PO LEUNG KUK TANG YUK TIEN COLLEGE
F.6 MOCK EXAMINATION (18/19)

Form	:	6	Date	:	31 – 01 – 2019
Subject	:	Physics	Time	:	08:30 - 11:00
Paper	:	I	Class	:	_____(____)
Full Mark	:	33 (Section A)	Name	:	_____

GENERAL INSTRUCTIONS

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

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

3. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book 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. Follow also the instructions given in the announcement before the start of the examination. You should write your Name, Class and Class number in the spaces provided on the Answer Sheet. No extra time will be given to candidates for filling in their personal information after the 'Time is up' announcement.

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

3. All questions carry equal marks.

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

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

6. No marks will be deducted for wrong answers.

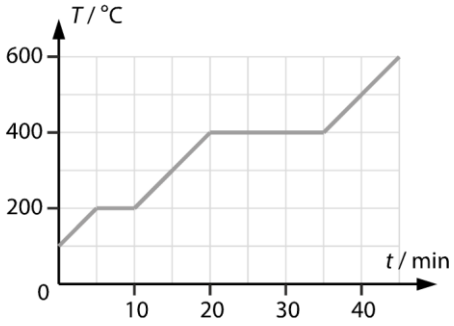
There are 33 questions.

Section A

1. Which of the following options does **NOT** correctly relate the type of thermometer and the corresponding temperature-dependent property used?

	Thermometer	Temperature-dependent property
A.	liquid-in-glass thermometer	Volume
B.	thermistor thermometer	electric resistance
C.	liquid crystal thermometer	density
D.	infra-red thermometer	infra-red radiation

2. Substance *X* is heated by an electric heater with a constant power. Below shows how its temperature *T* varies with time *t*.



Which of the following statements about substance *X* is/are correct?

(1) At *t* = 30 min, both liquid and gas are present at the same time.
(2) Its specific heat capacity in liquid state is twice of that in solid state.
(3) Its latent heat of vaporization is three times that of its latent heat of fusion.

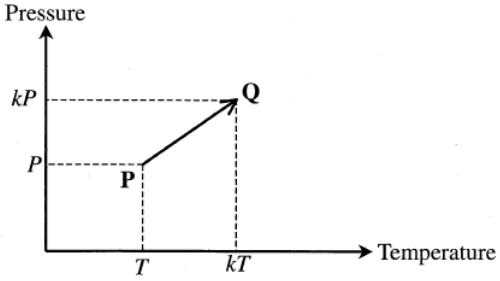
A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

3. Cold drinks inside a double wall glass cup can be kept at a low temperature for a longer time than conventional cups.

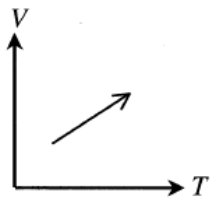
Which of the following statements best explains this phenomenon?

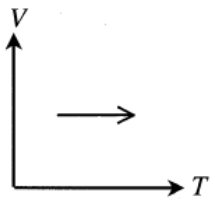
A. The double wall can reduce the heat transfer by radiation.
B. The double wall can prevent convection current from forming between the two layers of glass.
C. Glass has a better insulating ability than air.
D. The air between the two layers of glass is a poor conductor of heat.

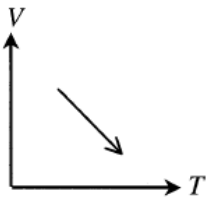
*4.

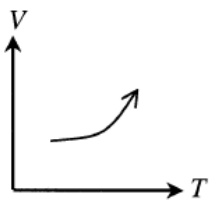


Which of the following graph best shows the corresponding volume-temperature (*V*-*T*) relationship from P to Q?

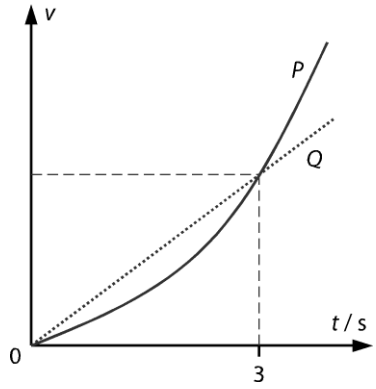
A. 

B. 

C. 

D. 

5. Two cars *P* and *Q* travel on a straight road with the same starting position. The velocity–time graph below shows how the move.

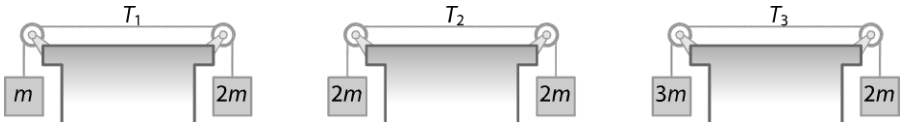


Which of the following statements is/are correct?

(1) The cars have the same instantaenous velocity at $t = 3$ s.
(2) The cars have the same average velocity from $t = 0$ to 3 s.
(3) *P* overtakes *Q* at $t = 3$ s.

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

6. A string is placed over two pulleys. Weights of different mass are hung in turn on the two ends of the string and released from rest. The tensions in the strings from left to right are T_1, T_2 and T_3.



Rank the tensions.

A. $T_2 > T_3 = T_1$
B. $T_3 > T_1 > T_2$
C. $T_3 = T_1 > T_2$
D. $T_3 > T_2 > T_1$

7. Which of the following is/are action-reaction pair(s)?

	Situation	Pair of forces
(1)	a man falling at the terminal speed in air	the weight of the man **and** the air resistance
(2)	a man travelling along a horizontal circular path	the frictional force acting on the man by the ground **and** the centripetal force acting on the man
(3)	a satellite orbiting around the Earth	the gravitational force acting on the satellite by the Earth **and** the gravitational force acting on the Earth by the satellite

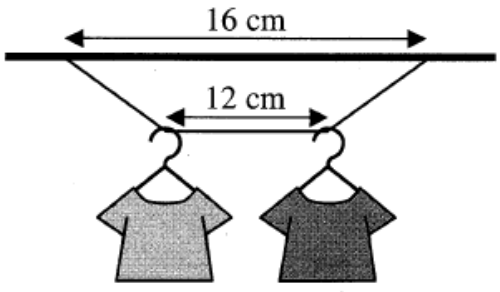
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

8.

In the figure above, four sets of forces are acting on four objects. How many objects are in equilibrium?

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

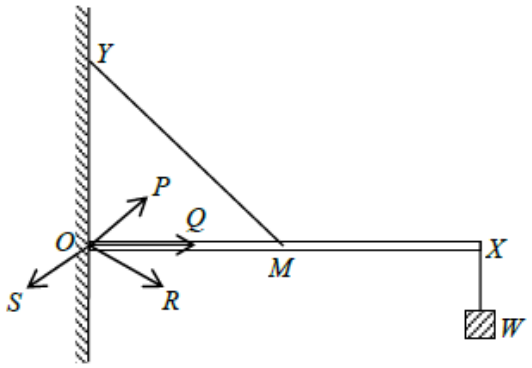
9.



Two clothes of 720 g each are hung on a 20 cm long inextensible string as shown above. What is the tension on the horizontal part of the string?

A. 4.08 N
B. 6.12 N
C. 8.16 N
D. 14.1 N

10.



A uniform light rigid rod *OX* is hinged smoothly to a wall at one end *O*. Its mid-point *M* is connected by a light inextensible string to a point *Y* directly above *O* while a weight *W* is suspected from the other end *X* of the rod as shown. Rod *OX* remains horizontal. The reaction force acting on the rod due to the wall is along the direction

A. *OP*
B. *OQ*
C. *OR*
D. *OS*

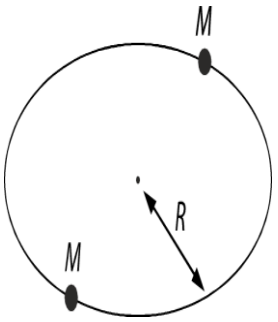
11. There are two carts *X* and *Y* sitting apart on a straight air track. Cart *X* has mass m_1 and cart *Y* has mass m_2. With a small push on cart *X*, it moves forwards and collides with the stationary cart *Y*. After collision, the two carts move at the same speed but in opposite directions. If the collision is elastic, how is m_1 related to m_2?

A. $3m_1 = m_2$
B. $2m_1 = m_2$
C. $m_1 = 2m_2$
D. $m_1 = 3m_2$

*12. A bullet is fired horizontally towards a vertical wall 1.0 m away. It hits the wall at a point 0.5 m below the point of projection. At what speed does the bullet hit the wall?

A. 3.13 m s^{-1}
B. 4.13 m s^{-1}
C. 4.43 m s^{-1}
D. 5.43 m s^{-1}

*13. A binary star system consists of two stars revolving around each other due to their mutual gravitational forces. Consider a binary system in which the two stars are of the same mass M. The two stars move in the same circular orbit of radius R and are always on the opposite sides of the centre.



What is the period T of the circular motion of the stars?

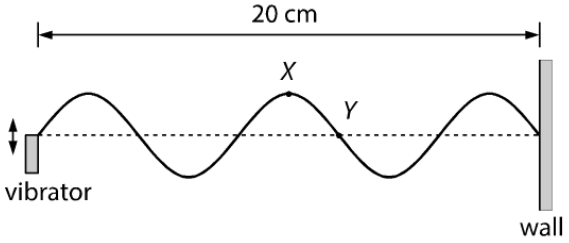
A. $T = \frac{2\pi}{GM} \cdot R^{3/2}$

B. $T = \frac{4\pi}{GM} \cdot R^{3/2}$

C. $T = \frac{2\pi}{\sqrt{GM}} \cdot R^{3/2}$

D. $T = \frac{4\pi}{\sqrt{GM}} \cdot R^{3/2}$

14. A string is attached to a vibrator at one end and is fixed on a wall at the other end. When the vibrator is set at a certain frequency, a stationary wave is formed in the string. At the instant shown, the displacements of all the particles in the string are at their maxima.



Which of the following statements are correct?

(1) The wavelength of the wave is 8 cm.
(2) Particle X is momentarily at rest.
(3) Particle X and particle Y has the same amplitude.

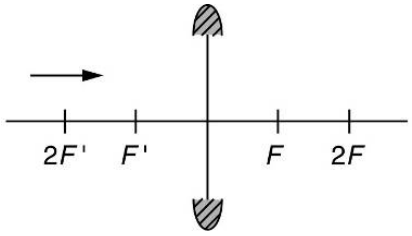
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

15. The critical angles of media X and Y are c_X and c_Y respectively. If $c_X > c_Y$, which of the following statements are correct?

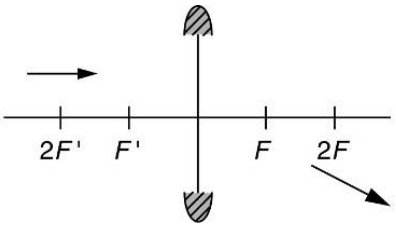
(1) X is optically denser than Y.
(2) Light travels at higher speed in X than that in Y.
(3) When light travels from X to Y, its wavelength decreases.

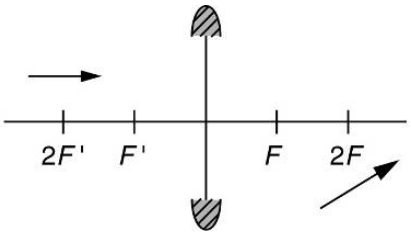
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

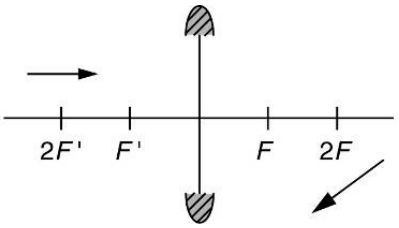
16. In the following diagram, F and F' are the foci of the lens and an arrow locates around $2F'$.

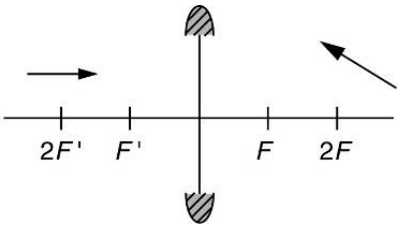


Which of the following diagrams shows the image correctly?

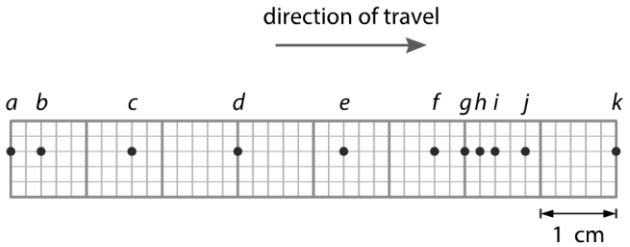
A.


B.


C.


D.


17. A train of longitudinal waves travels from left to right in a medium at a speed of 30 cm s^{-1}. Particles a to k are evenly distributed on a straight line when they are in their equilibrium positions. The figure below shows the positions of those particles when the train of waves passes through.

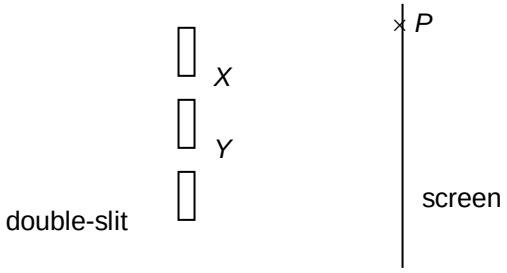


Which of the following statements is/are correct?

(1) Particles d and k are in phase.
(2) The wavelength of the waves is 5 cm.
(3) The period of the waves is 0.213 s.

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

*18.



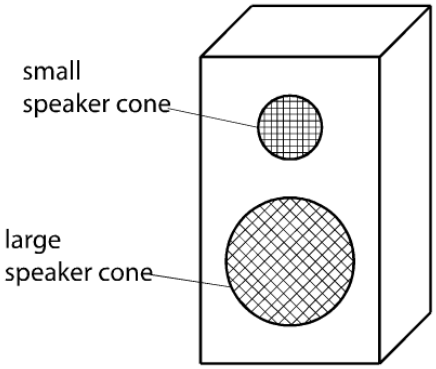
In a Young's double-slit experiment, light of wavelength 0.4 μm is used. If the path difference at point *P* on the screen is 3 μm, which of the followings are correct?

(1) The 8th order dark fringe forms at *P*.
(2) The fringe separation on the screen increases if a red light source is used.

(3) *P* becomes a bright fringe if light of wavelength 500 nm is used.

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

19. The figure shows a loudspeaker unit with two speaker cones, a big one and a small one. Audible sound generated by the speaker will bend around the rim of the cones.

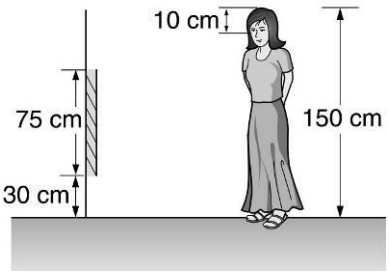


Which of the following statements is/are correct?

(1) Larger the loudness, larger the amplitude of the sound is.
(2) The bigger cone is more suitable for emitting high-pitch sounds.
(3) The sound emitted by the bigger cone travels faster in the air.

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

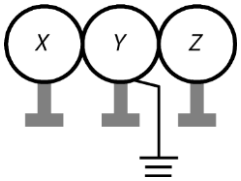
20. In the following figure, a girl 150 cm tall stands facing a 75 cm long mirror, the bottom edge of which is 30 cm above the floor.



If the girl's eyes are 10 cm below the top of her head, which of the following statements is **incorrect**?

A. The girl cannot see her whole image no matter how far she is from the mirror.
B. The girl cannot see her whole image no matter how high she hangs the mirror.
C. The distance between the girl and the mirror is the same as the distance between the girl's image and the mirror.
D. The girl's image can be photographed.

21. Three conducting spheres *X*, *Y* and *Z* are placed side by side on insulating stands, as shown. *X* is in contact with *Y* and *Y* is in contact with *Z*. The middle sphere *Y* is earthed.



If a positively charged rod is brought near *X* from the left without touching any sphere, in that situation which of the following statements is/are correct?

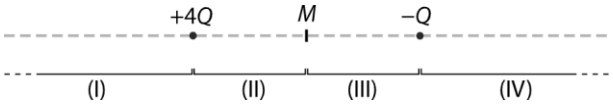
(1) *X* is negatively charged.
(2) *Y* is neutral.
(3) *Z* is positively charged.

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

22. A metal wire of length *l* and diameter *d* has resistance of 10 Ω. If another wire made of the same metal is 2*l* in length and 0.5*d* in diameter, what is its resistance?

A. 5 Ω
B. 10 Ω
C. 40 Ω
D. 80 Ω

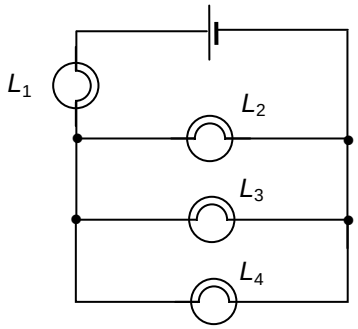
*23. Two point charges $+4Q$ and $-Q$ are fixed on a straight line as shown. M is the mid-point between the two charges.



In which regions on the line could the resultant electric field due to the two charges be zero?

A. Both (I) and (IV)
B. Both (II) and (III)
C. (III) only
D. (IV) only

24. In the following circuit, all lamps are identical.

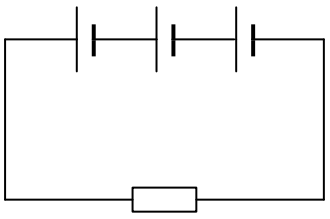


If the filament in L_3 is burnt, which of the following will happen?

(1) L_1 will be dimmer.
(2) L_2 will be dimmer.
(3) L_4 will be brighter.

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

*25. A resistor of resistance R is connected to three identical cells as shown. Each cell has an internal resistance r and an e.m.f. V.



What is the current flowing through the resistor?

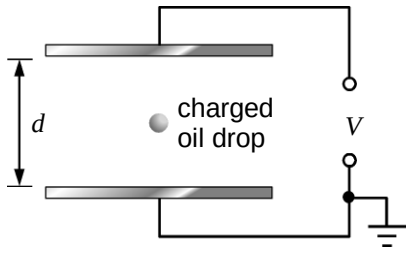
A. $\dfrac{3V}{r+R}$

B. $\dfrac{3V}{3r+R}$

C. $\dfrac{3V}{\frac{r}{3}+R}$

D. $\dfrac{V}{3r+R}$

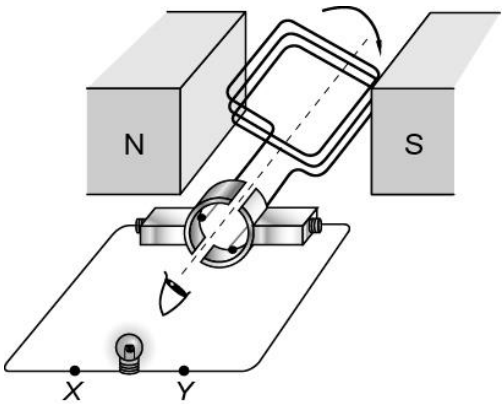
26. A p.d. V is applied across two horizontal parallel metal plates which are separated by d. A charged oil drop is floating in midair between the plates as shown.



Which of the following changes to V and d will keep the oil drop floating in midair?

	V	***d***
A.	halved	doubled
B.	doubled	halved
C.	doubled	doubled
D.	doubled	squared

*27. In the following figure, the coil in the simple generator rotates clockwise to the observer.

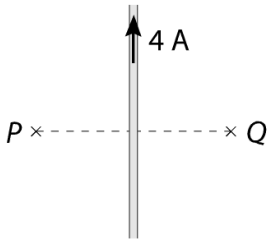


Which of the following statements about the generator is/are correct?

(1) It is an a.c. generator.
(2) The current produced passes through the lamp from X to Y.
(3) The brightness of the lamp increases with the rotation speed of the coil.

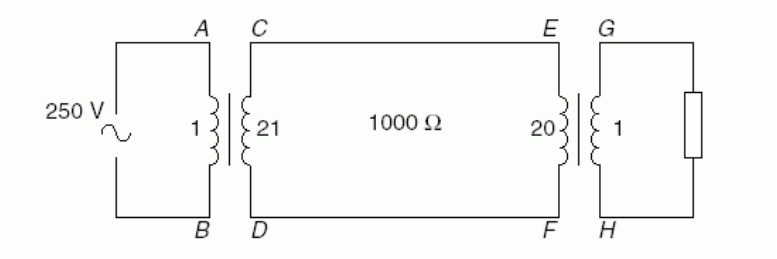
A (1) only
B (3) only
C (1) and (2) only
D (2) and (3) only

28. A straight wire carries a current of 4 A flowing upward. *P* and *Q* are two points equidistant from the wire, with *P* on the left and *Q* on the right as shown. The Earth's magnetic field is **NOT** negligible. When a magnetic field detector is placed at *P*, the recorded magnetic flux density is 10 μT. When the detector is placed at *Q*, the recorded value is 70 μT. What is the distance of *P* from the wire and the Earth's magnetic flux density at *P*?



	Distance of *P* from the wire	**Earth's magnetic field at *P***
A.	2.67 cm	40 μT
B.	2.67 cm	30 μT
C.	10 cm	40 μT
D.	10 cm	30 μT

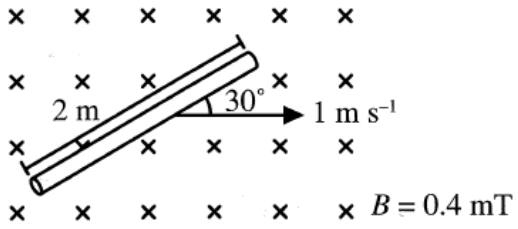
29. The following figure shows a power line for transmitting electrical power from a power station to a factory. The power line has a resistance of 1 kΩ and the current through the line is 0.25 A.



If the transformers are 100% efficient, what is the voltage across *GH*?

A. 200 V
B. 220 V
C. 250 V
D. 263 V

*30. A metal bar of length 2 m is moving at a speed of 1 ms^{-1} in a uniform magnetic field of strength 0.4 mT as shown. The angle between the metal bar and its direction of motion is 30°. Find the induced e.m.f. on the metal bar.



A. 0.1 mV
B. 0.4 mV
C. 0.8 mV
D. 2 mV

31. The radioisotope californium-249 ($^{249}_{98}Cf$) undergoes a series of decay to become neptunium-237 ($^{237}_{93}Np$). During the process, how many α and β decays does it undergo?

	α decay	β decay
A.	2	1
B.	3	1
C.	3	2
D.	6	5

32. A radioactive source is placed in front of a G-M tube connected to a counter. Different materials are placed between the source and the G-M tube. The following table shows the count rate recorded:

Material	Count per minute
Nothing	702
Paper	510
Aluminium (5 mm thick)	501
Lead (25 mm thick)	213

The source emits

A. α radiation only.
B. β radiation only.
C. α and γ radiation only.
D. β and γ radiation only.

33. The decay constant of a radioactive sample is 3×10^{-4} s^{-1}. The sample initially consists of 99% of undecayed nuclides. How long does it take for the percentage of the undecayed nuclides in the sample decrease to 1%?

A. 38.5 minutes
B. 62.9 minutes
C. 4.17 hours
D. 4.25 hours

END OF SECTION A

List of data, formulae and relationships

Data

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

Rectilinear motion

For uniformly accelerated motion:

$$v = u + at$$

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

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

Mathematics

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

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

Astronomy and Space Science

$U = -\frac{GMm}{r}$	gravitational potential energy
$P = \sigma AT^4$	Stefan's Law
$\left\|\frac{\Delta f}{f_0}\right\| \approx \frac{v}{c} \approx \left\|\frac{\Delta\lambda}{\lambda}\right\|$	Doppler effect

Energy and Use of Energy

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

Atomic World

$\frac{1}{2}m_c {v_{max}}^2 = hf - \phi$	Einstein's photoelectric equation
$E_n = -\frac{1}{n^2}\left\{\frac{m_e e^4}{8h^2\epsilon_0^2}\right\} = -\frac{13.6}{n^2}\text{eV}$	energy level equation for hydrogen atom
$\lambda = \frac{h}{p} = \frac{h}{mv}$	de Broglie formula
$\theta \approx \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)

Medical Physics

$\theta \approx \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)
power $= \frac{1}{f}$	power of a lens
$L = 10 \log \frac{I}{I_0}$	intensity level (dB)
$Z = \rho c$	acoustic impedance
$\alpha = \frac{I_r}{I_0} = \frac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$	intensity reflection coefficient
$I = I_0 e^{-\mu x}$	transmitted intensity through a medium

A1.	$E = mc\,\Delta T$	energy transfer during heating and cooling
A2.	$E = \ell \Delta m$	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.	$E_{\mathrm{K}} = \frac{3RT}{2N_{\mathrm{A}}}$	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.	$E_{\mathrm{P}} = mgh$	gravitational potential energy
B4.	$E_{\mathrm{K}} = \frac{1}{2}mv^2$	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.	$F = \frac{Q_1Q_2}{4\pi\epsilon_0 r^2}$	Coulomb's law
D2.	$E = \frac{Q}{4\pi\epsilon_0 r^2}$	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.	$\frac{V_{\mathrm{S}}}{V_{\mathrm{P}}} \approx \frac{N_{\mathrm{S}}}{N_{\mathrm{P}}}$	ratio of secondary voltage to primary voltage in a transformer
E1.	$N = N_0 \mathrm{e}^{-kt}$	law of radioactive decay
E2.	$t_{½} = \frac{\ln 2}{k}$	half-life and decay constant
E3.	$A = kN$	activity and the number of undecayed nuclei
E4.	$E = mc^2$	mass–energy relationship