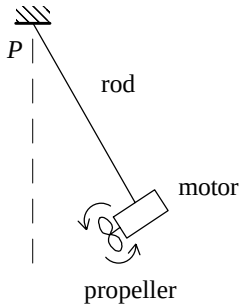
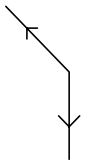
1994 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

1.



The above figure shows a propeller-motor system connected by a light, rigid rod to a fixed point *P* on the ceiling. The system remains stationary when the motor is on. Which of the following diagrams correctly represents the forces acting on the propeller-motor system?

A.



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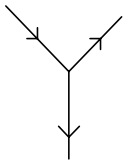

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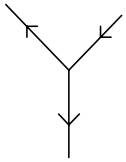

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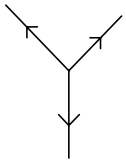
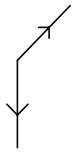
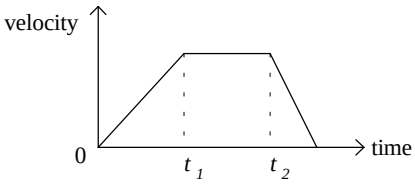


E.

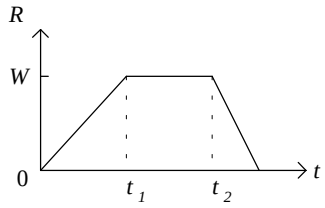


2. A man of weight *W* stands on a compression balance placed inside a lift. The velocity-time graph of the lift is shown below (The upward direction is taken to be positive):

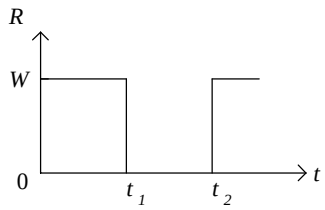


Which of the following graphs best shows the variation of the reading on the balance, *R*, with time, *t*?

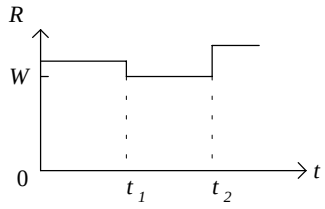
A.



B.



C.



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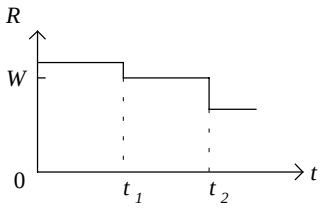
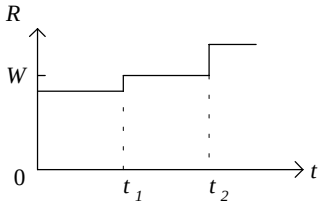
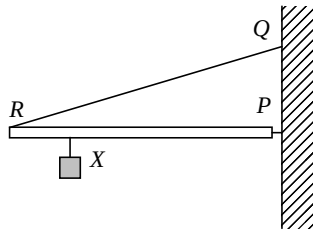


E.



3.



A uniform metre rule of mass 0.15 kg is hinged to a wall at *P* and the other end *R* is connected by a wire attached to the wall at *Q*, vertically above *P*. A block *X* of mass 0.1 kg is hung from the rule 30 cm from *R*. The metre rule is horizontal. Find the moment about *P* produced by the tension in the wire.

A. 1.45 Nm
B. 1.05 Nm
C. 0.75 Nm
D. 0.70 Nm
E. 0.25 Nm

4. A softball of mass 0.5 kg flies horizontally with a speed of 20 m/s towards a player. After being hit by the bat, it flies away at 30 m/s perpendicular to its original direction. Find the magnitude of the impulse acting on the softball.

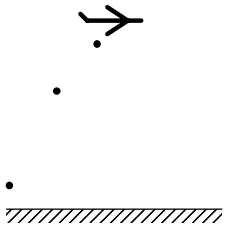
A. 5 kg m/s
B. 18 kg m/s
C. 20 kg m/s
D. 25 kg m/s
E. 36 kg m/s

5. A student whirls a small bucket of water in a vertical circle of radius 0.6 m. For no spilling, what is the minimum speed of the bucket at the highest point of its path?

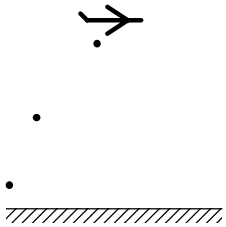
A. 2.45 m/s
B. 3.46 m/s
C. 4.08 m/s
D. 4.90 m/s
E. 5.77 m/s

6. Three bombs are released from a bomber flying horizontally with constant velocity to the right. They are released from rest (relative to the bomber) one by one at one-second intervals. Neglecting air resistance, which of the following diagrams correctly shows the positions of the bomber and the three bombs at a certain instant?

A.



B.



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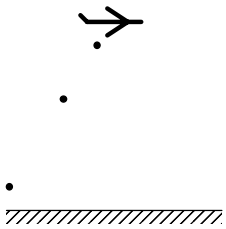

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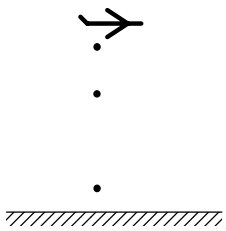
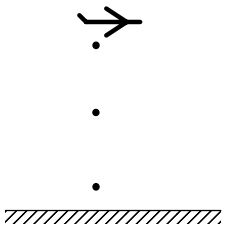


E.



7. When an object falls freely, its total energy

   A. increases during the fall.
   B. decreases during the fall.
   C. remains constant during the fall.
   D. is zero at the beginning of the fall.
   E. is at a maximum at the end of the fall.

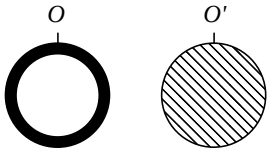
8. A small mass is hung vertically from a light spring fixed at its upper end. When the mass is pulled down 1 cm from its equilibrium position and released from rest, it takes 0.3 s to rise back to its equilibrium position. If the mass is pulled down 2 cm from its equilibrium position and released from rest, how long does it take for the mass to rise 1 cm? (Assume that the spring obeys Hooke's law.)

   A. 0.30 s
   B. 0.25 s
   C. 0.20 s
   D. 0.15 s
   E. 0.10 s

9. Which of the following physical quantities will decrease with time in damped harmonic motion?

   (1) Period
   (2) Amplitude
   (3) Mechanical energy

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

10. 

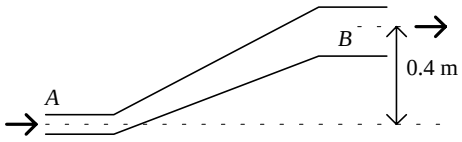
The above figure shows a uniform ring and a uniform disc, with equal mass and radius, smoothly hinged at points *O* and *O'* on their respective circumferences. The are set into small oscillation of equal amplitude about axes through *O* and *O'* perpendicular to the plane of the paper. Which of the following statements is/are correct?

(1) The moment of inertia of the ring about the axis through *O* is greater than that of the disc about the axis through *O'*.
(2) The period of oscillation of the ring is longer.
(3) Both the ring and the disc have the same total kinetic energy when their centres are vertically below their respective axes.

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

11. Two satellites *A* and *B* of the same mass are moving in circular orbits round the earth. The radius *A*'s orbit is *r* and that of *B*'s orbit is 2*r*. Their total mechanical energies are E_A and E_B respectively. Which of the following descriptions about E_A and E_B is correct? (Gravitational potential energy is taken to be zero at infinity)

   A. $E_A > 0$ and $E_B = 2E_A$
   B. $E_A > 0$ and $E_B = \frac{1}{2}E_A$
   C. $E_A > 0$ and $E_B = -2E_A$
   D. $E_A < 0$ and $E_B = 2E_A$
   E. $E_A < 0$ and $E_B = \frac{1}{2}E_A$

12. 

The figure above shows part of a pipe having circular cross-sections. The area of the cross-section at *B* is double that at *A* and the centre of the cross-section at *B* is 0.4 m higher than that at *A*. If an ideal liquid flows steadily through the pipe with speed 4 m/s at *A*, what is the difference in static pressure between *A* and *B*? (Given: density of the liquid is 1200 kg/m³)

A. 2 400 N/m²
B. 4 200 N/m²
C. 4 800 N/m²

D. 7 200 N/m²
E. 12 000 N/m²

13. One mole of an ideal gas is contained in a cylinder fitted with a light, frictionless piston. The gas is heated under constant pressure P so that its volume increases from V to $4V$ and the final temperature is T. If R is the universal gas constant, the work done by the gas is

A. $3RT/4$
B. $RT/3$
C. RT
D. $3RT$
E. $4RT$

14.

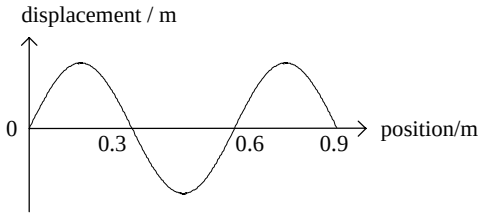


Figure (a)

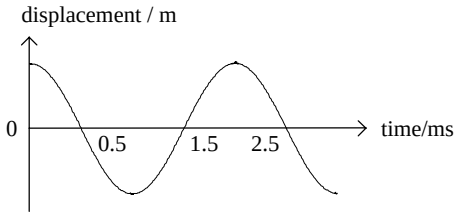


Figure (b)

Figure (a) represents the displacement-position graph of a travelling wave at a certain instant and Figure (b) represents the displacement-time graph of a particle in the wave. The speed of the wave is

A. 300 m/s
B. 150 m/s
C. 1.2 m/s
D. 0.6 m/s
E. 0.3 m/s

15. The speed of light in a certain material is 1.6×10^8 m/s. Find the critical angle for that material and air. (Speed of light in air = 3×10^8 m/s)

A. 28.1°
B. 32.2°
C. 41.8°
D. 48.0°
E. 57.8°

16. Three tuning forks X, Y and Z are of slightly different frequencies. If X and Y are sounded together, 3 beats per second are heard while X and Z sounded together give 1 beat per second. Which of the following is/are correct deduction(s)?

(1) 4 beats per second are heard when Y and Z are sounded together.
(2) The frequency of Z is higher than that of Y.
(3) If X has the highest frequency, then the frequency of Y must be the lowest.

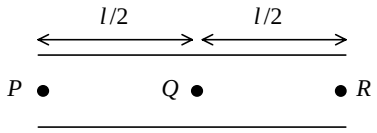
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only
E. (1), (2) and (3)

17. Which of the following waves can be polarised?

(1) microwaves
(2) X-rays
(3) ultrasonic waves

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

18.



A stationary sound wave vibrating in its fundamental mode is set up in a pipe open at both ends. If an air particle at P oscillates with amplitude a, what are the amplitudes of oscillation of the air particles at Q and R? (Neglect end corrections)

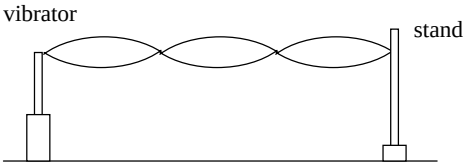
	Amplitude at Q	Amplitude at R
A.	0	$a/2$
B.	$a/2$	0
C.	0	a
D.	a	0

E *a* *a*

19. An ambulance, sounding its siren to produce a note of 800 Hz, approaches a stationary pedestrian *P* at a steady speed of 40 m/s. Calculate the frequency of the sound heard by *P*. (Speed of sound in air = 340 m/s)

A. 706 Hz
B. 716 Hz
C. 800 Hz
D. 894 Hz
E. 907 Hz

20.



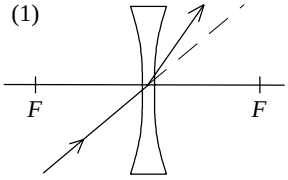
In the above experimental set-up, different stationary wave patterns are produced on an elastic string by adjusting the frequency *f* of the vibrator. Which of the following statements is/are correct?

(1) When *f* increases, the number of antinodes increases.
(2) When *f* increases, the speed of the waves on the string increases.
(3) The waves produced in air by the string has the same speed as the waves on the string.

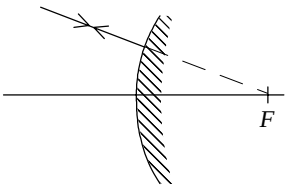
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only
E. (1), (2) and (3)

21. Which of the following ray diagrams is/are correct? (*F* is the focus of the corresponding optical instrument.)

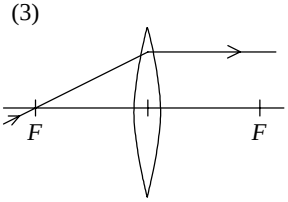
(1)



(2)



(3)



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

22. A uniform wire of force constant *k* and Young modulus *E* is cut into two shorter wires of equal length. If they are arranged side by side and treated as a single wire combination, what are the force constant and the Young modulus for this combination?

	Force Constant	Young modulus
A.	*k*	*E*
B.	2*k*	*E*
C.	2*k*	2*E*
D.	4*k*	*E*
E.	4*k*	2*E*

23. A 10 W light bulb gives a certain illumination on a surface 1.5 m away. At what distance would a 40 W light bulb give the same illumination? (You may regard a light bulb as a point source)

A. 1.5 m
B. 3.0 m
C. 6.0 m
D. 12.0 m
E. 24.0 m

24. *X*, *Y* are two different points in an electric field. A small charged object is released from rest at *X*. Which of the following conditions would ensure that the charged object will NOT pass through *Y*?

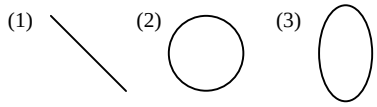
A. The electric field at *Y* is zero.
B. The electric field at *Y* is stronger than that at *X*.
C. The electric field between *X* and *Y* is not zero.
D. The electric potentials at *X* and *Y* are equal.
E. The electric potential difference between *X* and *Y* is not zero.

25. Which of the following pairs of physical quantities is/are both scalars?

(1) work done and electric field intensity
(2) pressure and force
(3) charge and electric potential

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

26. Two sinusoidal a.c. signals having a phase difference of 90º are applied to the *x*-plates and *y*-plates of a CRO. Which of the following traces may appear on the screen of the CRO?



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

27. The electric potential energy of a system of charges at infinitely large distances from one another is taken to be zero. What is the electric potential energy stored in a system of four charges, each of +1 C, placed at the vertices of a square with length of side 1 m? (ε_0 = permittivity of vacuum)

A. $\dfrac{3}{\pi\varepsilon_0}$

B. $\dfrac{1}{\pi\varepsilon_0}\left(2+\dfrac{1}{\sqrt{2}}\right)$

C. $\dfrac{1}{\pi\varepsilon_0}$

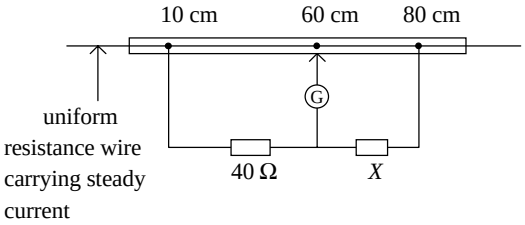
D. $\dfrac{5}{4\pi\varepsilon_0}$

E. $\dfrac{1}{4\pi\varepsilon_0}\left(4+\sqrt{2}\right)$

28. A parallel-plate capacitor of capacitance C_0 is formed by two rectangular metal plates having separation *d*. Now each of the plates is cut into two smaller, identical ones to form two capacitors, each with plate separation 2*d*. What is the capacitance when they are connected in parallel?

A. $\frac{1}{2}C_0$
B. $\frac{1}{4}C_0$
C. C_0
D. $2C_0$
E. $4C_0$

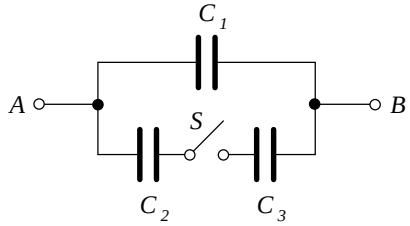
29.



In the above circuit, the galvanometer *G* reads zero. The resistance of resistor *X* is

A. $40 \times (5/2)\ \Omega$
B. $40 \times (4/3)\ \Omega$
C. $40 \times (2/5)\ \Omega$
D. $40 \times (3/4)\ \Omega$
E. $40 \times (7/5)\ \Omega$

30.



In the above circuit, a charged capacitor C_1 is connected across *AB* so that it is parallel with

two initially uncharged capacitors C_2 and C_3. Which of the following statements is/are correct when switch S is closed?

(1) The potential difference across AB will drop.
(2) The combined capacitance across AB will increase.
(3) The quantity of charge on C_2 is the same as that on C_3.

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

31. For two long, straight parallel conducting wires carrying the same current, the magnitude of the force acting on a section of the wires depends on

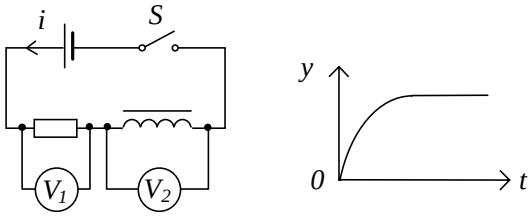
(1) the distance between the wires
(2) the length of that section of the wires
(3) the directions of current flow in the wires

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

32. The current in a coil changes steadily from 3 A to 6 A in 75 ms so that a back e.m.f. of 4 V is induced in the coil. The self-inductance of the coil is

A. 0.025 H
B. 0.10 H
C. 40 H
D. 100 H
E. 160 H

33.

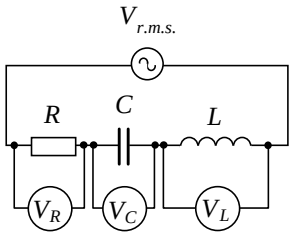


When the switch S in the above circuit is closed, the variation of quantity y with time t is plotted as shown. The quantity y could be

(1) the current i in the circuit.
(2) the voltage V_1 across the resistor.
(3) the voltage V_2 across the inductor.

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

34.



In the LCR series circuit shown above, the frequency of the a.c. source is varied while its r.m.s. output voltage $V_{r.m.s.}$ is kept constant. The voltmeters connected across R, C and L give r.m.s. readings V_R, V_C and V_L respectively. Which of the following statements is/are correct?

(1) At any instant, the current through R, C and L is the same.
(2) At resonance $V_L = V_C$.
(3) At any instant, $V_{r.m.s.} = V_R + V_C + V_L$.

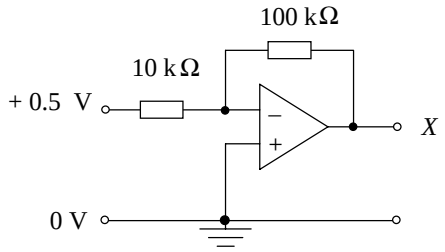
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only
E. (1), (2) and (3)

35. Which of the following statements about an operational amplifier is/are correct?

(1) It amplifies the difference between the voltages at its two inputs.
(2) For d.c., the open loop voltage gain is of the order 10^5.
(3) For a.c., the open loop voltage gain decreases with increasing frequency.

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

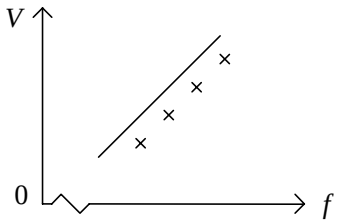
36.



The above figure shows an operational amplifier circuit which uses a ±15 V supply (not shown). If the input potential is +0.5 V, what is the potential at point *X*?

A. -5 V
B. -15 V
C. +0.5 V
D. +5 V
E. +15 V

37.



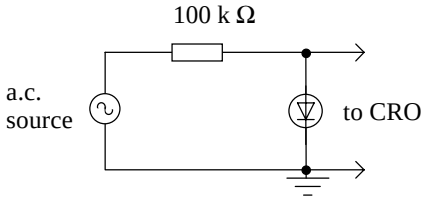
A student measures the p.d. *V* to stop photoelectrons emitted in a photocell illuminated by monochromatic light of various frequencies *f*. The resulting points when plotted on a *V*-*f* graph (as shown) do not lie on the solid line drawn from standard results obtained with a similar photocell. The reason could be

A. the standard results are obtained with light of higher intensity.
B. he has used a voltmeter which has a fixed zero error.
C. he has read the wrong scale on his voltmeter so that his readings always double the actual readings.
D. he has connected the variable d.c. supply with the wrong polarities to the photocell.
E. he has plotted the wavelength of light in place of the frequency on the horizontal axis.

38. In a hydrogen atom, electron transitions from the first excited state to the ground state give photons of frequency *f*. If an electron falls from the second excited state to the first one, the frequency of the photon emitted would be

A. 0.19 *f*
B. 0.44 *f*
C. 0.84 *f*
D. 1.19 *f*
E. 2.25 *f*

39.



In the above circuit, the waveform across the diode shown on the screen of the CRO should be

A.

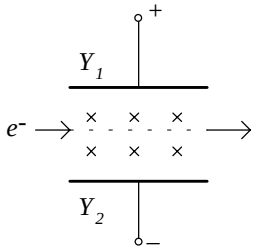
B.

C.

D.

E.

40. In Thomson's experiment, an electron is accelerated from rest through a p.d. *V* (not shown) and then passes without any deflection through a region with mutually perpendicular electric and magnetic fields.



The electric field is provided by the deflecting plates Y_1, Y_2 with p.d. V and separation d. The applied uniform magnetic field is B. The charge to mass ratio (e/m) of an electron is given by

A. $\frac{2B^2d^2}{V}$
B. $\frac{V}{2B^2d^2}$
C. $\frac{B^2d^2}{2V}$
D. $\frac{2V}{B^2d^2}$
E. $\frac{B^2d^2}{2V^3}$

41. When a radioactive atom emits γ-rays, which of the following statements about the atom is/are correct?

(1) Its mass number remains unchanged.
(2) The energy of the atomic nucleus decreases.
(3) An electron falls from a higher energy level to a lower one.

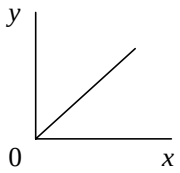
A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only
E. (1), (2) and (3)

42. Given: mass of proton = 1.0073 u
mass of neutron = 1.0087 u
mass of $^{206}_{82}\text{Pb}$ = 205.969 u
1 u corresponds to 931 MeV

Find the binding energy per nucleon for a $^{206}_{82}\text{Pb}$ nucleus.

A. 7.46 MeV
B. 7.72 MeV
C. 12.39 MeV
D. 12.83 MeV
E. 19.40 MeV

43.



A plot of two physical quantities x and y yields the above graph. Which of the following could be those two physical quantities?

	Quantity x	Quantity y
A.	radius of a satellite's orbit	period of the satellite
B.	distance from a point charge	electric potential due to the point charge
C.	extension of a spring	energy stored in the spring
D.	time	charge on a charging capacitor
E.	frequency of an a.c. supply	inductive reactance of an inductor connected to the a.c. supply

44. A detector is used for monitoring an α-source and a reading of 120 units is observed. After a time equal to the half-life of the α-source, the reading has fallen to 64 units. If a 5 mm thick lead sheet is inserted between the α-source and the detector, the reading would probably be

A. 0 unit
B. 4 units
C. 8 units
D. 16 units
E. 32 units

45. A stationary uranium-238 nucleus undergoes α -decay. What is the ratio of the kinetic energy of the daughter nucleus to that of the α -particle?

A. 238 : 4
B. 4 : 238
C. 234 : 4
D. 4 : 234
E. 1 : 1

- End of Paper -

Question No.	Key	Question No.	Key
1.	D	26.	D
2.	D	27.	E
3.	A	28.	A
4.	B	29.	C
5.	A	30.	E
6.	D	31.	C
7.	C	32.	B
8.	C	33.	C
9.	D	34.	C
10.	E	35.	E
11.	E	36.	A
12.	A	37.	B
13.	A	38.	A
14.	A	39.	E
15.	B	40.	B
16.	B	41.	C
17.	C	42.	B
18.	C	43.	E
19.	E	44.	C
20.	A	45.	D
21.	B		
22.	D		
23.	B		
24.	D		
25.	B		