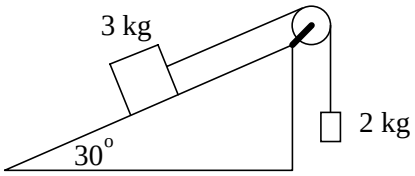
1986 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

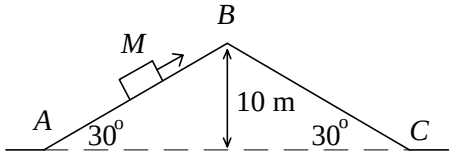
1.



An object of mass 3 kg is placed on a smooth plane inclined at 30º to the horizontal. It is connected by a light string passing over a frictionless pulley to another object of mass 2 kg, as shown above. Given that g = 10 m/s², when the system is released, the tension in the string will be

A. 18 N.
B. 20 N.
C. 24 N.
D. 25 N.
E. 30 N.

2.

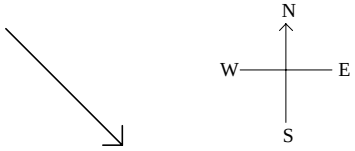


A small block *M* of mass 1 kg is transported across a small hill along the road *ABC* by an applied force *F* which is always parallel to the road. The speed of *M* is kept constant throughout the journey and the kinetic friction between the block and the road is 2.60 N. The total work done by *F* in transporting *M* from *A* to *C* is

A. zero.
B. 104 J.
C. 152 J.
D. 200 J.
E. 304 J.

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.



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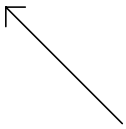

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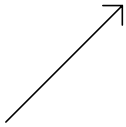

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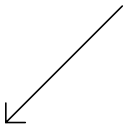
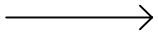


E.

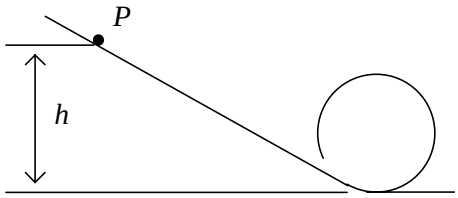


4. A sphere *X* moving with velocity *u* on a smooth horizontal plane makes a head-on collision with another sphere *Y* of the same mass which is initially at rest. If the collision is perfectly elastic, which of the following statements is/are correct?

(1) Kinetic energy is conserved in this collision.
(2) Linear momentum is conserved in this collision.
(3) *X* and *Y* stick together and move off with the same velocity after the collision.

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

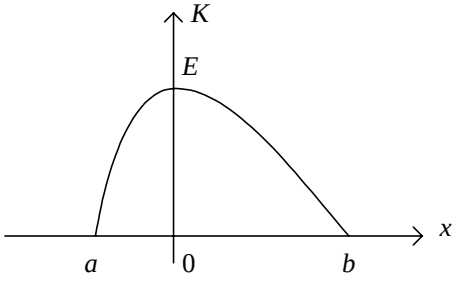
5.



A particle P is placed at a height h on a smooth loop-the-loop track, as shown. The radius of the loop is r. P is now released from rest. If P is to complete the loop, the minimum value of h should be

A. $2\,r$.
B. $2.5\,r$.
C. $3\,r$.
D. $4\,r$.
E. $5\,r$.

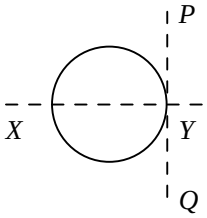
6.



An object is attached to a light spring which does not obey Hooke's law. The mass is set oscillating so that the system has a constant total mechanical energy E. The graph above shows the variation of the kinetic energy K of the mass with the extension x of the spring. The object will experience a force of maximum magnitude at

A. $x = 0$ only.
B. $x = a$ only.
C. $x = b$ only.
D. $x = (a + b)/2$ only.
E. both $x = a$ and $x = b$.

7.



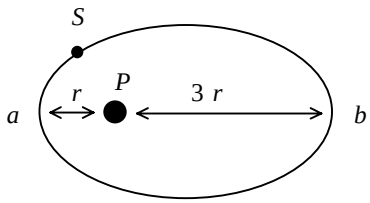
The moments of inertia of a circular loop, when rotated in turn about 3 different axes, are shown in the following table:

axis	moment of inertia
XY	I_1
PQ	I_2
an axis through Y and perpendicular to the plane of the loop	I_3

Which of the following is correct?

A. $I_1 > I_2 > I_3$
B. $I_2 > I_1 > I_3$
C. $I_2 > I_3 > I_1$
D. $I_3 > I_1 > I_2$
E. $I_3 > I_2 > I_1$

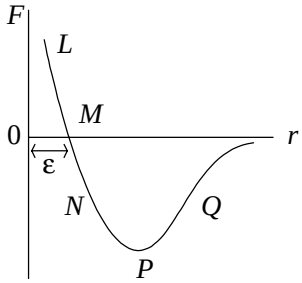
8.



A satellite S moves around a planet P in an elliptical orbit. The ratio of the speed of the satellite at point a to that at point b is

A. 1 : 9.
B. 1 : 3.
C. 1 : 1.
D. 3 : 1.
E. 9 : 1.

9.



Two neighbouring molecules with separation r experience a force F between them. The graph shows how F varies with r. Which of the following statements is/are correct?

(1) Hooke's law follows from the linearity of the region LMN.
(2) ε is the equilibrium separation of the molecules.

(3) Thermal expansion can be explained by the fact that the curve *NPQ* is not symmetrical about *P*.

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

10. Which of the following statements is/are correct?

(1) The surface tension of a liquid increases with temperature.
(2) Liquids tend to reduce their surface area as much as possible.
(3) Molecules in the surface layer of a liquid have more potential energy than those inside the liquid.

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

11. In a bromine diffusion experiment, the half-brown level rises by 5 cm in 240 s. If the mean free path of bromine in air is 10^{-7} m, the number of collisions made by a bromine molecule within this period of time will be

A. 5×10^5.
B. 5×10^7.
C. 2.5×10^{11}.
D. 5×10^{11}.
E. 7×10^{11}.

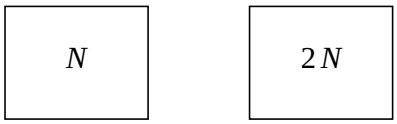
12. Two metal rods of the same Young modulus *Y* and the same cross-sectional area *A*, but of different lengths *L* and 2*L* respectively, are joined together end-to-end to form a rod of length 3*L*. What are the Young modulus and the force constant of the composite rod?

	Young modulus	Force constant
A.	$2Y$	$3AY/(2L)$
B.	$2Y$	$3AY/L$
C.	$2Y$	$AY/(3L)$
D.	Y	$3AY/L$
E.	Y	$AY/(3L)$

13. The electrical resistance of a certain device is given by $R = a + bt^2$, where *t* is the temperature indicated by a Celsius-scale mercury thermometer, and *a*, *b* are constants. If the device is calibrated at 0 ºC and 100 ºC, how will its performance, when used as a thermometer, compare with that of the mercury thermometer?

A. It will read the same temperature for all temperatures.
B. It will give a lower reading at all temperatures.
C. It will give a lower reading for temperatures between 0 ºC and 100 ºC.
D. It will give a lower reading for temperatures above 100 ºC.
E. It will never read the same temperature.

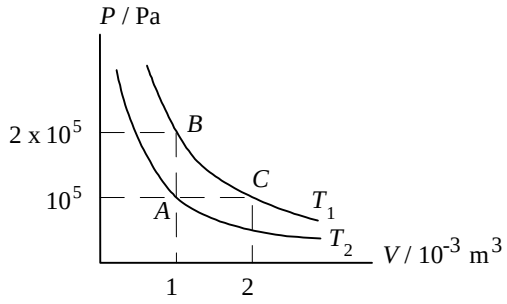
14.



Container *X* holds *N* molecules of a certain gas at atmospheric pressure. Container *Y* has the same volume as *X* and holds 2*N* molecules of the same gas. Both containers are at the same temperature. The ratio of the average number of collisions per second with the walls in *X* to those in *Y* is

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

15.



The figure above shows two curves for a given mass of gas at temperature T_1 and T_2. If the symbols *P*, *V* and *T* stand for the pressure, volume and absolute temperature of the gas, which of the following statements is FALSE?

A. Temperature T_1 is twice temperature T_2.
B. PV/T is constant for all the points on the two curves.
C. When the gas expands from state B to state C as represented by the curve BC, no energy is transferred from the surroundings to the gas.
D. No work is done by the gas when it changes from state A to state B along the line AB.
E. To take the gas from state A to state C, 100 J of energy is needed.

16. At 0 ºC temperature and 1.00×10^5 N/m² pressure, the density of a gas is 0.179 kg/m³. The r.m.s. speed of the gas molecules at 91 ºC will be

A. 231 m/s.
B. 470 m/s.
C. 1 290 m/s.
D. 1 490 m/s.
E. 1 730 m/s.

17. For an ideal gas expanded isothermally,

A. the work done by the gas is equal to the heat energy added to it.
B. the work done on the gas is equal to the heat energy rejected by it.
C. the work done on the surroundings is zero.
D. the heat energy transferred to the gas is zero.
E. the internal energy of the gas increases.

18. When a parallel beam of white light passes through a glass lens, it is separated into rays of different colours. For which colour of light does the lens have the greatest focal length and for which colour of light does glass have the greatest refractive index?

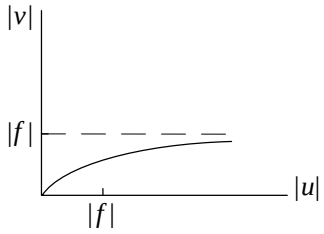
	The lens has the greatest focal length for	Glass has the greatest refractive index for
A.	blue light	blue light
B.	blue light	red light
C.	yellow light	yellow light
D.	red light	blue light
E.	red light	red light

19. A converging lens of focal length 12.5 cm is used as a magnifying glass with the final image formed at infinity. If the least distance of distinct vision is 25 cm, the angular magnification is

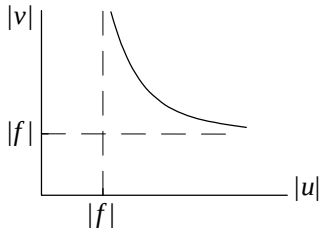
A. 1/2.
B. 1.
C. 2.
D. 4.
E. infinite.

20. A real object is placed in front of a convex mirror of focal length f. Images are formed by the convex mirror for various object distances u. If the image distances are denoted by v, which of the graphs below shows the variation of $|v|$ with $|u|$?

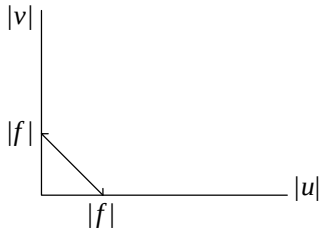
A.



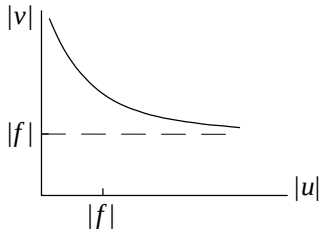
B.



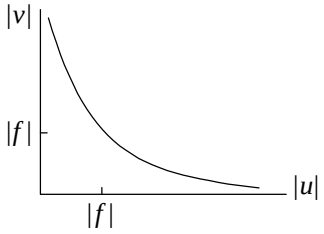
C.



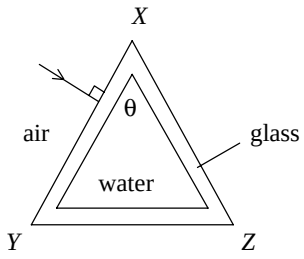
D.



E.



21.



A glass vessel in the shape of a triangular prism is filled with water, and light is incident normally on the face *XY*. If the refractive indices for water and glass are 4/3 and 3/2 respectively, total internal reflection will occur at the glass-air surface *XZ* only for sin θ greater than

A. 1/2.
B. 2/3.
C. 3/4.
D. 8/9.
E. 16/27.

22. In the diffraction of light round an obstacle, the angle of diffraction is increased when

A. the wavelength of the incident light wave is increased.
B. the wavelength of the incident light wave is decreased.
C. the amplitude of the incident light wave is increased.
D. the amplitude of the incident light wave is decreased.
E. the width of the obstacle is increased.

23. When a beam of unpolarised light travelling in air falls on the surface of a block of glass, it is possible to find an angle of incidence such that

A. none of the light is reflected.
B. all of the light is reflected.
C. the reflected light is completely plane polarised.
D. the transmitted light is completely plane polarised.
E. the reflected light and transmitted light are both completely plane polarised.

24.

Lens	Nature	Focal length
I	converging	40 cm
II	converging	10 cm
III	diverging	40 cm
IV	diverging	10 cm

A student is given the above 4 lenses, and asked to make a telescope which will give erect magnified final images. How should he choose the lenses?

	objective	eyepiece
A.	I	II
B.	I	III
C.	I	IV
D.	II	III
E.	II	IV

25. Two stretched wires are tuned to vibrate transversely at the same frequency of 1 200 Hz. When the tension in one of the wires is reduced by 1%, beats are heard as both wires vibrate. The beat frequency is

A. 3 Hz.
B. 6 Hz.
C. 12 Hz.
D. 24 Hz.
E. 1 188 Hz.

26. An aeroplane flies horizontally at a low altitude with a constant speed of 300 m/s. It transmits a radio signal of frequency 30 MHz as it passes a receiving station. What is the difference in the frequencies received a long time before and a long time after the passage of the plane?

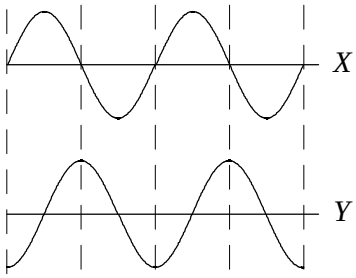
A. 10 Hz.
B. 30 Hz.
C. 60 Hz.
D. 120 Hz.
E. 150 Hz.

27. If two independent sources, each separately at a noise level of 70 dB, are sounded together, they will produce a noise level of

A. 35 dB.
B. 70 dB.
C. 73 dB.

D. 90 dB.
E. 140 dB.

28.



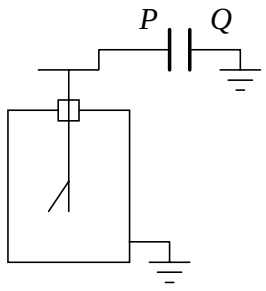
Two waveforms *X* and *Y* are displayed on a C.R.O. screen. Which of the following statements is correct?

A. *X* leads *Y* by a phase difference of $\pi/4$.
B. *X* leads *Y* by a phase difference of $\pi/2$.
C. *Y* leads *X* by a phase difference of $\pi/4$.
D. *Y* leads *X* by a phase difference of $\pi/2$.
E. There is no phase difference between *X* and *Y*.

29. An electric current is flowing in a copper wire which is part of a circuit. The electrons in the copper wire

A. were at rest until the switch was closed but now move along the wire with a drift velocity of a few millimetres per second.
B. were at rest until the switch was closed but now move along the wire at a speed approaching the speed of light.
C. had random motion onto which was imposed a drift velocity of a few millimetres per second when the switch was closed.
D. had random motion onto which was imposed a drift velocity of a few kilometres per second when the switch was closed.
E. had random motion until the switch was closed but now move along the wire at a speed approaching the speed of light.

30.



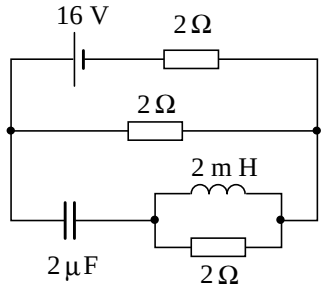
In the capacitor arrangement shown in the diagram, plate *P* has been changed and connected to the electroscope. If plate *Q* is moved towards plate *P*, the gold-leaf will

A. diverge a lot more.
B. diverge a little more.
C. remain where it is.
D. fall slightly.
E. fall completely.

31. Permittivity of free space = 8.85×10^{-12} F/m. A conducting sphere of radius 0.1 m carries a positive charge of 10^{-4} C. A particle *P* of mass 2×10^{-5} kg carrying a negative charge of 10^{-10} C is released from rest at a distance of 1 m from the centre of the sphere. If the force due to gravity is neglected, the velocity of *P* when it strikes the surface of the sphere will be

A. 2.8 m/s.
B. 9.0 m/s.
C. 29.8 m/s.
D. 81.0 m/s.
E. 890 m/s.

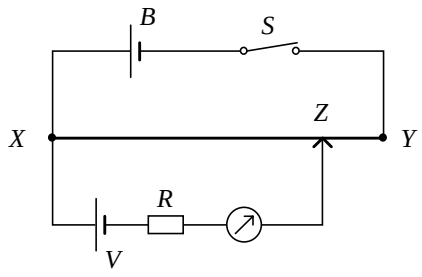
32.



When a steady state is reached, the current delivered by the battery is

A. zero.
B. 4.0 A.
C. 5.0 A.
D. 5.3 A.
E. 8.0 A.

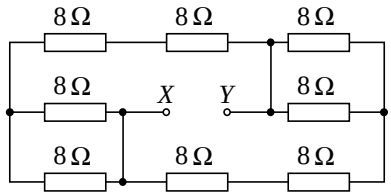
33.



In a potentiometer experiment, a balance point was found on the potentiometer wire *XY* at *Z*. After switch *S* had remained closed for some time, it was found that the contact at *Z* had to be moved towards *Y* to maintain the balance. The most likely reason was that

A. *XY* was getting warm and its resistance was increasing.
B. *R* was getting warm and its resistance was increasing.
C. the galvanometer coil was getting warm and its resistance was increasing.
D. the cell *B* was running down.
E. the cell *V* was running down.

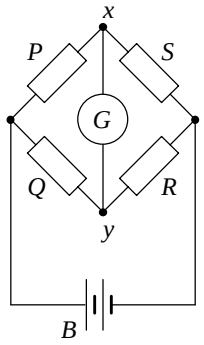
34.



In the circuit above, the equivalent resistance across *XY* is

A. 0 Ω.
B. 10 Ω.
C. 20 Ω.
D. 40 Ω.
E. 64 Ω.

35.

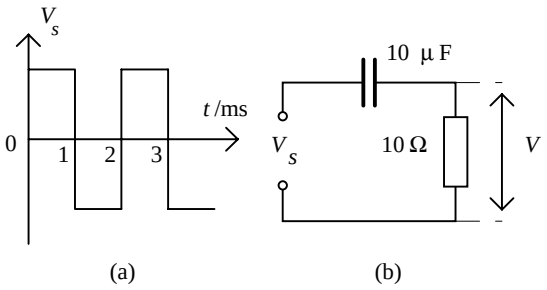


The figure above shows 4 resistors, of resistance *P*, *Q*, *R* and *S* in a Wheatstone bridge circuit. Which of the following statements is/are correct when the bridge is balanced?

(1) The p.d. across *R* is equal to the p.d. across *S*.
(2) The potential at point *x* is equal to the potential at point *y*.
(3) The current through *G* will still be zero when the battery and the galvanometer are interchanged.

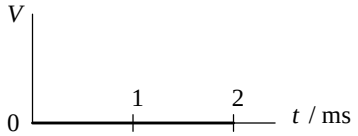
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

36.

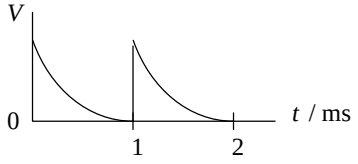


A square wave voltage V_s, as shown in Figure (a), is applied to a circuit containing a 10 μF capacitor and a 10 Ω resistor connected in series. Which of the following graphs best represents the variation of the p.d. *V* across the resistor with time *t*?

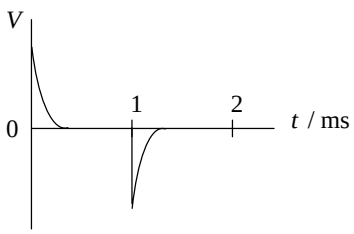
A.



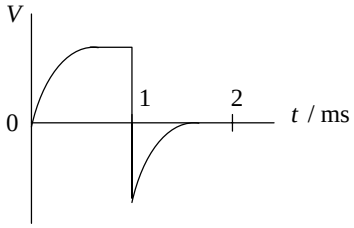
B.



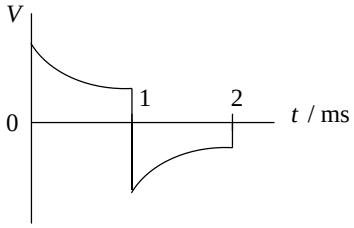
C.



D.



E.



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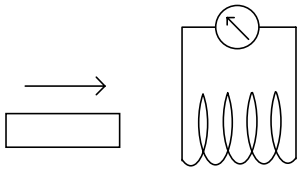
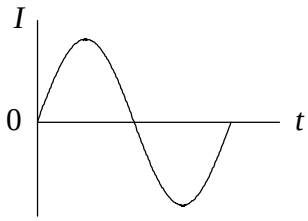
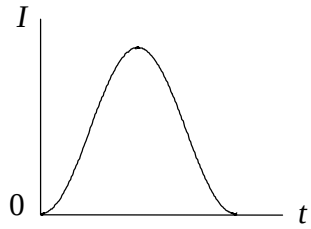


A short bar magnet passes through an air-cored solenoid of similar length with uniform velocity. Which of the following graphs best represents the variation of the current I in the solenoid with time t?

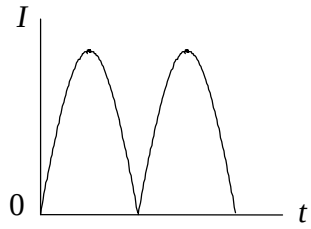
A.



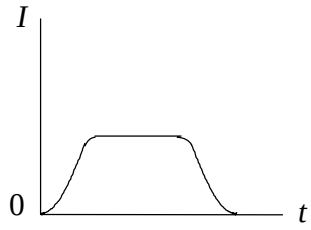
B.



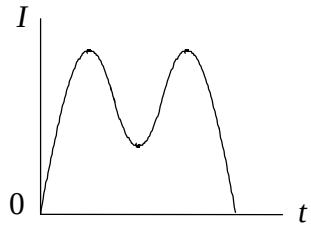
C.



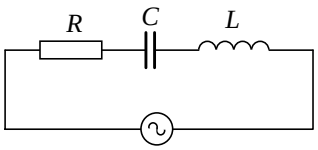
D.



E.



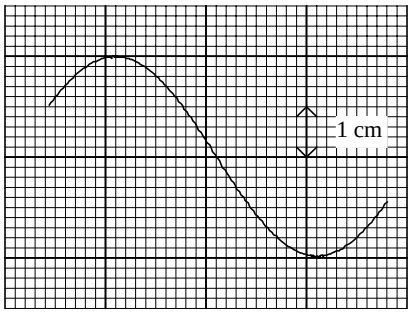
38.



In an *LCR*-series circuit carrying a sinusoidal alternating current, the voltages across the resistor and the capacitor are 4.0 V r.m.s. and 2.0 V r.m.s. respectively. If the applied voltage is 10.0 V r.m.s., then the r.m.s. voltage across the inductor will be

A. 4.0 V.
B. 8.9 V.
C. 9.8 V.
D. 11.2 V.
E. 13.8 V.

39.



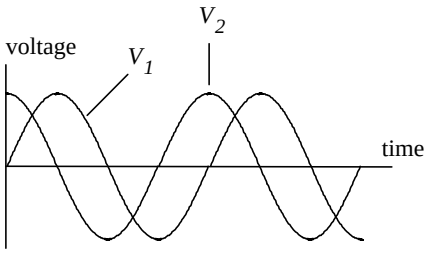
An alternating current passes through a resistor R of resistance 10 Ω. The voltage across the resistor is measured by a C.R.O. The figure above shows the waveform on the screen. The y-sensitivity of the C.R.O. is 2 V/cm. The average power dissipated in the resistor is

A. zero.
B. 0.1 W.
C. 0.4 W.
D. 0.8 W.
E. 1.6 W.

40. X and Y are two long solenoids having the same length and the same cross-sectional area. They are wound on the same type of core material. X has 500 turns and Y has 1 000 turns. If the self-inductance of X is 0.5 H, the self-inductance of Y is

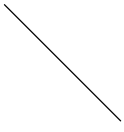
A. 0.5 H.
B. 0.7 H.
C. 1.0 H.
D. 2.0 H.
E. 4.0 H.

41.

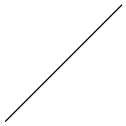


The inputs to the X and Y plates of a C.R.O. are V_1 and V_2, as shown above. Which of the diagrams below best represents the display on the screen?

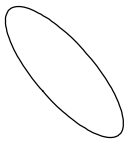
A.



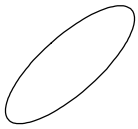
B.



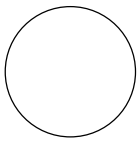
C.



D.

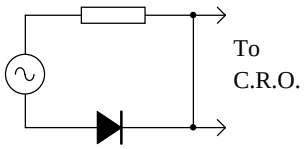


E.

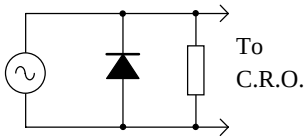


42. Which of the following circuits can give a half-wave rectification waveform on a C.R.O. ?

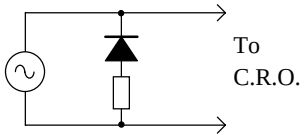
A.



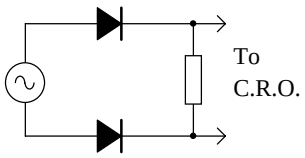
B.



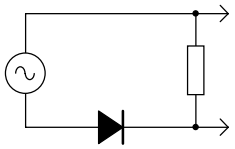
C.



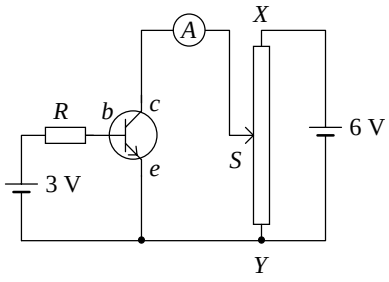
D.



E.

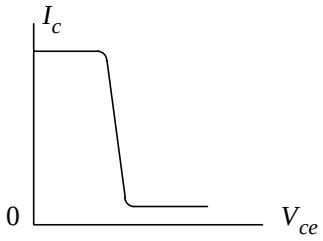


43.

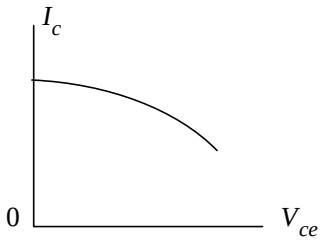


In the above circuit, the sliding contact *S* is moved between *X* and *Y* to give different voltages across *ce*. Which of the following graphs best represents the variation of the collector current I_c with the voltage V_{ce} across the emitter and the collector?

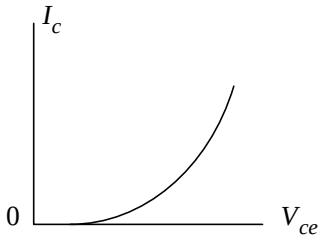
A.



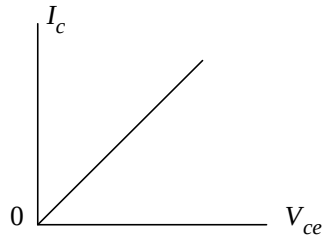
B.



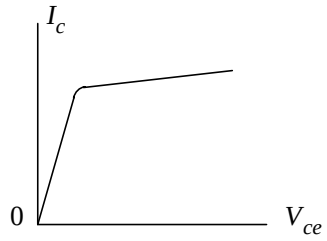
C.



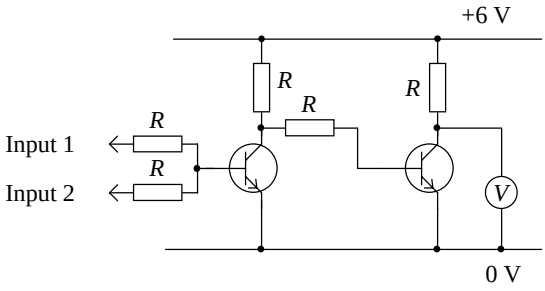
D.



E.



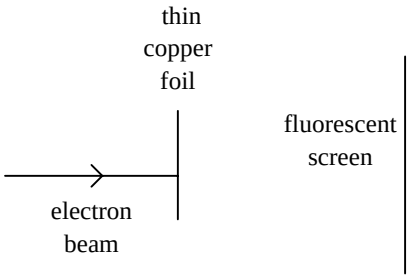
44.



In the above circuit, the reading of the voltmeter is zero. What should be the voltages applied at Input 1 and Input 2 respectively?

	Input 1	Input 2
A.	0 V	0 V
B.	0 V	6 V
C.	3 V	3 V
D.	6 V	0 V
E.	6 V	6 V

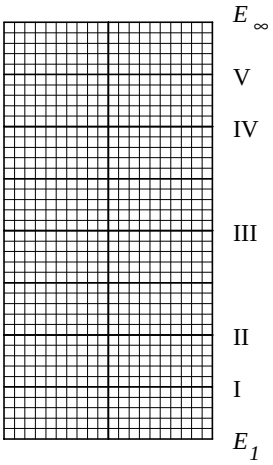
45.



In order to observe a diffraction ring pattern on the screen in the arrangement shown above, which of the following conditions must be met?

A. The copper foil must be a single crystal specimen.
B. The copper foil must be of uniform thickness.
C. The electron beam must strike the foil at normal incidence.
D. The electron beam must be polarised.
E. The electron beam must be approximately monoenergetic.

46.



In the diagram above, E_1 and E_∞ represent (to scale) the energy levels of a hydrogen atom in its ground state and the ionised state, respectively. Which of the drawn lines represents the energy level of the atom in its first excited state?

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

47. When a beam of light of intensity I and frequency f is shone on the surface of a metal connected to earth, 200 electrons are ejected form the surface per second. If a light beam of intensity 2 I and frequency 2 f is used, the number of electrons ejected from the metal per second will be

A. 50.
B. 100.
C. 200.
D. 400.
E. 800.

48. When fission occurs in a heavy nucleus, the two nuclei produced

(1) are stable.
(2) contains more protons than neutrons.
(3) have more binding energy per nucleon than the original nucleus.

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

49. In an alpha-particle scattering experiment, alpha particles having the same kinetic energy collide head-on with $^{107}_{47}Ag$ and $^{27}_{13}Al$ nuclei respectively. The ratio of the distance of closest approach for $^{107}_{47}Ag$ to that for $^{27}_{13}Al$ is

A. 0.25.
B. 0.28.
C. 1.00.
D. 3.62.
E. 3.96.

50. Which of the following best represents the order of magnitude of the radius of a nucleus?

A. 10^{-2} m
B. 10^{-6} m
C. 10^{-10} m
D. 10^{-14} m
E. 10^{-18} m

- End of Paper -

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