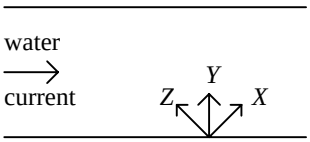
1988 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

1.



A boy wished to swim across a river with parallel banks as shown in the diagram above. Assuming the water current is flowing at 0.5 m/s, and the swimming speed of the boy is 1 m/s, along which direction should the boy swim if he wishes

(1) to reach the opposite bank in the shortest time?
(2) to take the shortest route to the opposite bank?

	(1) shortest time	(2) shortest route
A.	*X*	*Y*
B.	*X*	*Z*
C.	*Y*	*X*
D.	*Y*	*Z*
E.	*Z*	*Y*

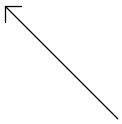
2. A smooth block of mass 2 kg slides down a wedge. The wedge, of mass 10 kg, is placed on a horizontal table, and its inclined plane makes an angle of 30º with the horizontal. If the wedge remains stationary all the time, the normal reaction of the table acting on the wedge is

A. 15 N.
B. 85 N.
C. 100 N.
D. 115 N.
E. 120 N.

3. A football player is running at a velocity of 3 m/s due north. After a violent collision with another player, he is moving at a velocity of 4 m/s due east. Which of the following arrows best represents the direction of his change of velocity?

A.

B.



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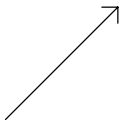

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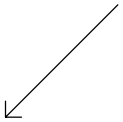
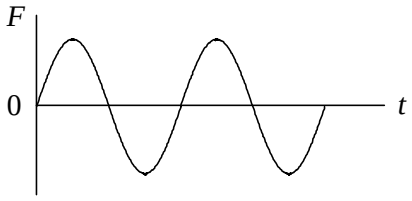


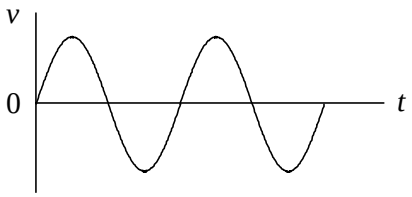
E.

4. A force F is applied to an initially stationary particle from time $t = 0$. F varies sinusoidally with time t as shown in the following graph:



Which of the following graphs best represents the variation of the subsequent velocity v of the particle with t?

A.



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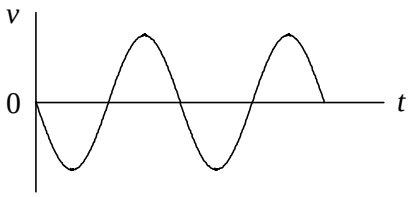

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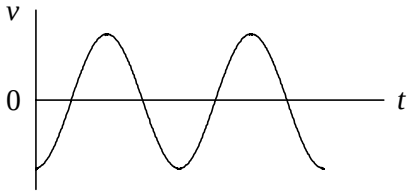

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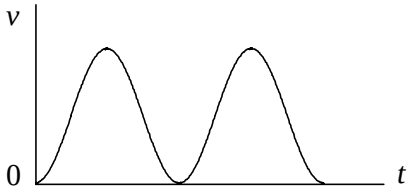

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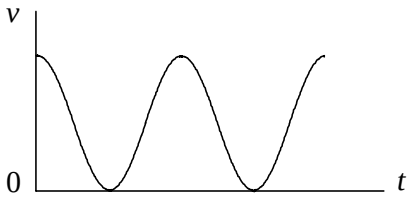

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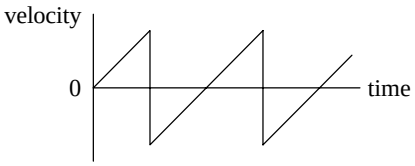


The graph shown is a possible representation of the relation between velocity and time for the motion of

(1) a mass, attached to a spiral spring, pulled vertically downwards and then released.

(2) the spot on the screen of a CRO when a linear time base is operating.

(3) a ball dropped vertically onto a hard, smooth and horizontal surface, where it undergoes elastic collisions.

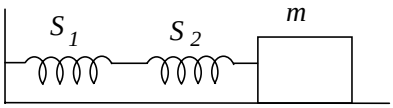
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

6.

A car of mass m travels into a region where the track is an arc of a vertical circle of radius r. At the bottom of this arc, the car travels at speed v. At this position the vertical force exerted upwards by the track on the car is

A. mv^2/r.
B. mg.
C. $mv^2/r - mg$.
D. $mg - mv^2/r$.
E. $mg + mv^2/r$.

7.



A block of mass m is attached to two identical springs S_1 and S_2 as shown. The force constant of the springs is k. If the block is made to execute simple harmonic motion, the period will be

A. $2\pi\sqrt{\frac{m}{4k}}$.
B. $2\pi\sqrt{\frac{m}{2k}}$.
C. $2\pi\sqrt{\frac{m}{k}}$.
D. $2\pi\sqrt{\frac{2m}{k}}$.

E. $2\pi\sqrt{\frac{4m}{k}}$.

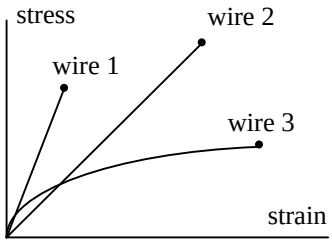
8. A satellite moving round the Earth in a circular orbit of radius R has a period T. What would the period be if the orbit were of radius $R/4$?

A. $T/8$
B. $T/4$
C. $T/2$
D. $2T$
E. $4T$

9. A body is suspended by a string and allowed to swing as a simple pendulum. When it is moved from the north pole to the equator, its period will

A. remain constant.
B. decrease.
C. increase.
D. decrease and then increase.
E. increase and then decrease.

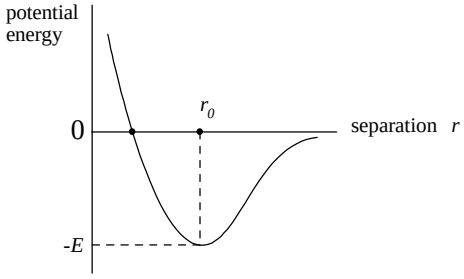
10.



Three wires of different material, but of the same length and cross-sectional area are stretched until they break. Their stress/strain curves are shown in the figure above. If E_1, E_2 and E_3 represent the energy required to break wire 1, wire 2 and wire 3 respectively, which of the following is correct?

A. $E_1 > E_2 > E_3$
B. $E_3 > E_2 > E_1$
C. $E_2 > E_1 > E_3$
D. $E_2 > E_3 > E_1$
E. $E_3 > E_1 > E_2$

11.



The graph above shows how the potential energy between molecules of a substance varies with their separation. Which of the following is an INCORRECT inference from the graph?

A. No resultant force acts on each molecule when $r = r_0$.
B. The force between molecules is repulsive when $r < r_0$.
C. The average separation between the molecules is r_0.
D. The energy required to separate two molecules completely is E.
E. The larger the value of E, the higher is the melting point of the substance.

12. For smoke particles undergoing Brownian motion in air, the motion of the smoke particles is mainly caused by

A. air convention currents.
B. the interaction between oxygen and nitrogen molecules.
C. collisions between air molecules.
D. collisions between smoke particles.
E. collisions between air molecules and smoke particles.

13. If the surface tension of a soap solution is T, the work done in increasing the radius of a soap bubble from a to $2a$ is

A. $2 \pi a^2 T$.
B. $4 \pi a^2 T$.
C. $8 \pi a^2 T$.
D. $12 \pi a^2 T$.
E. $24 \pi a^2 T$.

14. An ideal gas is contained in two metal cylinders A and B connected by a tap, which is

initially closed. The volume and pressure of the gas in the cylinders are as follows:

	pressure/Pa	volume/m³
A	5×10^5	11×10^{-3}
B	2×10^5	4×10^{-3}

When the tap connecting the two cylinders is opened, what will be the final pressure in the vessel? You may assume that the temperature remains constant.

A. 2.4×10^5 Pa.
B. 3.5×10^5 Pa.
C. 4.2×10^5 Pa.
D. 5.0×10^5 Pa.
E. 6.9×10^5 Pa.

15. A piston is SLOWLY pushed into a metal cylinder containing an ideal gas. Which of the following statements is INCORRECT?

A. The mass of the gas remains the same.
B. The pressure of the gas increases.
C. The number of the molecules per unit volume increases.
D. The average speed of gas molecules increases.
E. The frequency of collision of the gas molecules with the piston increases.

16. The energy which must be supplied to 1 mole of gas initially at absolute temperature *T*, pressure *p* and volume *V*, to raise its temperature by 1K, is Q_1 at constant pressure and Q_2 at constant volume. The value of Q_2 is

A. Q_1.
B. $Q_1 + pVT$.
C. $Q_1 - pVT$.
D. $Q_1 - pV/T$.
E. $Q_1 + pV/T$.

17. An ideal gas is at temperature *T*. If the mass of a gas molecule = *m*, the molar gas constant = *R* and the Avogadro constant = N_A, then the r.m.s. speed of the molecules is

A. $\sqrt{3RT / m}$.
B. $\sqrt{RT / (mN_A)}$.
C. $\sqrt{3RT / (mN_A)}$.
D. $\sqrt{RTN_A / m}$.
E. $\sqrt{3RTN_A / m}$.

18. Which of the following is NOT an assumption in deriving the kinetic theory of gases?

A. The volume of the molecules is negligible compared with the volume of the gas.
B. Attractive forces between the molecules are negligible.
C. The duration of a collision is negligible compared with the time between collisions.
D. Collisions with the walls of the container and with other molecules cause no change in the average kinetic energy of molecules.
E. The molecules suffer negligible change of momentum on collision with the walls of the container.

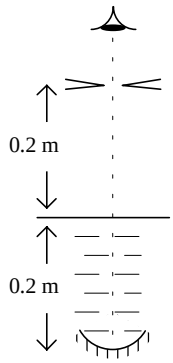
19. The mean free path of air molecules is equal to

A. the average diameter of an air molecule.
B. the average separation between air molecules.
C. the average distance between collisions of air molecules.
D. the average distance travelled by an air molecule in unit time.
E. the distance travelled by an air molecule in free space before coming to rest.

20. An inexpansible vessel contains 1.2 kg of gas at 300 K. What is the mass of gas expelled from the vessel if it is heated from 300 K to 400 K under constant pressure?

A. 0.25 kg
B. 0.3 kg
C. 0.6 kg
D. 0.75 kg
E. 0.9 kg

21.



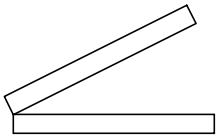
When a pin is moved along the principal axis of a small concave mirror, the image position coincides with the object at a point 0.5 m from the mirror. If the mirror is placed at a depth of 0.2 m in a transparent liquid, the same phenomenon occurs when the pin is placed 0.4 m from the mirror. The refractive index of the liquid is

A. 6/5.
B. 5/4.
C. 4/3.
D. 3/2.
E. 5/3.

22. A projector lens produces a clear, enlarged image of a slide on a screen. How could a clear image with greater magnification be obtained?

	screen movement	lens movement
A.	farther away	closer to the slide
B.	farther away	none
C.	closer	away from the slide
D.	none	closer to the slide
E.	closer	closer to the slide

23.

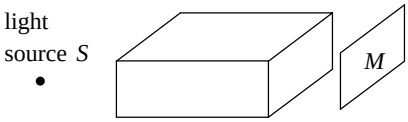


When monochromatic light is incident normally on a wedge-shaped thin air film, an interference pattern may be seen by reflection. Which of the following is/are correct?

(1) Parallel fringes are observed.
(2) If water is introduced into the region between the plates, the fringe separation decreases.
(3) If the angle of the wedge is increased, the fringe separation decreases.

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

24.

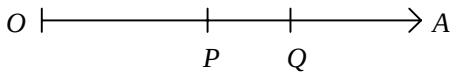


Polarized light is obtained by passing a narrow beam of unpolarized light from source *S* through a tank of water to which a drop of milk has been added. Which of the following statements is/are correct?

(1) Light from source *S* must be monochromatic.
(2) Completely polarized light is detected at position *M*.
(3) The drop of milk provides particles to scatter the light.

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

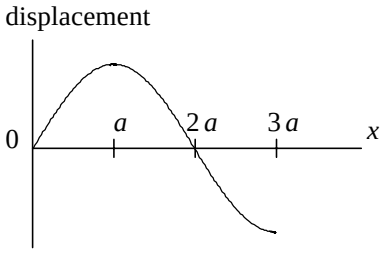
25.



A loudspeaker at *O* produces a progressive sound wave of frequency 330 Hz which propagates along *OA* with a speed of 330 m/s. The phase difference between the air vibrations at *P* and *Q*, 0.5 m apart, is

A. dependent on the distance *OP*.
B. zero.
C. 0.5 radians.
D. $\pi/2$ radians.
E. π radians.

26.



The figure above shows the variation of the displacement of air molecules along the x-axis in a standing sound wave at a particular time. At what positions will the pressure remain constant with respect to time?

A. $x = 0$ and $x = 2a$ only
B. $x = a$ and $x = 3a$ only
C. $x = 0$ and $x = a$ only
D. $x = 2a$ and $x = 3a$ only
E. $x = 0$, $x = a$, $x = 2a$ and $x = 3a$

27. A moving train sounds a whistle of frequency 500 Hz. The apparent frequency heard by an observer standing close to the railroad is 462 Hz. If the speed of sound in air is 300 m/s, the train is moving at a speed of

A. 23 m/s away from the observer.
B. 23 m/s towards the observer.
C. 25 m/s away from the observer.
D. 25 m/s towards the observer.
E. 28 m/s away from the observer.

28. If the sound level of a source increases by 6 dB, the power emitted by the source will have its initial value multiplied by approximately

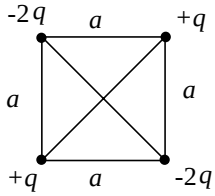
A. $\log_{10} 6$.
B. 2.
C. 4.
D. 6.
E. 10^6.

29. Which of the following is/are equivalent to a unit energy?

(1) electron-volt
(2) kilowatt-hour
(3) volt-coulomb

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

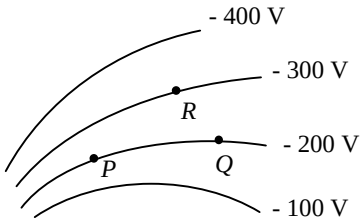
30.



Four particles carrying charges + q, + q, -2 q and -2 q are placed at the vertices of a square of side a. The electric potential at the centre of the square is

A. zero.
B. $\dfrac{-\sqrt{2}q}{2\pi\varepsilon_0 a}$.
C. $\dfrac{-\sqrt{2}q}{\pi\varepsilon_0 a}$.
D. $\dfrac{+\sqrt{2}q}{2\pi\varepsilon_0 a}$.
E. $\dfrac{+\sqrt{2}q}{\pi\varepsilon_0 a}$.

31.



The diagram shows points of equal potential joined as equipotential lines. Which of the following statements is/are correct?

(1) The electric field at P is in a direction tangential to the line passing through P.
(2) The electric field is the same at the points P and Q.
(3) Work has to be done in moving an electron from point P to point R.

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

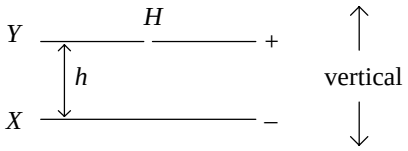
C. (2) and (3) only
D. (1) only
E. (3) only

32. If a metal conductor, of cross-sectional area *A*, has *n* free electrons per unit volume, each carrying a charge *e* and moving with a drift velocity *v*, the

(1) current density will be *nev*.
(2) current flow will be *evA*.
(3) drift velocity will increase with temperature.

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

33.



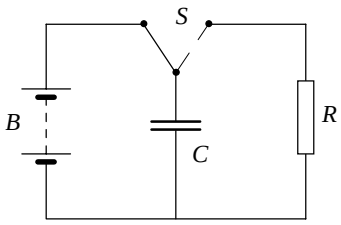
A potential difference *V* is maintained between plates *X* and *Y*, separated by a distance *h*. A particle of mass *m* and positive charge *q* enters the region between *X* and *Y* through the hole *H* with negligible velocity. If it makes no collisions on the way, it will strike *X* with kinetic energy.

A. *mgh*.
B. *qV*.
C. *qV* + *mgh*.
D. *qV* - *mgh*.
E. *mgh* - *qV*.

34. A parallel-plate capacitor is charged by a battery and the energy stored in the capacitor is *E*. The connections to the battery are then removed. If one of the plates is moved so that the plate-separation is halved, the electrical energy stored in the capacitor will

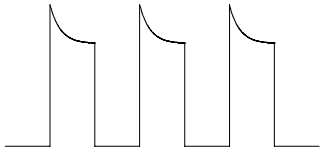
A. decrease to *E*/4.
B. decrease to *E*/2.
C. remain the same.
D. increase to 2*E*.
E. increase to 4*E*.

35.

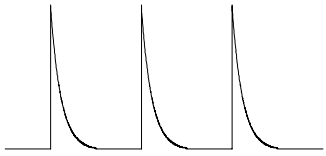


Using the vibrating reed switch *S*, in the above circuit, the capacitor *C* is charged from battery *B* and completely discharged through the resistor *R* with a frequency of 25 Hz. When a CRO is connected across *R*, the waveform will look like:

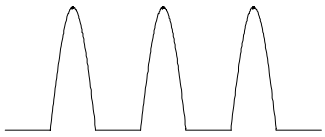
A.



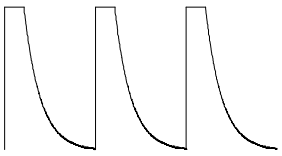
B.



C.

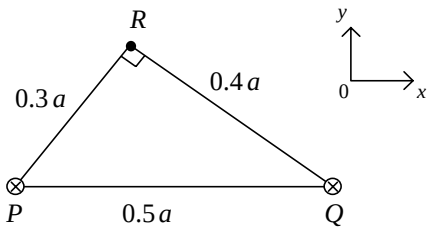


D.



E.

36.



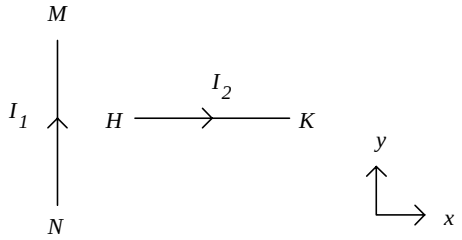
P and *Q* represent two long, straight, parallel, conducting wires separated by a distance of 0.5 *a*, as shown in the figure above. Each of them carries a current *I* flowing into the plane of the paper. The magnitude of the *y*-component of the magnetic induction at point *R* is

A. zero.
B. $\frac{\mu_0 I}{2\pi a} \times (1.17)$.
C. $\frac{\mu_0 I}{2\pi a} \times (4.00)$.
D. $\frac{\mu_0 I}{2\pi a} \times (4.17)$.
E. $\frac{\mu_0 I}{2\pi a} \times (5.38)$.

37. A particle of mass *m* and charge *q* moves in a circular orbit in a magnetic field *B*. The time taken to complete a single orbit is

A. $Bq/(2\pi m)$.
B. $2\pi m/(Bq)$.
C. $2mq/(B\pi)$.
D. $Bm/(2\pi q)$.
E. $2\pi/(mBq)$.

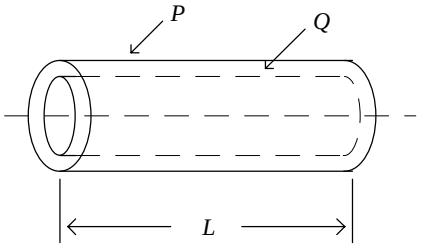
38.



In the figure shown, *MN* is a fixed long conductor, carrying a current I_1. *HK* is another conductor perpendicular to *MN*. When a current I_2 is allowed to pass through *HK* in the direction shown, the force on *HK*

A. acts in the +*y* direction.
B. acts in the -*y* direction.
C. acts in the +*x* direction.
D. acts in the -*x* direction.
E. is zero.

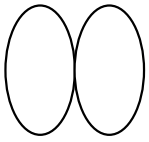
39.



Two coaxial solenoids *P* and *Q* are arranged as shown. The cross-sectional areas of *P* and *Q* are A_1 and A_2 respectively. *P* contains N_1 turns while *Q* contains N_2 turns. *Q* is now connected to a power supply so that the current through it rises at a uniform rate *S*. The maximum e.m.f. induced in *P* is

A. $\mu_0 N_1 N_2 A_1 S$.
B. $\mu_0 N_1 N_2 A_2 S$.
C. $\mu_0 N_1 N_2 A_1 S/L$.
D. $\mu_0 N_1 N_2 A_2 S/L$.
E. zero.

40.



If the pattern shown above appears on the CRO screen when two sinusoidal a.c. voltages are applied across the *x*-plates and the *y*-plates, what is the ratio of the frequency of the voltage across the *x*-plates to that across the *y*-plates?

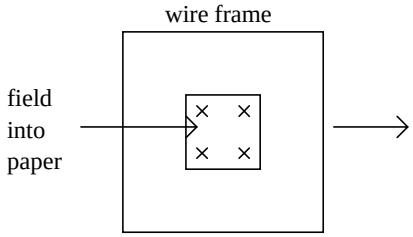
A. 1 : 4
B. 1 : 2
C. 1 : 1
D. 2 : 1
E. 4 : 1

41. A resistor *R* and a capacitor *C* are connected in series with an a.c. supply. The r.m.s. applied voltage and the r.m.s. current are *V* and *I*, respectively. If the resistance of *R* is one half

of the total impedance of the circuit, the power consumed in the circuit will be

A. $IV/4$.
B. $IV/2$.
C. $IV/\sqrt{3}$.
D. IV.
E. $\sqrt{3}\,IV/2$.

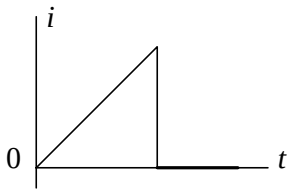
42.



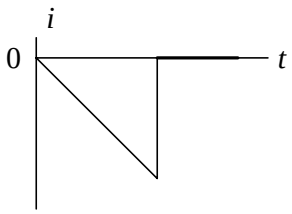
A rectangular wire frame surrounds a uniform magnetic field which is confined to a square region as shown in the diagram. The magnetic field is situated at the centre of the frame and is perpendicular to the plane of the paper. If the frame moves to the right with a uniform velocity, which of the graphs below best represents the variation of the induced current i with time t?

(The clockwise direction of the current is taken as positive.)

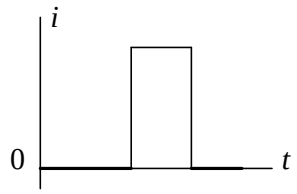
A.



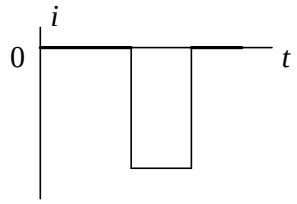
B.



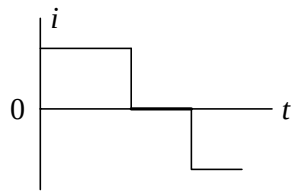
C.



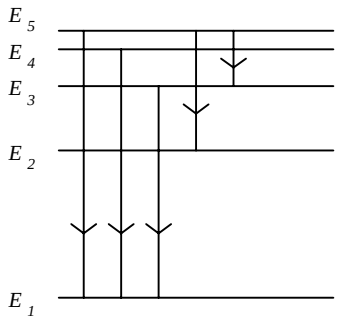
D.



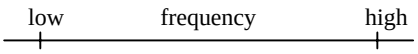
E.



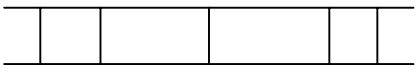
43.



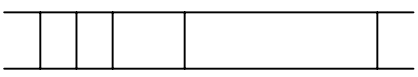
The diagram shows the first five energy levels of an atom. Which of the spectra below best corresponds to the transitions indicated?



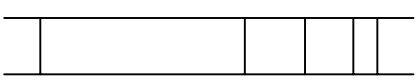
A.



B.



C.



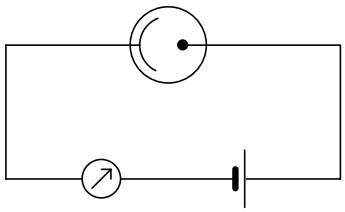
D.

E.

44. An α-source originally consisted entirely of the element polonium. After the emission of a single α-particle, each polonium atom becomes an atom of lead. At the end of two years, the source was found to contain 98% lead and 2% polonium. At the end of one year, the sample would have had the approximate composition:

A. 14% lead, 86% polonium.
B. 25% lead, 75% polonium.
C. 50% lead, 50% polonium.
D. 75% lead, 25% polonium.
E. 86% lead, 14% polonium.

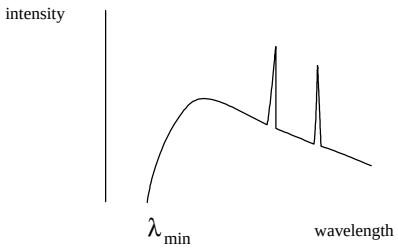
45.



Light falls on the photo-sensitive metal surface of a photocell. A battery and a sensitive meter are connected to the photocell as shown. Which of the following statements is correct?

A. The number of electrons emitted from the metal surface per second is proportional to the potential difference between the metal surface and the anode.
B. No current is observed in the meter until after a considerable time, when the metal surface has heated up.
C. The maximum energy of the electrons emitted is proportional to the intensity of light.
D. The maximum kinetic energy of the electrons emitted is independent of the particular metal used.
E. No current is observed in the meter unless the frequency of light is above a minimum value.

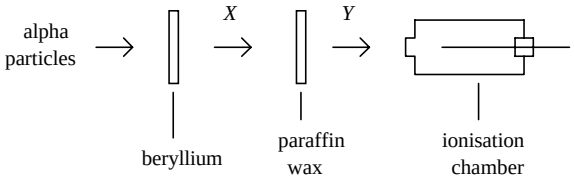
46.



The graph above shows the spectrum of X-rays from an X-ray tube. When the accelerating potential is increased, what will happen to λ_{min} and the wavelengths of the characteristic lines?

	λ_{min}	wavelengths of characteristics lines
A.	decreased	unchanged
B.	decreased	decreased
C.	decreased	increased
D.	increased	unchanged
E.	increased	decreased

47.



The figure above shows the experimental set-up used by Chadwick to demonstrate the existence and properties of neutrons. Radiation *X* is produced when beryllium is bombarded by alpha-particles. Radiation *Y* is produced when *X* bombards paraffin wax. Which of the following statements concerning this experiment is NOT true?

A. *X* is not affected by magnetic fields.
B. The current registered by the ionisation chamber increases when the sheet of paraffin wax is removed.
C. *Y* is a stream of protons.
D. Both momentum and mechanical energy is conserved for the collision of *X* on paraffin wax to produce *Y*.
E. The mass of *X* is found to be approximately that of a proton.

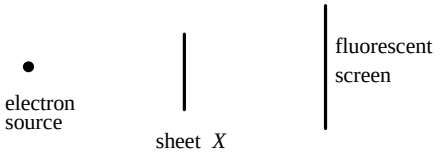
48. In a controlled thermal fission reactor, the use of the control rods will NOT affect

A. the speed of the neutrons released on fission.
B. the rate of production of the neutrons.
C. the energy generated in the nuclear reactor.
D. the amount of radioactive radiations produced in the nuclear reactor.
E. the rate of disintegration of the ^{235}U nucleus.

49. If electron *A* has twice the kinetic energy of electron *B*, what is the ratio of the de Broglie wavelength of electron *A* to that of electron *B*?

A. 1 : 2
B. 1 : $\sqrt{2}$
C. 1 : 1
D. $\sqrt{2}$: 1
E. 2 : 1

50.



In an evacuated tube, a beam of electrons is accelerated through a potential difference *V* and strikes a graphite sheet *X*. Rings are seen on a fluorescent screen positioned behind *X*. Which of the following statements is/are correct?

(1) Sheet *X* acts as a diffraction grating.
(2) The rings indicate the wave nature of electrons.
(3) When *V* is increased, the rings are wider apart.

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

- End of Paper -

Question No.	Key	Question No.	Key
1.	D	26.	B
2.	D	27.	C
3.	A	28.	C
4.	D	29.	A
5.	E	30.	B
6.	E	31.	E
7.	D	32.	D
8.	A	33.	C
9.	C	34.	B
10.	D	35.	B
11.	C	36.	A
12.	E	37.	B
13.	E	38.	A
14.	C	39.	D
15.	D	40.	B
16.	D	41.	B
17.	C	42.	C
18.	E	43.	E
19.	C	44.	E
20.	B	45.	E
21.	D	46.	A
22.	A	47.	B
23.	A	48.	A
24.	E	49.	B
25.	E	50.	B