1987 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

1. Steel ball bearings, each of mass m, are fired at the rate of n ball bearings per second towards a fixed vertical steel block with a horizontal speed v. They rebound from the block with the same speed. The average force exerted on the block is

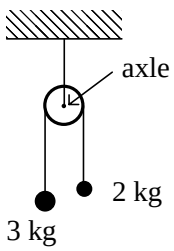
   A. zero.
   B. mnv.
   C. $2mnv$.
   D. $mgnv$.
   E. $2mgnv$.

2. A parachutist of mass m falls in air under the influence of gravity. The air resistance is equal to bv, where v is his speed and b is a constant. After falling a height s from rest, he reaches a terminal speed u. His kinetic energy at that instant is

   A. mgs.
   B. $mgs - bus$.
   C. $mgs - (m^3g^2)/(2b^2)$.
   D. $mgs + (m^3g^2)/(2b^2)$.
   E. $m^3g^2/(2b^2)$.

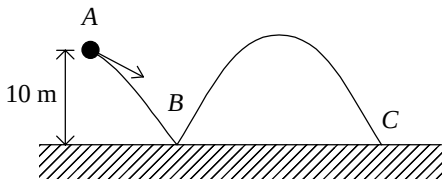
3. A particle performs S.H.M. between two points A and B with period T. If O is the centre of oscillation, the shortest time for the particle to move from point B to the mid-point of OA is

   A. $T/3$.
   B. $3T/8$.
   C. $2T/5$.
   D. $2T/3$.
   E. $3T/4$.

4. 

   An object of mass 3 kg is tied to another object of mass 2 kg with a string passing over a fixed smooth pulley. The weight of the pulley is negligible. When the objects move under the action of gravity, the vertical upward force acting on the axle of the pulley is

   A. zero.
   B. 10 N.
   C. 24 N.
   D. 48 N.
   E. 50 N.

5. 

   A sphere is projected downwards from A with a speed of 10 m/s at an angle of 30° to the horizontal. The sphere rebounds from the ground, first at B and then at C. If the collisions are perfectly elastic, the horizontal distance BC is equal to

   A. 8.7 m.
   B. 10.0 m.
   C. 26.0 m.
   D. 43.5 m.
   E. 100.0 m.

6. A space capsule is launched with speed u from the surface of the Earth to a maximum height above the ground equal to the radius of the Earth. A rocket is then fired horizontally which keeps the space capsule revolving in a circular orbit round the earth at that altitude with speed v. The ratio $u : v$ is equal to

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

7. A toy car has a lead flywheel of moment of inertia 0.001 kgm² attached to the axle of its rear wheels. The flywheel is now accelerated to rotate at 150 revolutions per minute and the toy car is allowed to move on a table. If the

effective decelerating force experienced by the car is 0.025 N, the car will stop after travelling a distance

A. 1.23 m.
B. 2.47 m.
C. 3.00 m.
D. 4.93 m.
E. 6.00 m.

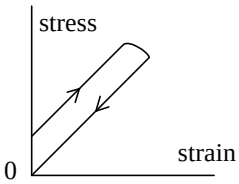
8. A sphere and a cylinder, each having the same mass and radius, are released together, side by side, at the top of an inclined plane and roll down along lines of greatest slope, without slipping. It is observed that the sphere reaches the bottom first. Which of the following statements is/are correct?

(1) The angular acceleration of each is the same.
(2) The cylinder has a greater moment of inertia.
(3) The kinetic energy of each is the same at the bottom.

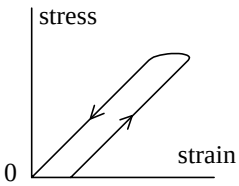
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

9. A metal wire is gradually loaded until the elastic limit is exceeded, and then gradually unloaded. Which of the following graphs best represents the variation of stress with strain?

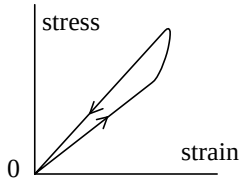
A.



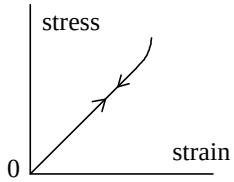
B.



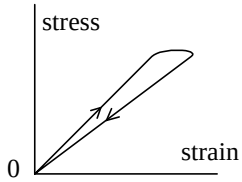
C.



D.



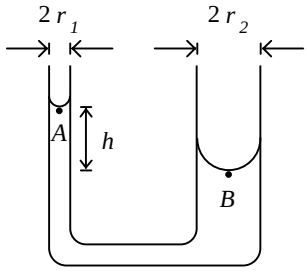
E.



10. In an experiment to measure the Young modulus for steel in the form of a long wire, each measurement is made with the same percentage error. Which of the following measurements contributes the greatest error to the final result?

A. the applied force
B. the diameter of the wire
C. the extension of the wire
D. the length of the wire
E. The above 4 measurements will make an equal contribution.

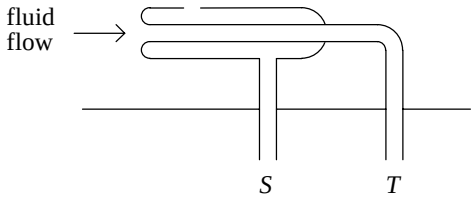
11.



Water, of density ρ, is introduced into a capillary U-tube as shown. *A* and *B* are points just below the corresponding meniscuses. If the angle of contact is zero and the surface tension is *T*, then the pressure difference of the points *A* and *B* will be

A. $\frac{2T}{r_1}-\frac{2T}{r_2}+\rho gh$ and the pressure at A is higher.
B. $\frac{2T}{r_1}-\frac{2T}{r_2}+\rho gh$ and the pressure at B is higher.
C. ρgh and the pressure at A is higher.
D. ρgh and the pressure at B is higher.
E. $\frac{2T}{r_1}-\frac{2T}{r_2}$ and the pressure at A is higher.

12.



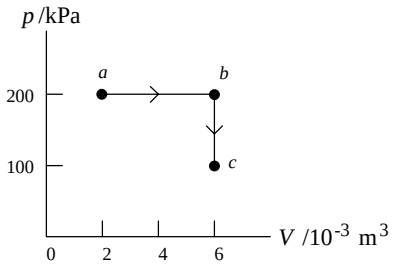
The above diagram shows a Pitot-static tube situated in a moving fluid. A manometer connected to S and T shows a difference h in the liquid levels. If

v = the velocity of the moving fluid,
d = the density of the moving fluid,
ρ = the density of the liquid in the manometer,

then v^2 is equal to

A. $2\rho gh/d$.
B. $2dgh/\rho$.
C. $\rho gh/d$.
D. dgh/ρ.
E. ρdgh.

13.

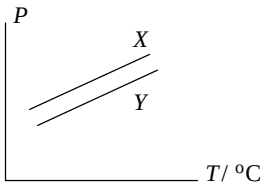


An ideal gas undergoes the processes marked *abc* in the above *p*-*V* diagram. If the total heat energy supplied to the gas during the processes is 3100 J, the change in internal energy of the gas will be

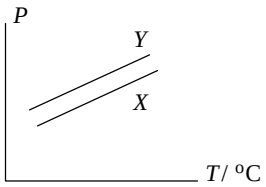
A. -3900 J.
B. -2700 J.
C. 2300 J.
D. 2700 J.
E. 3500 J.

14. Two closed vessels X and Y contain equal masses of an ideal gas. X has a greater volume than Y. When the temperature T changes, which of the following represents the variation of the pressure P of the gas in each vessel with temperature T?

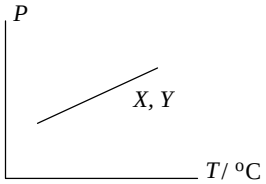
A.



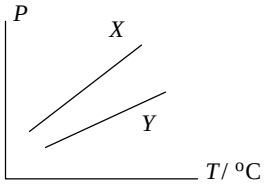
B.



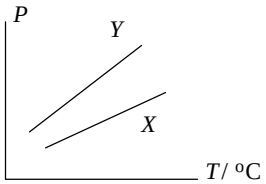
C.



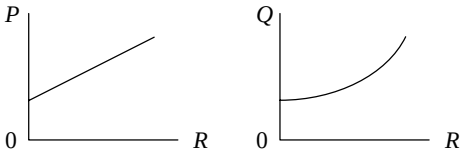
D.



E.



15.



The variations of properties P, Q and R of three different substances with temperature may be used to define three different temperature scales. The variations of P with R and of Q with R are shown above. Which of the following is/are correct?

(1) Temperature scales defined in terms of Q and R will agree only at the fixed points.
(2) Temperature scales defined in terms of P and R will agree at all points.
(3) Temperature scales defined in terms of P and Q will not agree at any point.

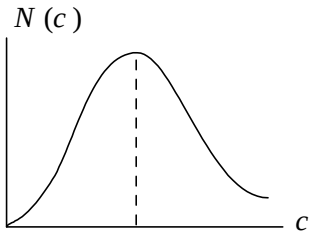
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

16. An ideal gas inside a container without thermal insulation is compressed very slowly to 70% of its original volume. While the gas is being compressed, there is a heat energy transfer of 5000 J. Which of the following statements is/are correct?

(1) Heat energy is transferred out of the system.
(2) Work done on the gas during compression is equal to 5000 J.
(3) The internal energy increases by 5000 J.

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

17.



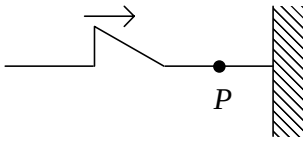
The graph shows the distribution of molecular speeds c for a gas at room temperature. $N(c)$ represents the number of molecules ΔN in a small range of speeds c to $c + \Delta c$ so that $\Delta N = N(c)\,\Delta c$. As the temperature is increased,

A. the peak position will move to the right and its height will increase.
B. the peak position will move to the right and its height will decrease.
C. the peak position will move to the left and its height will increase.
D. the peak position will move to the left and its height will decrease.
E. the peak position and its height will both remain unchanged.

18. A stroboscope is used to freeze a wave pattern. When the flashing frequency of the stroboscope is slightly reduced, the wave pattern appears to

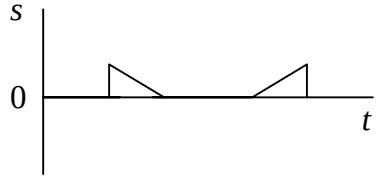
A. move forward.
B. move backward.
C. move forward and then backward.
D. move backward and then forward.
E. remain stationary.

19.

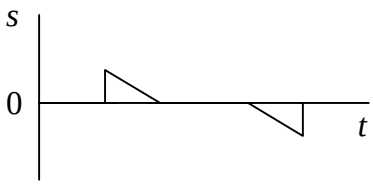


A wave pulse is moving with uniform speed along a rope attached to a fixed wall. A graph of the vertical displacement s against time t for a point P on the rope would be:

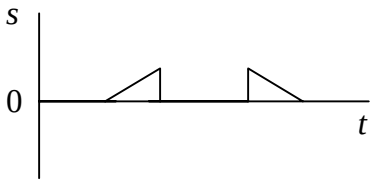
A.



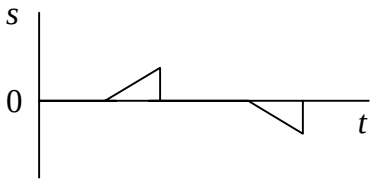
B.



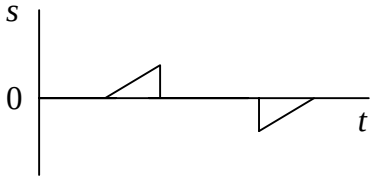
C.



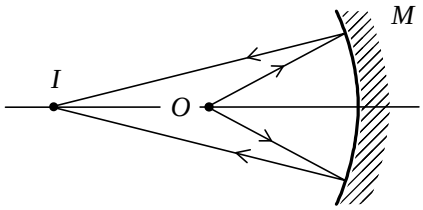
D.



E.



20.

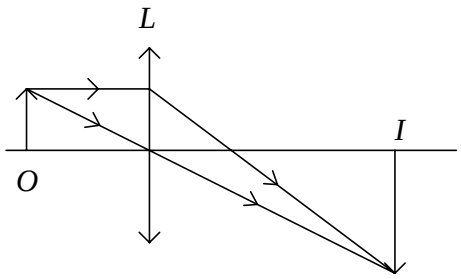


Rays from a point light source *O* are reflected by concave mirror *M* and converge to a point *I* as shown. Which of the following operations would enable a parallel beam of light to be reflected from *M*?

(1) moving the mirror *M* towards *O*
(2) replacing *M* by a concave mirror of shorter focal length
(3) placing a converging lens of suitable focal length between *O* and *M*

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

21.

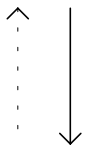


A real image *I* of an object *O* is formed by a converging lens *L* as shown above. A diverging lens L_1 is placed between *L* and *I* such that a real image *I'* is obtained. Which of the following statements is/are correct?

(1) *I'* is also an inverted image.
(2) *I'* is larger than *I*.
(3) *I'* is further away from *L* than *I*.

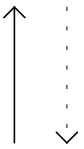
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

22.

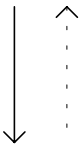


A distant object consisting of two arrows is viewed through an astronomical refracting telescope consisting of two converging lenses. Which of the following corresponds to the image seen?

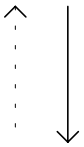
A.



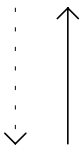
B.



C.

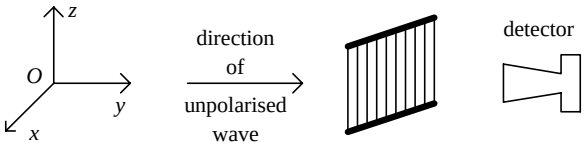


D.



E.

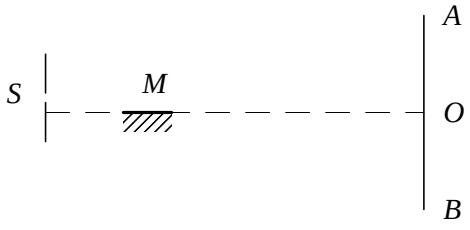
23.



An unpolarised microwave travels along the positive *y*-axis. A metal grid is placed in the *xz*-plane. The electromagnetic wave detected by the detector is

A. of zero intensity.
B. unpolarised.
C. plane-polarised in the *yz*-plane.
D. plane-polarised in the *xz*-plane.
E. plane-polarised in the *xy*-plane.

24.



A plane mirror *M* is illuminated by monochromatic light from a slit *S*. The virtual image of *S* by reflection and *S* itself act as 2 coherent sources and the interference pattern is observed on the screen *AOB* at a distance from the mirror. Which of the following statements about the interference pattern on the screen is/are correct?

(1) No interference pattern can be seen in the region *OB* on the screen.
(2) As the mirror *M* moves downward, the separation of the fringes decreases.
(3) As the mirror *M* moves horizontally away from the screen, the separation of the fringes increases.

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

25. An open tube of length *L* and a string of length *L* produce the same fundamental note. However when each is sounded independently the sound produced can be distinguished readily. This is because

A. the string produces some harmonics which are not produced by the open pipe.
B. the open pipe produces some harmonics which are not produced by the string.
C. they produce completely different harmonics.
D. the pipe produces longitudinal standing waves while the string produces transverse standing waves.
E. they produce the same harmonics but the amplitudes of corresponding harmonics are different.

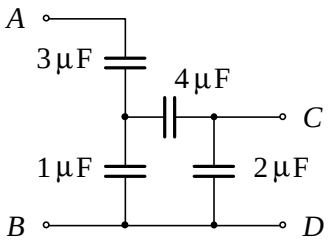
26. Two identical sound sources send out sound waves to an observer. One of the sources is now moved away from the observer. The observer then hears alternate loud and weak signals, and loud signals are detected whenever the source moves through a distance of 0.50 m. If the speed of the source is 1/10 of the speed of sound, the wavelength emitted by the stationary source is

A. 0.25 m.
B. 0.45 m.
C. 0.50 m.
D. 0.55 m.
E. 1.00 m.

27. If 3/4 of the sound energy produced by a typewriter is absorbed by a sponge rubber pad placed underneath, the sound level produced will fall by

A. 0.25 dB.
B. 0.75 dB.
C. 3.00 dB.
D. 6.00 dB.
E. 12 dB.

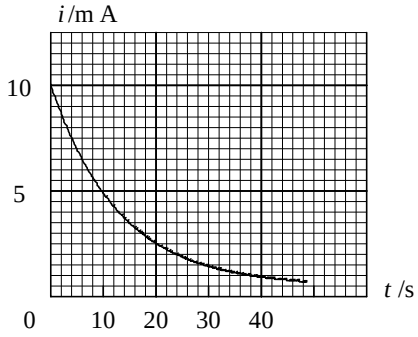
28.



A voltage of 1200 V is applied across *AB* in the capacitor network shown above. The voltage across *CD* is found to be 450 V. If after some time, the voltage across *CD* suddenly jumps to 600 V, which capacitor(s) has been shorted?

A. 1 μF
B. 2 μF
C. 3 μF
D. 4 μF
E. All 4 capacitors have been shorted.

29.

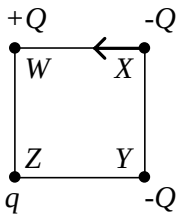


A capacitor *C* is charged to a certain pd. and then discharged through a resistor *R*. The variation of the current *i* with time *t* is shown in the above graph. Which of the following is/are correct?

(1) The time constant of the circuit is about 15 s.
(2) The area under the graph is proportional to the energy stored in the capacitor.
(3) If the resistance of *R* is doubled, the current at $t = 0$ will also be doubled.

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

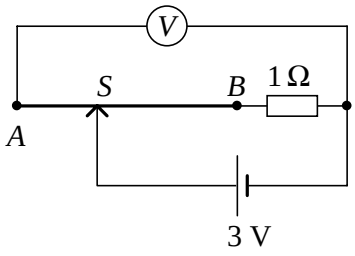
30.



Three charges $+Q$, $-Q$ and $-Q$ are fixed at the corners *W*, *X* and *Y* respectively of a square as shown. A forth charge, *q*, is fixed at *Z*, after which the charge at *X* experiences a NET electrostatic force indicated by the arrow. *q* is equal to

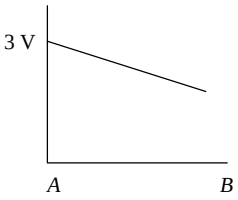
A. $+Q$.
B. $+2\,Q$.
C. $+4\,Q$.
D. $+\sqrt{2}\,Q$.
E. $+2\sqrt{2}\,Q$.

31.

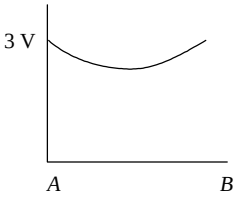


In the above figure, *AB* is a resistance wire of uniform cross-section, and *S* is a sliding contact. The 3 V battery has negligible internal resistance, and *V* is a high resistance voltmeter. Which of the following graphs shows the correct variation of voltage measured by *V* when the contact *S* is moved from *A* to *B*?

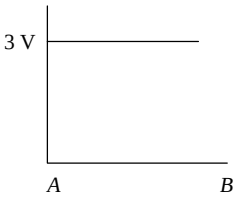
A.



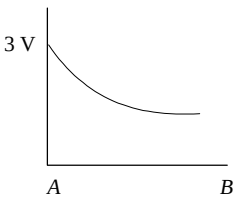
B.



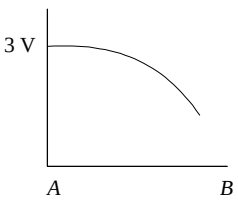
C.



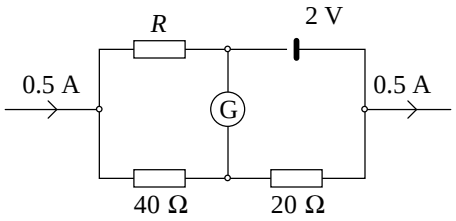
D.



E.



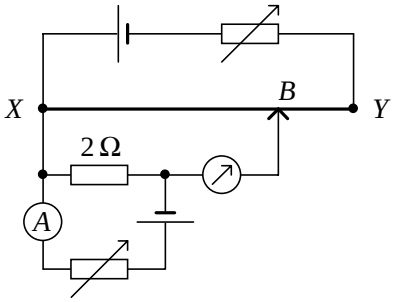
32.



In the circuit shown, no current flows through the galvanometer. If the internal resistance of the cell is negligible, the value of R is

A. 4.3 Ω.
B. 8 Ω.
C. 10 Ω.
D. 32 Ω.
E. 160 Ω.

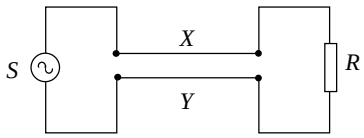
33.



The above potentiometer circuit is used to calibrate an ammeter A. XY is the potentiometer wire and the potential drop across the wire is 0.02 V/cm. B is the balance point and XB = 75 cm. The current passing through the ammeter A is

A. 0.40 A.
B. 0.75 A.
C. 1.33 A.
D. 1.50 A.
E. 3.00 A.

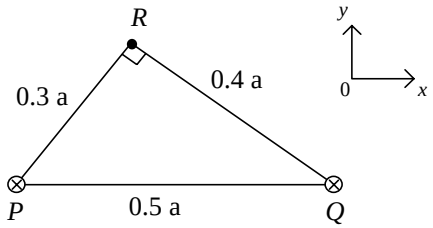
34.



An a.c. supply S of frequency 50 Hz is connected to a resistor R via two long, parallel, straight metal wires X and Y, as shown. The force between X and Y

A. is equal to zero.
B. always attracts.
C. always repels.
D. sometimes attracts and sometimes repels; the frequency of variation is 50 Hz.
E. sometimes attracts and sometimes repels; the frequency of variation is 100 Hz.

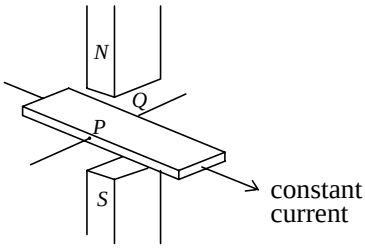
35.



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 *x*-component of magnetic density at the 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. $\frac{\mu_0 I}{2\pi a} \times 5.38$.

36.

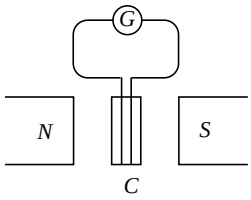


The figure shows the essential parts of an apparatus to demonstrate the Hall effect. Which of the following statements is/are correct?

(1) In the arrangement above, the Hall p.d. is developed across *PQ*.
(2) The magnitude of the Hall potential is greater if the applied magnetic flux density is increased.
(3) The magnitude of the Hall potential is less if the width *PQ* of the specimen is decreased.

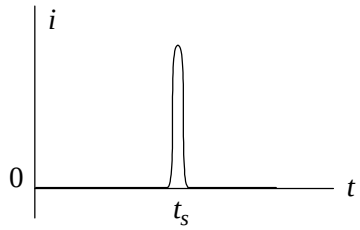
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

37.

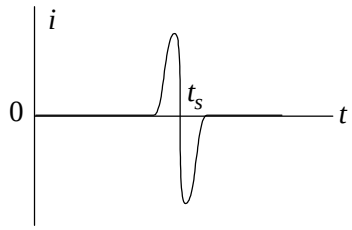


A narrow coil *C* connected to a sensitive galvanometer *G* is placed between the poles of a powerful electromagnet, with its plane normal to the magnetic field which is uniform. Initially the electromagnet is on, then it is switched off at time t_s. Which of the following graphs best represents the variation of the galvanometer current *i* with time *t*?

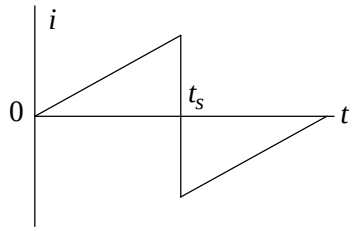
A.



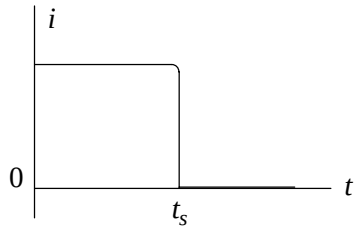
B.



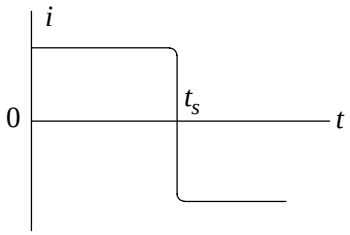
C.



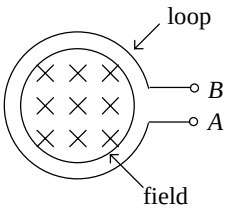
D.



E.



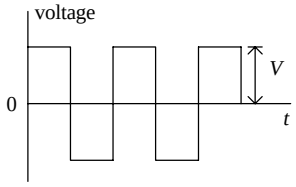
38.



The uniform magnetic field shown pointing into, and acting perpendicular to, the plane of the paper is confined to a cylindrical volume of radius 8 cm. The magnetic flux density now decreases at a constant rate of 0.01 T/s. A circular loop of radius 10 cm is placed so that its plane is perpendicular to the magnetic field, as shown. What will be the magnitude and direction of the induced e.m.f. in the loop?

	Magnitude	Direction
A.	2.0×10^{-4} V	from *A* to *B* via the loop
B.	2.0×10^{-4} V	from *B* to *A* via the loop
C.	3.1×10^{-4} V	from *A* to *B* via the loop
D.	3.1×10^{-4} V	from *B* to *A* via the loop
E.	there is no induced e.m.f.	

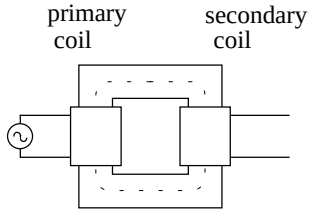
39.



The voltage of an a.c. source varies with time *t* as shown. The r.m.s. value of the applied voltage is

A. zero.
B. $V/2$.
C. $V/\sqrt{2}$.
D. V.
E. $V\sqrt{2}$.

40.



The above diagram shows a step-down voltage transformer. Which of the following is/are correct?

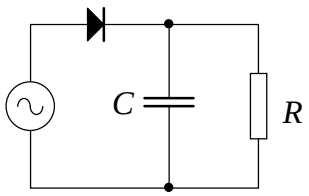
(1) The dotted line indicates the path of the eddy current.
(2) If the terminals of the secondary coil are shorted, the primary current will increase.
(3) The number of turns in the primary is higher than that of the secondary.

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

41. A 120 V, 60 W lamp is run from a 240 V, 50 Hz mains supply using a capacitor connected in series with the lamp and supply. What is the theoretical value of the capacitor required to operate the lamp at its normal rating?

A. 3.8 μF
B. 6.6 μF
C. 7.7 μF
D. 13.3 μF
E. 83.3 μF

42.



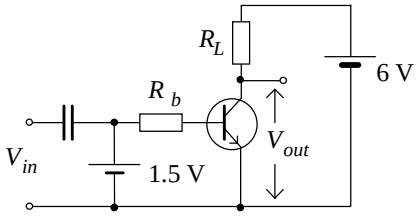
In the above a.c. smoothing circuit, the ripple on the current passing through the load *R* can be reduced by increasing

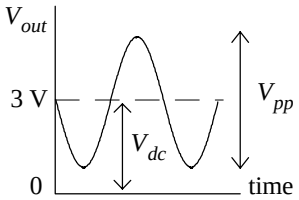
(1) the load resistance *R*.
(2) the capacitance *C*.

(3) the a.c. supply frequency.

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

43. A NPN transistor is operated as a linear voltage amplifier and the output voltage is displayed on a CRO screen as shown:



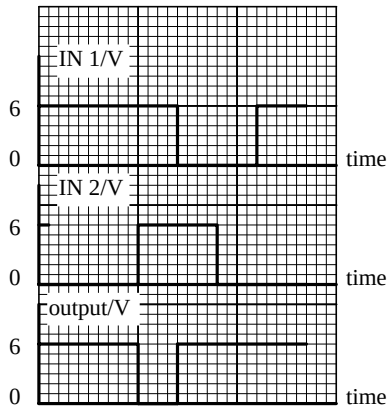


What changes will occur when R_L is slightly increased?

	V_{dc}	V_{pp}
A.	decreases	increases
B.	decreases	decreases
C.	increases	increases
D.	increases	decreases
E.	no change	increases

44.

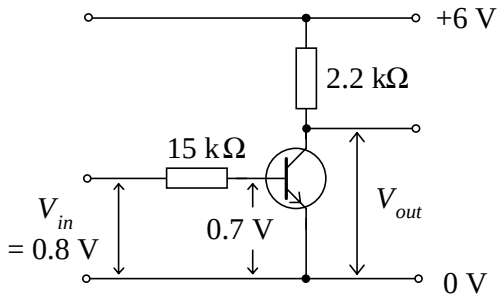
A certain logic gate with two inputs IN 1, IN 2 and an output is shown above. The variation of the input and output voltages are as follows:



What is the logic gate?

A. NOT gate
B. OR gate
C. NOR gate
D. AND gate
E. none of the above

45.



In the above circuit, if the current amplification factor $\beta = 130$, what is the output voltage V_{out}?

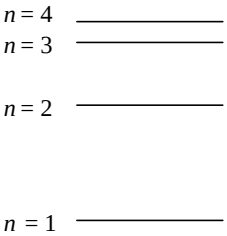
A. 0 V
B. 3.0 V
C. 4.1 V
D. 4.9 V
E. 6 V

46. The timebase of a C.R.O. is set at 5 ms/cm. An a.c. supply of frequency 50 Hz is now applied to the *y*-plates of the C.R.O. If the width of the screen of the C.R.O. is 10 cm, how many cycles can be displayed on the screen?

A. 0.25
B. 0.5
C. 1
D. 2.5

E. 5

47.

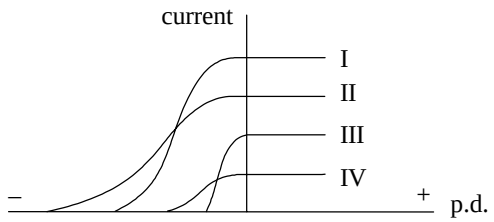


The figure shows the four lowest energy levels of a hydrogen atom. The hydrogen atom is excited from ground state to the energy level $n = 3$ when an electron collides inelastically with it. What is the minimum energy required for the electron to do this?

(ionisation potential of hydrogen = 13.6 V)

A. 4.9 eV
B. 12.1 eV
C. 12.8 eV
D. 15.1 eV
E. 20.0 eV

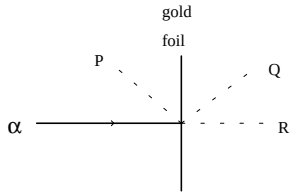
48.



The above figure shows the currents observed in a photocell circuit as a function of the p.d. between the plates of the photocell when light beams I, II, III and IV were each directed in turn at the cathode. Which of the beams has the highest frequency?

A. I
B. II
C. III
D. IV
E. they all have the same frequency.

49.



In an experiment on α-particle scattering, α-particles are directed onto a gold foil, and detectors are placed at positions *P*, *Q* and *R* as shown. What is the distribution of α-particles as recorded at *P*, *Q* and *R* respectively?

	P	*Q*	*R*
A.	all	none	none
B.	none	none	all
C.	most	some	none
D.	most	some	few
E.	few	some	most

50. Which of the following experiments provide direct evidence for the existence of energy levels in atoms?

A. the Chadwick experiment
B. the Franck-Hertz experiment
C. the Geiger-Marsden experiment
D. the Millikan experiment
E. none of the above

- End of Paper -

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