a) From the graph, threshold frequency : $f_o = 3.6 \times 10^{14}$ Hz

Work function : $\phi = h f_o = (6.63 \times 10^{-34})(3.6 \times 10^{14}) = 2.39 \times 10^{-19}$ J = 1.49 eV [1]

(b) By $hf = \phi + K_{max}$

$\therefore K_{max} = hf - \phi$

Slope represents the Planck constant h. [1]

(c) (i) Frequency of the incident light : $f = \frac{(3 \times 10^8)}{(417 \times 10^{-9})} = 7.2 \times 10^{14}$ Hz [1]

From the graph, the corresponding value of K_{max} is 1.5 eV.

Thus, the stopping potential is 1.5 V. [1]

OR

By $hf = \phi + K_{max}$

$\therefore (6.63 \times 10^{-34}) \times \frac{(3 \times 10^8)}{(417 \times 10^{-9})} = (2.39 \times 10^{-19}) + (1.6 \times 10^{-19}) V_s$ [1]

$\therefore V_s = 1.49$ V [1]

(ii) Power of the radiation : $P = IA = (1.25) \times (18 \times 10^{-4}) = 0.00225$ W

Energy of a photon : $E = hf = (6.63 \times 10^{-34})(7.2 \times 10^{14}) = 4.77 \times 10^{-19}$ J [1]

By $P = \frac{N}{t} E$

$\therefore (0.00225) = \frac{N}{t} (4.77 \times 10^{-19})$

$\frac{N}{t} = 4.72 \times 10^{15}$ s^{-1} <accept 4.71×10^{15} s^{-1} OR 4.7×10^{15} s^{-1}> [1]

(iii) Number of photoelectrons emitted per second : $\frac{n}{t} = 4.71 \times 10^{15} \times 5\% = 2.36 \times 10^{14}$ s^{-1} [1]

Saturation current : $I = \frac{n}{t} e = (2.36 \times 10^{14}) \times (1.6 \times 10^{-19}) = 3.77 \times 10^{-5}$ A [1]

(d) (i) No change of the maximum kinetic energy of the photoelectrons [1]

(ii) According to the Wave theory of light,

higher intensity of light should give greater maximum K.E. of photoelectrons.

However, the result shows that same maximum K.E. of photoelectrons are emitted. [1]

Section C : Energy and Use of Energy

3.1 A

- ✗ A After passing through the compressor, the refrigerant condenses to give out latent heat of vaporization. Thus, it should flow to X to give out heat to outdoor.
- ✓ B Since the refrigerant condenses in component X, it is called the condenser.
- ✓ C Component Y is the evaporator that the refrigerant changes from liquid to vapour.
- ✓ D. Since the refrigerant evaporates from liquid to vapour in Y, latent heat is absorbed, thus the refrigerant has the lowest temperature at Y, heat is then removed from indoor by Y

3.2 B

$E = \frac{\Phi}{4\pi r^2}$ $\therefore (20) = \frac{\Phi}{4\pi (2.6)^2}\cos 0°$ $\therefore \Phi = 1700$ lm

$P = VI = (220) \times (0.114) = 25.1$ W

Efficacy $= \frac{\Phi}{P} = \frac{1700}{25.1} = 68$ lm W^{-1}

3.3 C

For the windows : $\frac{Q}{t} = UA\Delta T = (4.5)(120)(8) = 4320$ J

For the walls : $\frac{Q}{t} = UA\Delta T = (1.8)(480)(8) = 6912$ J

OTTV $= \frac{Q/t}{A} = \frac{(4320+6912)}{(120+480)} = 18.7$ W m^{-2}

3.4 C

- ✓ A Since the energy levels of the holes and electrons in the respective p-layer and n-layer are fixed, the difference produces photons of fixed frequency, thus the light is monochromatic.
- B In proper operation, the positive terminal of d.c. voltage should be connected to the p-layer and negative terminal to the n-layer
  The electric field due to the supply then directs from p-layer to n-layer.
- C Due to the electric field, holes move along the direction of the electric field and electrons move in the opposite direction.
  When a pair of hole and electron combines, a light photon is produced.
- D. LED is a diode that only allows current flowing in one direction.

3.5 A

The binding energy of a nucleus is the energy equivalent of the mass defect when the nucleus is formed.

$\therefore [1.0073 \times 92 + 1.0087 \times (235 - 92) - M] \times 931 = 7.50 \times 235$

$M = 235.0226$ u

All rights reserved by Beacon College Ltd. except that all public exam questions

3.6 B

- ✗ (1) The fuel rod should be enriched to have a higher percentage of U-235 but cannot be pure U-235
- ✗ (2) Moderator should be used to decrease the speed of fission neutrons
- ✓ (3) Control rods are used to control the rate of fission reaction by absorbing the excess fission neutrons.

3.7 B

$P_{out} = \frac{1}{2}\rho A v^3 \times \eta \times N$

$\therefore (30 \times 10^6) = \frac{1}{2}(1.2)(\pi \times 25^2) v^3 \times 35\% \times 30$

$\therefore v = 13.4$ m s^{-1}

3.8 A

By $\Delta P \times \eta = \frac{m}{t} g h$

$\therefore (500 - 320) \times 10^6 \times 72\% = \frac{m}{t} \times (9.81) \times (120)$

$\frac{m}{t} = 1.1 \times 10^5$ kg s^{-1}

Q3 (a) (i) Fossil fuel originates from living things millions of years ago under high pressure and heat by Earth's crust. [1]

(ii) X : internal energy Y : kinetic energy [1]

(iii) Overall efficiency = $100\% \times (1 - 60\%) \times (1 - 25\%) = 30\%$ [1]

(b) (i) kinetic energy → electrical energy → chemical energy [1]

(ii) When the car is not in full power, the excess power of the engine can be used to charge the battery [1]

(iii) $E = Pt \times \eta = \frac{1}{2}mv^2$

$\therefore (50 + 35) \times 10^3 \times t \times 73\% = \frac{1}{2}(950) \times (100 \times \frac{1000}{3600})^2$ [1]

$\therefore t = 5.91$ s <accept 5.9 s> [1]

(iv) Heat removed : $Q_C = C\Delta T = (1850) \times (40 - 25) = 27750$ J

Cooling capacity = $\frac{Q_C}{t} = \frac{27750}{1.2 \times 60} = 385$ W [1]

Power rating : $P = \frac{385}{2.8} = 138$ W [1]

(v) Any ONE of the following : [1]

* Heat continues to enter the car from the surroundings.
* Heat has to be removed from the furniture inside the car
* Heat may be generated by human bodies inside the car.

All rights reserved by Beacon College Ltd. except that all public exam question...

Section D : Medical Physics

4.1 B

✓ (1) Since John has to wear spectacles to correct eye defect for viewing near objects, he is suffering from long sight.

✗ (2) The cause of long sight is due to the reason that the eye lens is too thin.

· (3) By $P = \frac{1}{u} + \frac{1}{v}$ $\therefore (+2.75) = \frac{1}{(0.25)} + \frac{1}{v}$ $\therefore v = -0.8$ m

Thus, the near point is at 80 cm.

4.2 A

Minimum angular separation : $\theta = \frac{a}{L} = \frac{1.5 \times 10^{-3}}{5.9} = 2.54 \times 10^{-4}$ rad

By Rayleigh criterion, resolving power : $\theta = 1.22\frac{\lambda}{d}$

$\therefore (2.54 \times 10^{-4}) = 1.22 \times \frac{550 \times 10^{-9}}{d}$

$\therefore d = 2.6 \times 10^{-3}$ m = 2.6 mm

4.3 C

By $\frac{I_2}{I_1} = (\frac{d_1}{d_2})^2$ $\therefore \frac{I_2}{I_1} = (\frac{4}{6})^2 = \frac{4}{9}$

By $L_2 - L_1 = 10\log(\frac{I_2}{I_1})$ $\therefore L_2 - (65) = 10\log(\frac{4}{9})$ $\therefore L_2 = 61.5$ dB

4.4 B

✓ A By passing a small tool such as a tiny forcep through the tool channel, tissue sample can be cut out for biopsy.

✗ B. Only the light within the range of guided mode can be transmitted to the other end by total internal reflection.

✓ C Optical fibre can transmit the original colour of the image to the observer.

✓ D. Finer fibres can give image of better resolution.

4.5 C

✗ A. Ultrasound scanning is not suitable for lung scanning as ultrasound can hardly enter air and bone.

✗ B. Optic endoscopy can only show the internal structure of a hollow organ. The mass is outside the lung that cannot be viewed by endoscope.

✓ C. CT can provide a 3-D orientation of the mass that can give more information for further treatment.

✗ D. Radionuclide imaging can only provide information about the function of an organ.

...that all public exam questions, if any, are licensed by copyright owner HKEAA.

4.6 C

By $I = I_o e^{-\mu x}$ $\therefore \left(\frac{I}{I_o}\right) = e^{-\mu x}$ $\ln\left(\frac{I}{I_o}\right) = -\mu x$

By comparing with the straight line equation : $y = mx + c$ $\therefore$ slope of the graph $= -\mu$

$\therefore$ Magnitude of the slope $= \mu = \frac{1.5}{2.0} = 0.75\ \text{cm}^{-1}$

$\therefore$ Half-value thickness $= \frac{\ln 2}{\mu} = \frac{\ln 2}{0.75} = 0.924\ \text{cm}$

4.7 A

By $\frac{1}{T_e} = \frac{1}{T_p} + \frac{1}{T_b} = \frac{1}{6} + \frac{1}{9}$ $\therefore$ effective half-life : $T_e = 3.6$ hours

By $A = A_o (\frac{1}{2})^{t/T_e}$ $\therefore A_t = (2500)(\frac{1}{2})^{3/3.6} = 1400\ \text{Bq}$

4.8 D

- ✗ A. RNI cannot show the clear picture of an organ.
- ✗ B. There is no attenuation of gamma rays in the human body.
- ✗ C. A hot spot may show different inflammation, infection or tumour.
- ✓ D. A cold spot confirm that the organ cannot function properly.

All rights reserved by Beacon College Ltd, except that ...

Q4. (a) By $Z = \rho c$

$\therefore (4.23 \times 10^6) = \rho(2850)$

$\therefore \rho = 1480\ \text{kg m}^{-3}$ < accept 1484 kg m^{-3} > [1]

(b) (i) $\alpha = \frac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2} = \frac{(1.65\times10^6 - 430)^2}{(1.65\times10^6 + 430)^2}$ [1]

$\alpha = 0.999$ < accept $\alpha \approx 1$ > [1]

(ii) Since the intensity reflection coefficient is almost equal to 1,
almost ultrasound is reflected from the air-tissue interface,
and no ultrasound can enter the tissue of the human body. [1]

(iii) Apply coupling gel that have same acoustic impedance as the tissue to the skin
so that ultrasound can enter the tissue from the transducer. [1]

(c) $d = \frac{1}{2} v t = \frac{1}{2}(1620) \times (75 \times 10^{-6}) = 0.06075\ \text{m}$ < accept 0.0608 m or 0.061 m > [1]

(d) Low frequency ultrasound has higher penetrating power that can reach the organ deep inside the human body [1]
The disadvantage is that it has lower resolving power. [1]

(e) A-scan gives one dimensional image but B-scan gives two dimensional image. [1]
B-scan provides real-time image but A-scan cannot. [1]