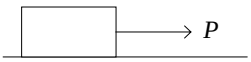
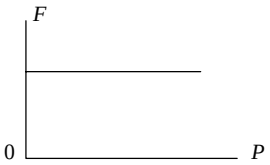
1984 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

1.



A horizontal force P is applied to a wooden block at rest on a rough horizontal table. P is increased uniformly from zero. Which of the following graphs best describes the variation of the frictional force F acting on the block with P?

A.



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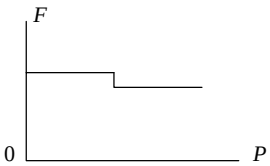

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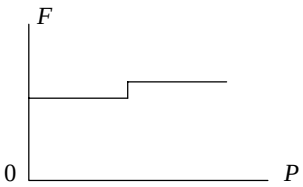

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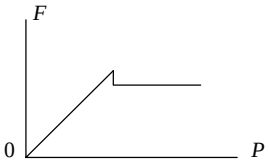

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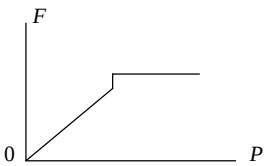


2. An object is thrown horizontally from the top of a cliff at a speed 20 m/s. If the gravitational acceleration g = 10 m/s², what will be the speed of the object after 3 s?

A. 20 m/s
B. 25 m/s
C. 30 m/s
D. 36 m/s
E. 50 m/s

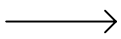
3. In an elastic collision between two bodies, and in the absence of external forces,

A. kinetic energy and momentum are both conserved.
B. kinetic energy is not conserved but momentum is conserved.
C. kinetic energy is conserved but momentum is not conserved.
D. neither kinetic energy nor momentum is conserved.
E. kinetic energy is not conserved and the momentum changes direction.

4.

The diagram represents the rear view of a motor car moving, away from an observer on a level road at a constant speed around a bend of which the centre of curvature is at P. Which of the arrows best represents the direction of the resultant of the forces exerted by the road on the car?

A.



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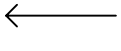

C.

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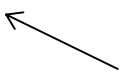

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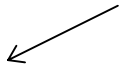


5. A circular loop, of mass M and radius r, is hung over a peg, and makes small oscillations in its own plane of period 2 s. If the moment of inertia of the loop about the axis of oscillation is $2\ Mr^2$ and the gravitational acceleration $g = 10\ m/s^2$, then the value of r is

   A. 0.51 m.
   B. 0.68 m.
   C. 0.76 m.
   D. 1.01 m.
   E. 2.03 m.

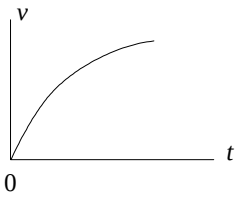
6. The tip of each prong of a tuning fork, emitting a sound wave of frequency 250 Hz, has an amplitude of 0.5 mm. What is the speed of each tip when its displacement is 0.4 mm?

   A. 0.47 m/s
   B. 0.79 m/s
   C. 7.85 m/s
   D. 740 m/s
   E. 1.23 m/s

7. A system oscillates under the influence of an external periodic driving force. Which of the following statements is INCORRECT?

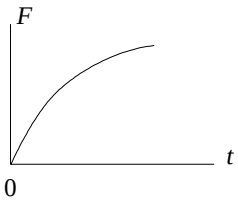
   A. In steady state the system vibrates at the frequency of the driving force.
   B. The amplitude of vibration becomes very large when the frequency of the driving force is close to the natural frequency of vibration of the system.
   C. The amplitude of vibration remains finite if damping forces are present.
   D. A resonance the displacement of the system is in phase with the driving force.
   E. At resonance the power transferred from the driving force to the system is a maximum.

8. The velocity v of a small steel ball falling in a viscous liquid inside a long vertical tube varies with time t, as follows:



Which of the following graphs best represents the variation of the viscous force F acting on the body?

A.



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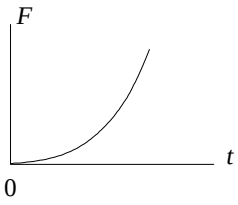

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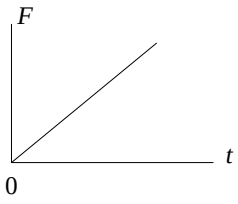

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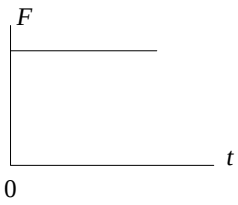

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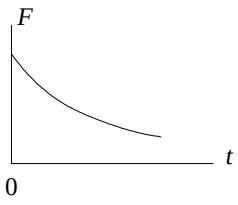
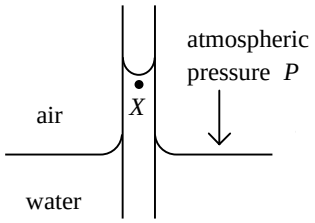


9.



Water, of density ρ, rises up a capillary tube of radius *r* to a height *h*. If the angle of contact is zero and the surface tension is γ, then the pressure at *X* is

A. $P - \rho gh$.
B. P.
C. $P + \rho gh$.
D. $P + \rho gh - 2\gamma/r$.
E. $P + \rho gh + 2\gamma/r$.

10. Equal and steadily increasing forces are applied to each of the following three wires: a carbon fibre, a steel wire and a brass wire. Numerical values for the Young modulus *E*, the ultimate tensile stress *S*, and the area of cross-section *A* of the wires are:

	$E/10^{10}$ N/m²	$S/10^{8}$ N/m²	$A/10^{-6}$ m²
carbon fibre	40	17	0.10
steel wire	21	10	0.30
brass wire	12	40	0.05

Which of the wires is the stiffest and which of the wires will break first? Choose the combination satisfying both criteria.

	Stiffest wire	Wire which will break first
A.	carbon fibre	steel wire
B.	steel wire	carbon wire
C.	brass wire	steel wire
D.	carbon fibre	carbon fibre
E.	brass wire	brass wire

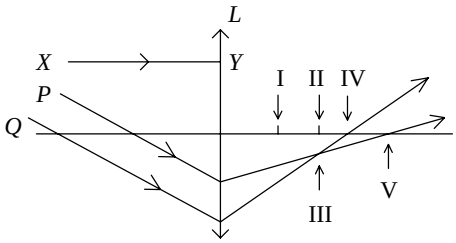
11. A fixed mass of gas at s.t.p. occupies a volume of 1 m³. The gas is heated and allowed to expand to a final volume of 2 m³ with its pressure doubled. The average kinetic energy of the gas molecules is

A. reduced to one quarter of its initial value.
B. halved.
C. unchanged.
D. doubled.
E. increased four times.

12. An astronomical telescope has an objective of focal length 40 cm, and an eyepiece of focal length 2 cm. It is used to look at a distant object when its lenses are set 42 cm apart. the final image seen is

A. upright, virtual and at infinity.
B. inverted, virtual and at infinity.
C. upright, real and at infinity.
D. inverted, real and at infinity.
E. upright, virtual and at the least distance of distinct vision.

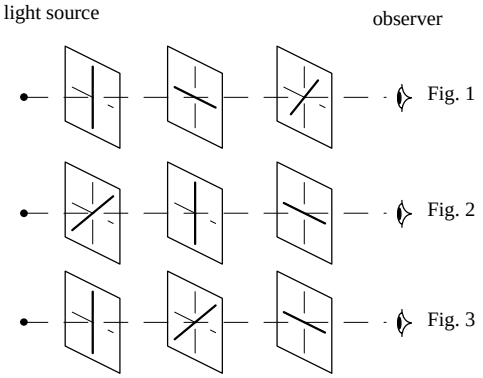
13.



The diagram shows two incoming parallel rays of light *P* and *Q* which pass through a thin converging lens *L*. The ray *XY* after passing through the lens will pass through the point

A. I.
B. II.
C. III.
D. IV.
E. V.

14.



Three polaroid sheets are arranged in the three different ways as shown in Figures 1, 2 and 3 and an observer looks towards the light source as shown in the diagrams. The bold lines indicate the directions of the transmission axes

in each case. Which of the following statements correctly describes the effect of the combination?

	Figure 1	Figure 2	Figure 3
A.	opaque	opaque	opaque
B.	opaque	opaque	transparent
C.	opaque	transparent	opaque
D.	opaque	transparent	transparent
E.	transparent	opaque	transparent

15. Newton's rings produced when a biconvex lens rests on a plane glass plate are observed using a travelling microscope. If the biconvex lens is very slowly moved vertically upwards from the lower glass plate, which of the following would be observed?

A. The central spot remains dark all the time.
B. The rings disappear immediately.
C. The rings move towards the centre.
D. The rings move out from the centre.
E. The rings are no longer concentric.

16. Young's slits are used to produce interference fringes with light of wavelength 600 nm. A thin sheet of mica of refractive index 1.6 is placed in front of one of the slits and the centre of the fringe-system is displaced through 8 fringe widths. The thickness of the mica is

A. 120 nm.
B. 3 000 nm.
C. 4 000 nm.
D. 7 700 nm.
E. 8 000 nm.

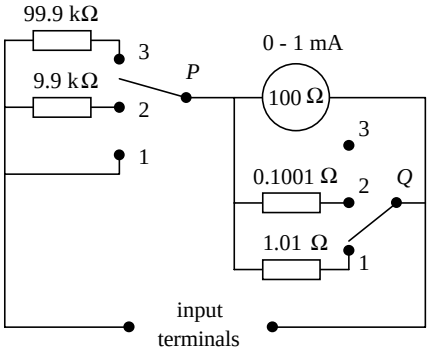
17. In the tuning of a violin string, a pitch pipe of frequency 427 Hz was blown at the same time as the string was plucked and 5 beats were heard every 2 seconds. Then the violin string was slightly tightened with a fine-adjustment screw. When the pitch pipe and the string were sounded together again no beats were heard. The initial frequency of the note produced by the string before any adjustment was made must have been

A. 422.0 Hz.
B. 424.5 Hz.
C. 429.5 Hz.
D. 432.0 Hz.
E. 437.0 Hz.

18. A sound reproduction system produces a sound level of 95 dB above threshold. Assuming the threshold of hearing to be 10^{-12} W/m², 95 dB corresponds to an intensity of

A. 5.6×10^{-8} W/m².
B. 0.00316 W/m².
C. 0.0316 W/m².
D. 1.12 W/m².
E. 6.3×10^{4} W/m².

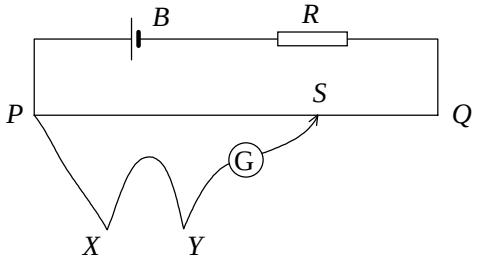
19.



The diagram shows the circuit of a multimeter with ranges 0 - 0.1 A, 0 - 1 A, 0 - 10 V and 0 - 100 V. What must be the positions of the range switches *P* and *Q* if the current to be measured is about 0.5 A?

	P	*Q*
A.	1	1
B.	1	2
C.	1	3
D.	2	1
E.	2	2

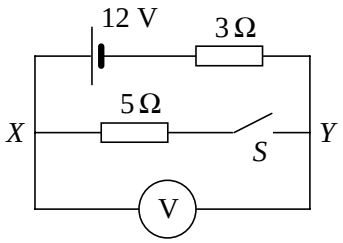
20.



The potentiometer circuit above was set up to determine the e.m.f. of a thermocouple *XY*. *PQ* is a uniform resistance wire. As the sliding contact *S* is moved along *PQ* towards *Q*, the galvanometer deflection decreases continuously in the same direction, but does not become zero. What is the reason?

A. The e.m.f. of the thermocouple is too small.
B. The resistance R is too small.
C. The resistance R is too large.
D. The e.m.f. of the battery B is too large.
E. The galvanometer resistance is too small.

21.



A high resistance voltmeter is connected between points X and Y in the circuit shown. When the switch S is open, the reading on the voltmeter is approximately

A. 0 V.
B. 1.5 V.
C. 2.5 V.
D. 4.0 V.
E. 12 V.

22. 1 000 turns of wire are wound on a solenoid of length 0.30 m and area of cross-section 3.2×10^{-4} m². When the solenoid carries a current of 1.5 A, the magnetic flux through the solenoid is

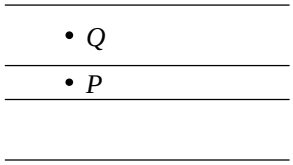
A. 6.0×10^{-7} Wb.
B. 2.0×10^{-6} Wb.
C. 5.7×10^{-4} Wb.
D. 2.0×10^{-3} Wb.
E. 6.3×10^{-3} Wb.

($\mu_0 = 1.26 \times 10^{-6}$ H/m)

23. A sinusoidal voltage is generated by an a.c. dynamo. If the speed of rotation of the dynamo is doubled, what will happen to the frequency and the amplitude of the voltage formed?

	frequency	amplitude
A.	no change	no change
B.	doubled	no change
C.	no change	doubled
D.	doubled	halved
E.	doubled	doubled

24.



A sheet of dielectric occupies part of the space between the parallel plates of an evacuated capacitor. P is a point in the dielectric and Q is a point in the vacuum between the plates. Neglecting edge effects, the electric filed strength at P when the capacitor is charged is

A. zero.
B. the same as that at Q.
C. equal in magnitude but opposite in direction to that at Q.
D. less than that at Q.
E. greater than that at Q.

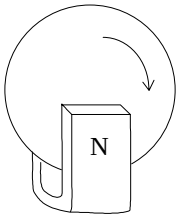
25. A transistor is used for current amplification in the common emitter configuration. The measured currents through the emitter, collector and base of the transistor are i_e, i_c and i_b respectively. What are the possible values of i_c/i_e and i_e/i_b as obtained from the measurement of the various currents?

	i_c/i_e	i_e/i_b
A.	0.98	50
B.	1	1
C.	0.5	50
D.	1.02	50
E.	50	0.98

26. A power station supplies electrical power to a user. The power generated by the station is 1200 kW and is transmitted at 132 000 V. If the resistance of the lines connecting the power station to the user is 550 Ω, the power available to the user is about

A. 700 kW.
B. 1 155 kW.
C. 1 195 kW.
D. 1 200 kW.
E. 31 680 kW.

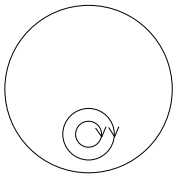
27.



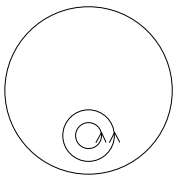
28.

A large aluminium disc mounted on a horizontal axle is spun in the clockwise direction between the poles of a powerful horseshoe magnet. Which of the following diagrams shows how the eddy currents flow in the disc?

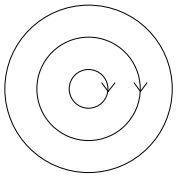
A.



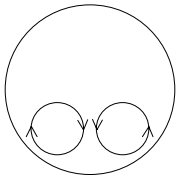
B.



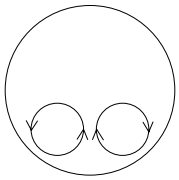
C.



D.



E.



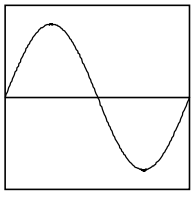


Figure (a)

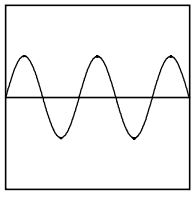


Figure (b)

A step-down transformer of turns-ratio 20 : 1 has its primary winding connected to the mains (50 Hz) and its secondary winding connected across the *Y* plates of an oscilloscope, with the time-base freely running. The trace observed on the screen is as shown in Figure (a). the transformer is now disconnected from the oscilloscope. With the same time base setting, a signal of unknown frequency *f* is connected across the *Y* plates, and the trace is as shown in Figure (b). The value of *f* is

A. 6.25 Hz.
B. 20.0 Hz.
C. 125 Hz.
D. 150 Hz.
E. 2 500 Hz.

29.

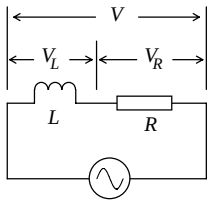


Figure (a)

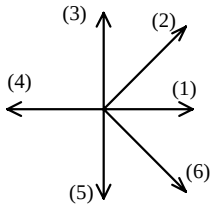
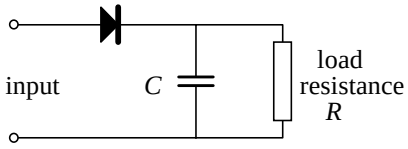


Figure (b)

In Figure (a), an alternating voltage *V* is applied across an inductor *L* and a resistor *R* connected in series. V_L represents the instantaneous voltage across the inductor, and V_R represents the voltage across the resistor. In the phasor diagram in Figure (b), the phasor representing V_R points in the direction (1). In which of the directions shown in Figure (b) will the phasors representing V_L and *V* point?

	V_L	*V*
A.	(1)	(1)
B.	(2)	(3)
C.	(3)	(2)
D.	(5)	(6)
E.	(6)	(5)

30.



The above figure shows a half-wave rectifier with a smoothing circuit. The time constant of C and R should be

A. small compared with the time of one cycle.
B. equal to half the time of one cycle.
C. equal to the time of one cycle.
D. equal to twice the time of one cycle.
E. large compared with the time of one cycle.

31. The ionisation energy of an atom in its ground state is

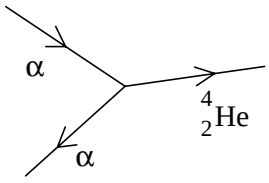
A. the energy required to separate all the electrons from the remainder of the atom.
B. the maximum energy required to separate one electron from the remainder of the atom.
C. the minimum energy required to separate one electron from the remainder of the atom.
D. the minimum energy required to add one electron to the atom.
E. the minimum energy required for an electron to change its state while at the same time remaining attached to the nucleus.

32. For the photoelectric effect, which of the following is the correct relationship between the energy E of a photon, the work function w of the surface which it strikes, and the maximum kinetic energy K of the emitted photoelectron?

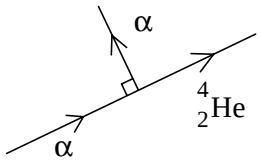
A. $E = w + K$
B. $E = w - K$
C. $E = K - w$
D. $K = 2(w + E)$
E. $w = ½(K + E)$

33. An alpha particle collides with a stationary helium nucleus (^4_2He) in a cloud chamber. Which of the following diagrams represents the most probable set of tracks?

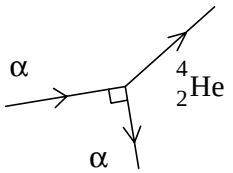
A.



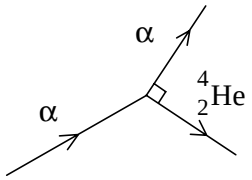
B.



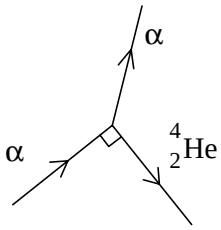
C.



D.



E.



34. The minimum wavelength of the X-rays emitted from a hot cathode X-ray tube is controlled by

A. the cathode temperature.
B. the nature of the target.
C. the anode-cathode voltage.
D. the size of the target.
E. the length of the X-ray tube.

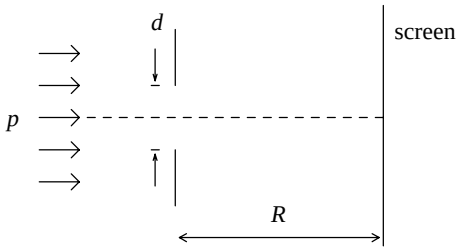
35. ^{3}He is an isotope of helium. If the masses of a proton, a neutron and a ^{3}He nucleus are, respectively, 938.3 MeV/c², 939.6 MeV/c² and 2808.5 MeV/c², the binding energy of ^{3}He is

A. zero.
B. 7.7 MeV.
C. 9.0 MeV.
D. 930.6 MeV.
E. 947.3 MeV.

36. In a controlled thermal fission reactor, the function of the moderators is to reduce

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.

37.



A beam of electrons, travelling with uniform momentum p, is incident on a narrow slit of width d. A fluorescent screen is placed at a distance R from the opening. What is the width of the central maximum of the diffraction pattern observed on the screen?

(h = Planck constant)

A. $d/2$
B. $2d^2 / R$
C. $2h / p$
D. $2hd / Rp$
E. $2hR / dp$

38. Two bodies are allowed to fall freely from the same location, one of which is released a short time before the other. If the air resistance can be neglected, while they are falling,

(1) the two bodies have the same acceleration.
(2) their speeds always differ by the same amount.
(3) their distance of separation is always the same.

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

39. An ice-skater spinning on one foot brings her arms as close as possible to her body. In doing so which of the following quantities must have increased?

(1) The angular velocity of rotation of the skater.
(2) The moment of inertia of the skater.
(3) The angular momentum of the skater.

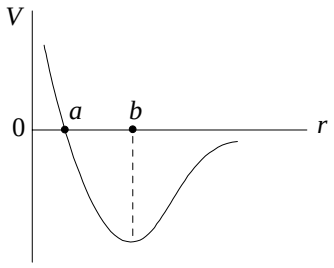
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

40. Taking the Earth to be a perfect sphere of uniform density rotating about its polar axis, which of the following statements concerning the observed acceleration due gravity, g, at the surface of the Earth is NOT true?

(1) g at the equator is smaller than that at the poles.
(2) If the rate of rotation of the Earth slows down, g at the equator increases.
(3) If the radius of the Earth increases with its density remaining unchanged, g at the poles decreases.

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

41.

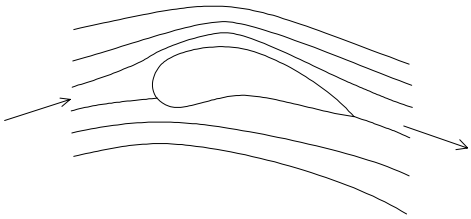


The figure above shows the variation of the potential energy V between two atoms with the distance r separating them. Which of the following statements is/are correct?

(1) The atoms will experience a repulsive force when $r < a$.
(2) The atoms will experience an attractive force when $r > b$.
(3) The atoms can be in equilibrium when $r = a$.

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

42.



The above figure shows the stream lines for air flowing past the wing of an aeroplane. Which of the following is/are correct?

(1) The pressure above the wing is greater than that below the wing.
(2) The speed of the air flow above the wing is greater than that below the wing.
(3) The pressure difference between locations above and below the wing increases when the density of air increases.
(Assume the same speed of air flow.)

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

43. A candidate places an electrical heater in the middle of a lump of ice and measures the time it takes to just melt all of the ice. The power of the electric heater and the initial mass of ice were measured and found to be 12 W and 0.10 kg, respectively. From these measurements, he calculates the specific latent heat of fusion of ice, but finds that his answer is lower than expected. This result is possibly due to the fact that

(1) energy has been lost to the surroundings.
(2) the mass of ice is actually more than the measured value.
(3) the power of the heater is actually more than the measured value.

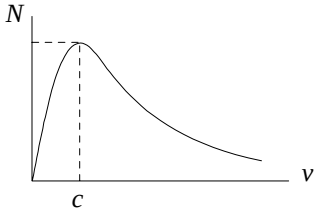
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

44. One mole of an ideal gas of volume V_1 is at an initial pressure P_1 and temperature T_1. If the gas undergoes an isothermal expansion, so that its volume increases to V_2.

(1) there is no heat exchange between the gas and the surroundings.
(2) the external work done is equal to $P_1(V_2 - V_1)$.
(3) the internal energy of the gas remains unchanged.

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

45.



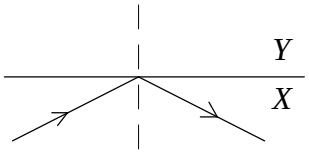
The above graph shows the distribution of speeds (v) of the molecules in a constant mass of gas. Which of the following statements is/are correct?

(1) The value $v = c$ at which the peak of the curve occurs increases when the temperature rises.
(2) The peak of the curve rises when the temperature rises.
(3) Provided that the temperature does not change, the kinetic energy of each molecules is fixed.

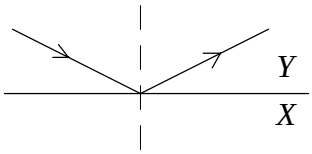
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

46. Light travels between two media *X* and *Y*. If the refractive index of *X* is greater than the refractive index of *Y*, which of the following is/are possible ray diagram(s)?

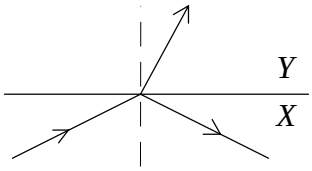
(1)



(2)



(3)



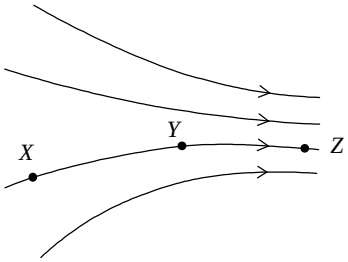
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

47. Which of the following statements about wave motion is correct?

(1) Diffraction cannot be exhibited by longitudinal waves.
(2) Refraction prevents the formation of shadows with perfectly sharp edges.
(3) Reflection is sometimes accompanied by a phase change of π radians.

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

48.



The diagram shows a pattern of electric field lines in which *X*, *Y* and *Z* are points marked on one of the field lines. It would be correct to say that

(1) *X* is at a higher potential than *Z*.
(2) a negative charge placed at *Z* would accelerate to the left along the tangent to the field line at *Z*.
(3) the force exerted on a charge at *Y* would be greater than if the charge were placed at *X*.

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

49. A capacitor (of negligible resistance) and a solenoid (whose resistance is not negligible) are connected in series with an a.c. supply. The resonant frequency of the circuit can be increased by

(1) replacing the solenoid with one of lower resistance, but the same inductance.
(2) replacing the capacitor with one of greater capacitance.
(3) replacing the solenoid with one of lower inductance, but the same resistance.

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

50. The time base of a cathode ray oscilloscope

(1) provides a sawtooth voltages of variable frequency across the X-plates.
(2) enables the electron beam to be deflected across the screen at different speeds.
(3) varies the number of electrons reaching the screen and hence controls the brightness.

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.	D
3.	B	28.	C
4.	D	29.	C
5.	A	30.	E
6.	A	31.	C
7.	D	32.	A
8.	A	33.	D
9.	A	34.	C
10.	D	35.	B
11.	E	36.	A
12.	B	37.	E
13.	B	38.	B
14.	B	39.	D
15.	C	40.	E
16.	E	41.	B
17.	B	42.	C
18.	B	43.	E
19.	B	44.	E
20.	C	45.	D
21.	E	46.	D
22.	B	47.	E
23.	E	48.	A
24.	D	49.	E
25.	A	50.	B