අධ්‍යාපන අමාත්‍යාංශය/கல்வி அமைச்சு/Ministry of Education

අධ්‍යාපන පොදු සහතික පත්‍ර (උසස් පෙළ) පෙරහුරු ප්‍රශ්න පත්‍රය 2022

கல்விப் பொதுத் தராதரப் பத்திர (உயர்தர) பரீட்சை 2022

General Certificate of Education (Adv. Level) 2022

භෞතික විද්‍යාව I/பௌதிகவியல் I (Physics I)

01 E I

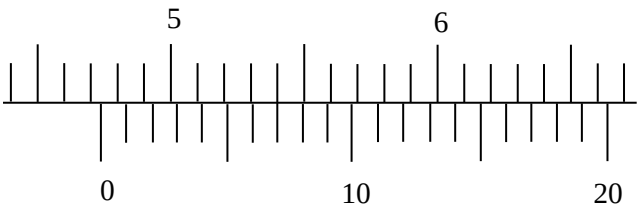
පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Answer all the questions.

01. What are the dimensions of efficiency?
(1) $ML^{-1}T^{-1}$ (2) $ML^{-3}T^{2}$ (3) $ML^{2}T^{-3}$ (4) $ML^{2}T^{-1}$ (5) $L^{2}T^{-1}$

02. From the following physical quantities, the units of Impulse equals to the units of,
(1) work. (2) efficiency (3) momentum (4) moment of force (5) pressure

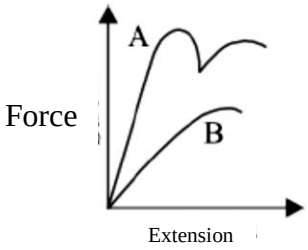
03. The part of the scale of the vernier caliper is given below. It's one part of the main scale is 1mm. What is the reading of the measurement of the caliper?
(1) 4.77 mm (2) 4.735 mm
(3) 47.07 mm (4) 47.35 mm
(5) 47.70 mm



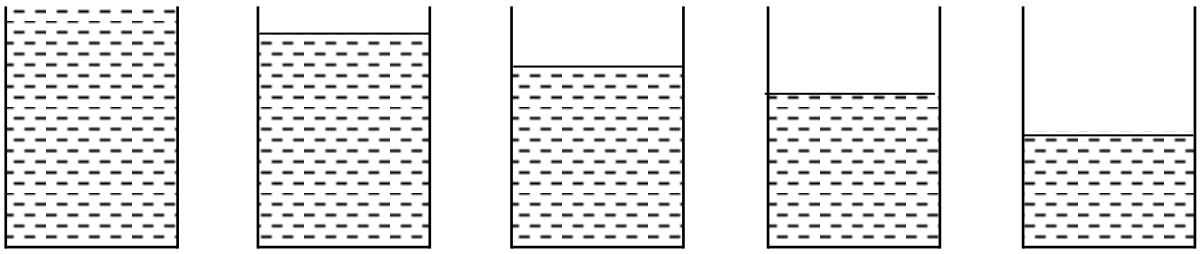
Figure

04. When the meniscus of the liquid inside the capillary tube is convex, its contact angle is
(1) greater than 90^0 (2) smaller than 90^0 (3) equals to 90^0
(4) equals to 45^0 (5) equals to 0^0

05. The force-extension diagram for two materials A and B is shown in the given graph. From those two curves, it is assumed that
(1) A is brittle but B is ductile
(2) A is ductile but B is brittle
(3) Both A and B are ductile
(4) Both are brittle
(5) Both A and B are not ductile or not brittle



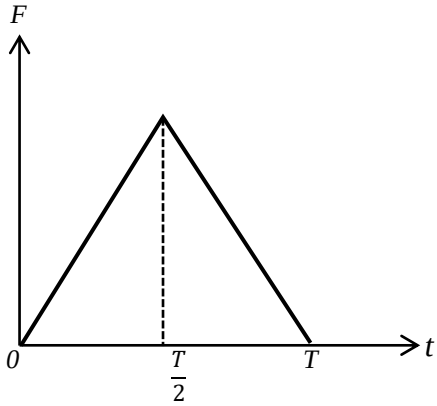
06. Which of the following diagrams shows the correct amount of liquid that should be filled in to the calorimeter of about 10 cm height to find the specific heat capacity of the liquid using cooling method?



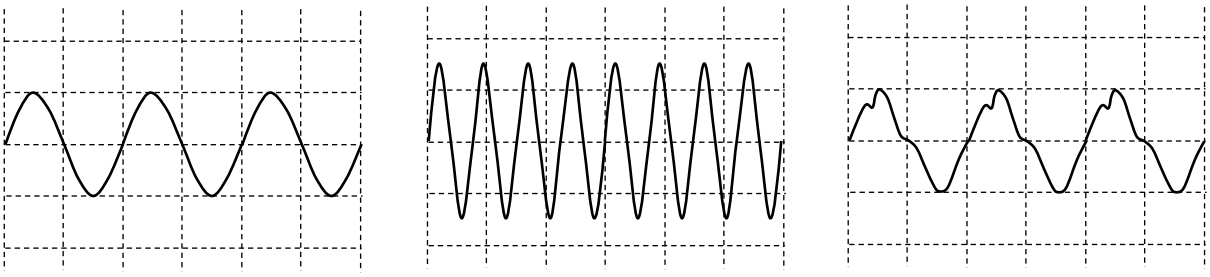
(1) (2) (3) (4) (5)

07. The ball of mass *m* moves in a velocity *u* bounces perfectly elastic manner after colliding on the wall. The reaction between the wall and the ball varies with time as shown in the following graph. The value of F_0 will be,

(1) $\frac{mu}{T}$ (2) $\frac{2mu}{T}$ (3) $\frac{4mu}{T}$
(4) $\frac{mu}{2T}$ (5) $\frac{mu}{4T}$



08. The following P, Q and R diagrams show the wave forms of three types of sounds obtaining from cathode ray Oscilloscope which is adjusted to the same scale.



P Q R

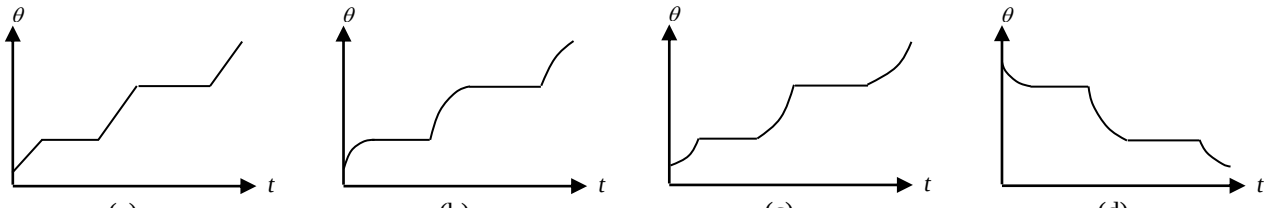
Consider the following statements on those waveforms.

(A). P and Q have different loudness and same pitch.
(B). P and R have different quality of sounds and same pitch.
(C). P and R have same loudness and different pitches.

The correct statements of the above are,

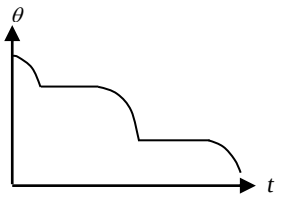
(1) Only (A) (2) Only (B) (3) Only (C) (4) (A) and (B) only (5) (B) and (C) only

09. A solid is heated until evaporating using a constant heat supply at normal environment. Then it is let to cool. Select the correct answer which shows the variation of temperature with time for the above mentioned process.



(a) (b) (c) (d)

	When heating	When cooling
(1)	Graph (a)	Graph (d)
(2)	Graph (b)	Graph (d)
(3)	Graph (c)	Graph (d)
(4)	Graph (b)	Graph (e)
(5)	Graph (c)	Graph (e)

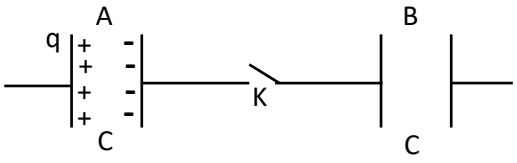


(e)

10. A hot air balloon of mass *M* is moving down in *'a'* acceleration. After removing *m* mass from the balloon, that balloon starts to move up with *'a'* acceleration. What would be the correct expression for *m*?

(1) $\frac{aM}{a+g}$ (2) $\frac{2aM}{a+g}$ (3) $\frac{(a+g)M}{a}$ (4) $\frac{(a+g)M}{2a}$ (5) $\frac{gM}{2a}$

11. An identical two capacitors A and B are connected using an open switch K. Initially A is given a charge *q* and B is not charged. Now K is closed and kept for a sufficient time, what are the charges of A and B ?

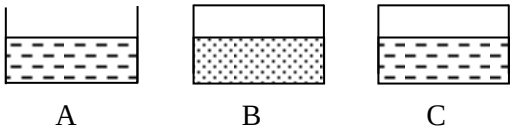


	(1)	(2)	(3)	(4)	(5)
A	q	q/2	0	q	0
B	q	q/2	q	0	0

12. The box of mass *M* is slightly kept on a belt which is moving with '*v*' velocity. The frictional coefficient between the floor and the box is μ. How far does the box slip until obtaining the speed of the belt?

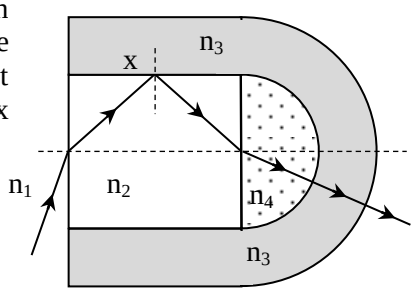
(1) $\frac{v}{\mu g}$ (2) $\frac{v^2}{\mu g}$ (3) $\frac{v}{2\mu g}$ (4) $\frac{v^2}{2\mu g}$ (5) $\frac{v}{g}$

13. Three identical vessels A, B and C contain water , alcohol and water respectively and kept inside the laboratory in a dry day of less relative humadity. A is opened and B and C are closed. Assuming that the atmosperic temperature (θ_1) is constant, the temperatures of the vessels A, B and C are θ_2, θ_3 and θ_4 respectively after sometimes. What are the correct relationships among those temperatures?



(1) $\theta_1 = \theta_2 = \theta_3 = \theta_4$ (2) $\theta_1 > \theta_4 > \theta_3 > \theta_2$ (3) $\theta_1 = \theta_4 > \theta_3 > \theta_2$ (4) $\theta_1 > \theta_4 > \theta_2 > \theta_3$ (5) $\theta_1 = \theta_4 = \theta_3 > \theta_2$

14. The given figure shows the path of a ray which is refracted through several media of absolute refractive indices n_1, n_2, n_3 and n_4. At the point X, there is a total internal reflection. What is the correct relationship among the refractive indices? (n_1 is the refractive index of air)



(1) $n_1 < n_3 < n_2 < n_4$ (2) $n_1 < n_2 < n_3 < n_4$
(3) $n_4 < n_3 < n_2 < n_1$ (4) $n_1 < n_3 = n_4 < n_2$
(5) $n_1 < n_2 = n_3 = n_4$

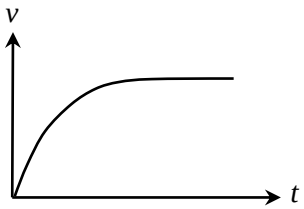
15. When vibrating the tuning fork A of frequency 255 Hz with the tuning fork B, the beat frequency is 3 Hz. Then a small metal ring is connected to the prong of the tuning fork B and again vibrated with A. At that moment, the beat frequency is 2 Hz. What would be the frequency of B after connecting the metal ring?

(1) 258Hz (2) 257 Hz (3)253 Hz
(4) 258 Hz or 252 Hz (5) 257 Hz or 253 Hz

16. The maximum speed which the motor car of mass 2000 kg can obtain on the inclined road of inclination 6^0 to the horizontal when climbing up is 36 km h^{-1}.If the frictional coefficient of that road is 1/6, what is the efficiency of the car ? (Consider that $\sin 6^o = 0.1$, $\cos 6^o = 0.99$)

(1) 36 kW (2) 53 kW (3) 60 kW (4) 72 kW (5) 106 kW

17. The graph shows the velocity – time graph for the motion of the object and the given statements are about the motions of several objects.

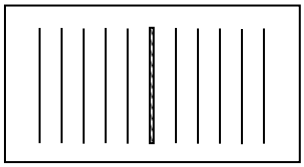


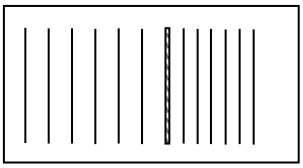
(A). The motion of a metal sphere which comes down from the rest through the viscous fluid.
(B). The motion of a car which moves in maximum efficiency from the rest on the rough uniform road.
(C). When moving the meteoroid from space until colliding on earth's surface.

Among the above given motions, which statement /s represent the given graph ?

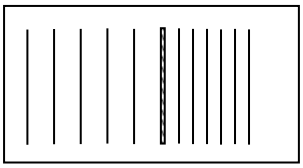
(1) Only (A) . (2) Only (B). (3) Only (A) and (B) .
(4) Only (A) and (C) . (5) (A), (B) and (C) .

18. The given figure shows the wave fronts of a ripple tank which are generated due to the vibration of a pointer of constant frequency. The system is used to demonstrate the Doppler Effect. When a pointer is moving right side with constant acceleration, which diagram shows the correct behavior of water wave fronts ?

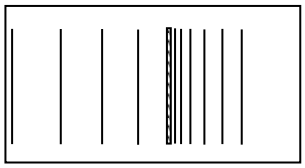




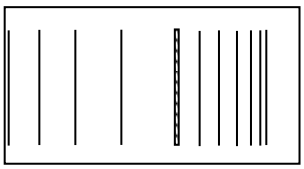
(1)

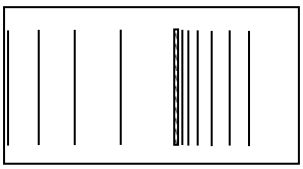


(2)



(3)





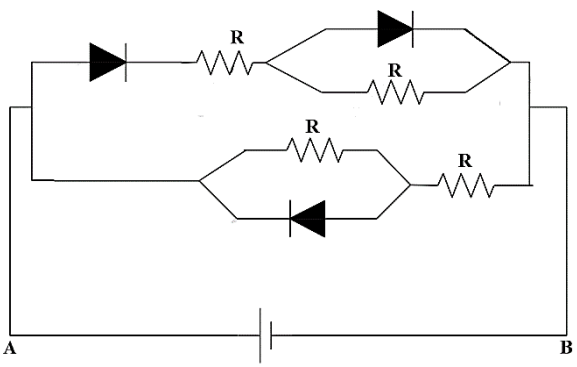
19. An object is projected along the direction of the coordinates (0, 1) to (4,9) which is on the vertical plane of the Earth's surface. After 1 s from the projectile, it comes to the X axis. What are the coordinates of that point?

(1) (3,0) (2) (4,0) (3) (2,0) (4) $(2\sqrt{5}, 0)$ (5) (1,0)

20. A pointing charge Q is kept on the center of the equilateral triangle in order to be equilibrium when keeping three $+q$ pointing charges at vertices. Find the value of Q.

(1) $+q$ (2) $-q$ (3) $\frac{+q}{3}$ (4) $\frac{-q}{3}$ (5) $\frac{-q}{\sqrt{3}}$

21. In the given circuit, the values of resistors are R and all diodes are ideal. Internal resistance of the cell is negligible and its emf is E, what are the current supplied to the circuit by the cell ?

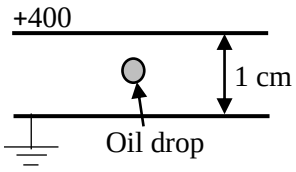


(1) $\frac{2E}{R}$ (2) $\frac{3E}{2R}$

(3) $\frac{E}{R}$ (4) $\frac{2E}{3R}$

(5) $\frac{E}{2R}$

22. Two conducting plates are kept parallel 1 cm apart from each other and +400 V potential is supplied to the upper plate while the lower plate is grounded. An oil drop of mass 0.16 mg is in between two plates in equilibrium position. If the charge of an electron is -1.6×10^{-19} C, how many electrons are there in an oil drop?



(1) 2.5×10^{8} (2) 2.5×10^{9} (3) 2.5×10^{10} (4) 2.5×10^{11} (5) 2.5×10^{12}

23. An electron of mass m_e is initially at rest in a uniform electric field and then it moves a particular distance with t_1 time period. A proton of mass m_p is also moves the same distance with t_2 time period inside the same electric field. Which of the following expressions give the ratio of $\frac{t_1}{t_2}$? Here the gravitational forces are negligible.

(1) $\frac{m_p}{m_e}$ (2) $\frac{m_e}{m_p}$ (3) $\sqrt{\frac{m_p}{m_e}}$ (4) $\sqrt{\frac{m_e}{m_p}}$ (5) 1

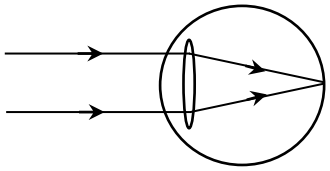
24. The terminal velocity of a gold sphere inside the viscous fluid of density 1.5 g cm^{-3} is 0.2 m s^{-1}. What is the terminal velocity of the silver sphere of same radius? (The densities of gold and silver are 19.5 g cm^{-3} and 10.5 g cm^{-3} respectively.)

(1) 0.10 m s^{-1} (2) 0.13 m s^{-1} (3) 0.20 m s^{-1} (4) 0.30 m s^{-1} (5) 0.40 m s^{-1}

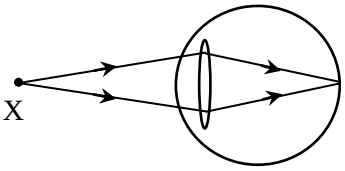
25. The distance between two real images of magnifying power formed by the convex lens of focal length 60 cm is,

(1) 240 cm (2) 180 cm (3)120 cm (4)60 cm (5)30 cm

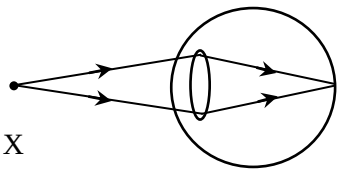
26. The given figure shows the formation of the image of a distinct object of the person who is having hypermetropia (long sightedenes). The correct ray diagram when he looks at an object X which is at his near point which can see the objects easily and the ray diagram when a healthy person looks at an object (Y) which is at the least distance of distinct vision are represented by the follwing ray diagrams.The correct diagrams are,



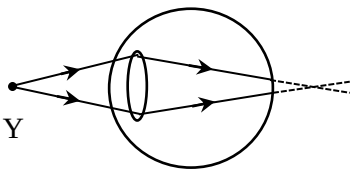
(1) A and C
(2) A and D
(3) B and C
(4) B and D
(5) B and E



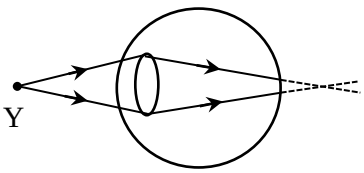
A



B



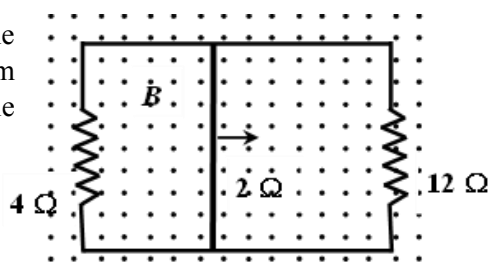
C



D

27. A uniform magnetic field 0.5 T is perpendicular to the plane of the circuit as shown in the figure. The sliding rod of length 0.25 m moves uniformly with constant speed 4 ms^{-1}. If the resistance of the slider is 2 Ω, then what is the current through the sliding rod?

(1)0.01A (2) 0.08A (3) 0.1A
(4) 0.17A (5) 0.18A



28. The maximum wavelength of an electromagnetic wave which can do photo electric effect for the given metal surface is 250 nm. If the incident wave of wave length is 200 nm, what is the maximum kinetic energy of the emitted electron ?(h = 6.62 × 10^{-34}J s, c = 3.0 × 10^{8} m s^{-1})

(1) 89.61 ×10^{-20} J (2) 69.81 ×10^{-20} J (3) 18.96 ×10^{-20} J (4) 19.86 ×10^{-20} J (5) 89.81 ×10^{-20} J

29. What fundamental particles make up a Tritium ($^{3}_{1}H$)?

(1) 5 up-quarks , 4 down-quarks and1 electron

(2) 4 up-quarks , 5 down-quarks and1 electron

(3) 2 up-quarks , 4 down-quarks and1 electron

(4) 4 down-quarks, 4 up-quarks and1 electron

(5) 5 down -quarks, 2 up-quarks and1 electron

30. A Copper wire of length 50 cm and area of cross section 10^{-6} m^2 carries 0.5 A current. If the resistivity of Copper is 1.8×10^{-8} Ω m what the electric field across the wire?

(1) 90 V m^{-1} (2) 9 V m^{-1} (3) 0.9 V m^{-1} (4) 0.09 V m^{-1} (5) 0.009 V m^{-1}

31. The two ways of projecting a uniform rod with an inclination to the horizontal are described as follows. In the first method initial velocity is given at one end of the rod and in the second method its initial velocity is given from the center of the rod. Consider the following statements about the above mentioned incidents.

A - The rod is moving while rotating in the first method while the rod is not rotating in the second method.
B - The center of mass of the rod moves in a parabolic path in both ways.
C - The center of mass of the rod does not move in a parabolic path in the first method while it moves in the parabolic path in the second method.

The correct statements from the above are,

(1) only (A) (2) only (B) (3) only (C) (4) only (A) and (B) (5) only (A) and (C)

32. A geostatic satellite is orbited at *6R* height from the Earth's surface. Here *R* denotes the radius of the Earth. What is the time period of another satellite which is orbited at *2.5R* height from the Earth's surface in hours?

(1) $4\sqrt{2}$ (2) 6 (3)$6\sqrt{2}$ (4) 10 (5) 12

33. A hollow sphere of internal radius 3a and external radius 4a is immersing ¾ th of its total volume in water. When the hollow part of the sphere is fully filled with wax, the sphere is fully immersed in water. What is the relative density of wax?

(1) 48/37 (2) 27/37 (3) 27/48 (4) 16/27 (5) 16/37

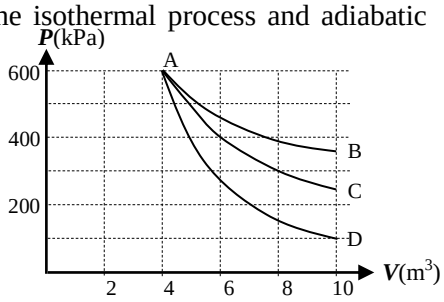
34. In order to read the readings clearly from the thermometer which is made with minimum length, the least distance between two consecutive scale lines should be 0.5 mm. Such a Mercury in glass thermometer has a least count 0.1 ^{0}C and the range is 0 ^{0}C to 50 ^{0}C. If the volume expansion coefficient of Mercury is 2 x 10^{-4} $^{0}C^{-1}$, cross sectional area of the capillary tube is 0.02 mm^2 what is the volume of Mercury inside the thermometer at 0 ^{0}C?

(1) 0.25 cm^3 (2) 0.50 cm^3 (3) 1.00 cm^3 (4) 2.00 cm^3 (5) 5.00 cm^3

35. A well insulated vessel contains 600 g of water at 30 ^{0}C and its heat capacity is 830J K^{-1}. 450 g of ice at 0 ^{0}C is added to that vessel, after sometimes what amount of maximum water can be remained inside the vessel? (Specific heat capacity of water is 4200 J kg^{-1} ^{0}C^{-1}, Specific latent heat capacity of fusion of ice is 335 kJ kg^{-1} and the density of water is 1000 kg m^{-3})

(1) 750 ml (2) 775 ml (3) 850 ml (4) 900 ml (5) 1050 ml

36. An ideal gas is set to three thermodynamic processes and the obtained curves related to the process are shown in the figure. Among them which curves are best explained the isothermal process and adiabatic process respectively?



(1) From AB curve and AC curve
(2) FromAB curve and AD curve
(3) FromAC curve and AB curve
(4) FromAC curve and AD curve
(5) FromAD curve and AB curve

37. The minimum energy to roll the given cylinder of mass *M* and radius *R* from the step of height '*h*' as shown in the figure is,

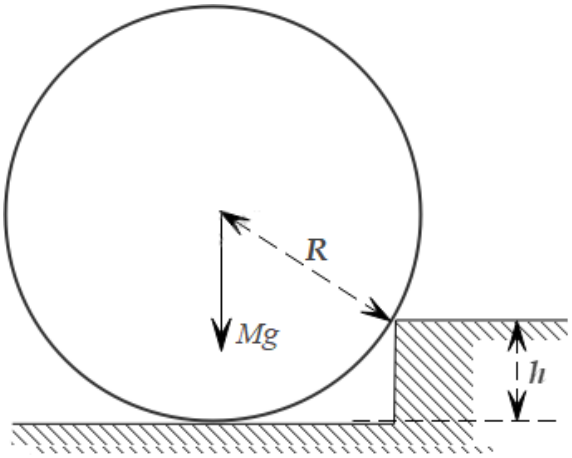
(1) $\frac{Mg\sqrt{(R^2-(R-h)^2)}}{2R}$

(2) $\frac{Mg\sqrt{(R^2-h)}}{R}$

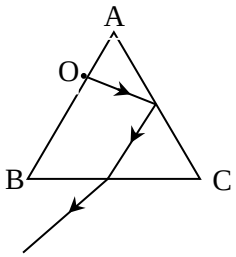
(3) $\frac{Mg\,R}{2}$

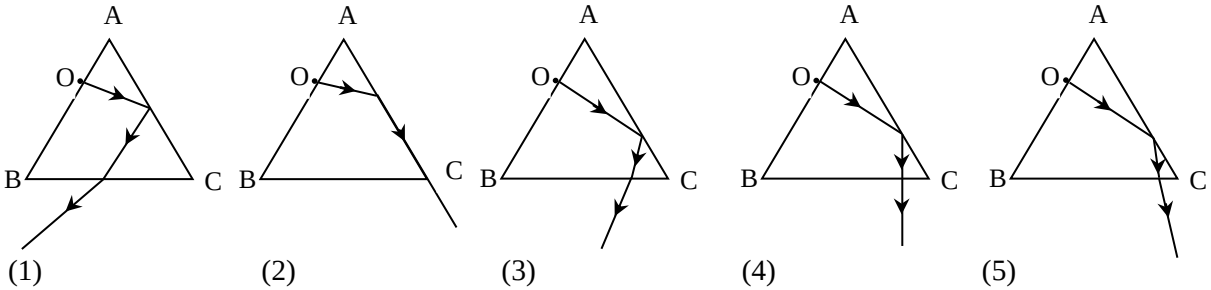
(4) $\frac{Mg\sqrt{(R^2-(h)^2}}{2R}$

(5) $\frac{\sqrt{(R^2-h)^2)}}{2R}$



38. The pin ' O' is fixed to touch the side AB of the equilateral prism ABC. The given figure shows the light ray which is incident on AC with critical angle and emerge from BC after the total internal reflection. Then the glass slide is pasted using a small water drop on AC side. Which diagram shows the correct ray diagram which the light ray incident on AC with critical angle related to glass – water interface and emerges from BC after the total internal reflection. (The critical angle for the glass-water interface is 63^o.)





(1) (2) (3) (4) (5)

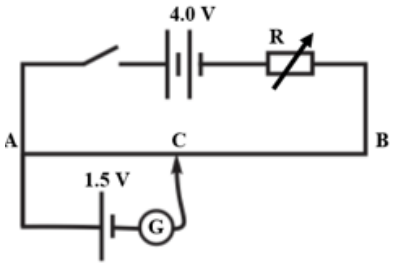
39. The masses of Sun, Earth and moon are M_S, M_E and M_m respectively. The distance between sun and the Earth is d and the distance between moon and the Earth is r. If the universal gravitational constant is G, which of the following expression represents the resultant gravitational force on moon at full moon eclipse?

(1) $\frac{GM_SM_m}{(d+r)^2}+\frac{GM_EM_m}{r^2}$ (2) $\frac{GM_SM_m}{(d+r)^2}-\frac{GM_EM_m}{r^2}$

(3) $\frac{GM_SM_m}{d^2}+\frac{GM_EM_m}{r^2}$ (4) $\frac{GM_SM_m}{(d-r)^2}+\frac{GM_EM_m}{r^2}$

(5) $\frac{GM_SM_m}{(d-r)^2}-\frac{GM_EM_m}{r^2}$

40. A uniform metal string of length (AB) 1 m and resistance 2 Ω is connected to the given potentiometer. The resistance of the lead – acid accumulator of electro motive force (emf) 4 V is negligible. If 2.4 Ω is given to the variable resistor, what would be the length of AC in order to give zero deflection from center zero galvanometer?

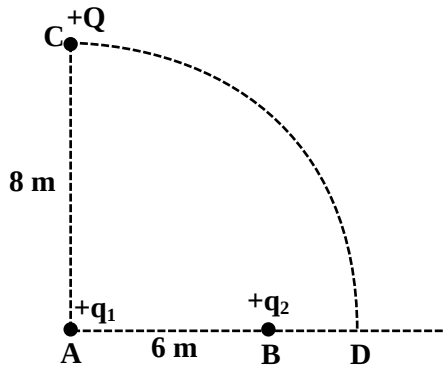


(1) 8.2 cm (2) 8.5 cm (3) 67.5 cm (4) 82.5 cm (5) 85.0 cm

41. A photon of energy E and work function $\emptyset_o$ is incident on the metal surface. At that moment, the emitted electron has the mass m and charge e enters the uniform magnetic field of magnetic field intensity B perpendicularly and goes on a circular path. What expression gives the maximum radius of the path?

(1) $\frac{\sqrt{2m(E+\emptyset_o)}}{eB}$ (2) $\sqrt{\frac{2m(E+\emptyset_o)}{eB}}$ (3) $\sqrt{\frac{2m(E-\emptyset_o)}{eB}}$ (4) $\frac{\sqrt{2m(E-\emptyset_o)}}{eB}$ (5) $\frac{2m(E-\emptyset_o)}{eB}$

42. The $q_1$and q_2 point charges are kept 6 m away from each other at A and B points. The $+Q$ charge which is at C is taken from C to D along a circular path of radius 8 cm as shown in the figure. Which of the following expression gives the change of the potential energy of the system?

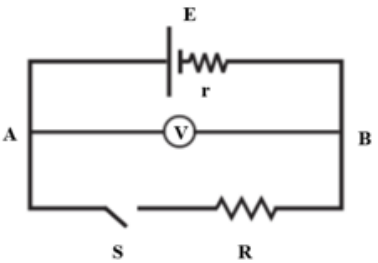


(1) $\frac{1}{4\pi\epsilon_0}\left[\frac{Qq_2}{8}-\frac{Qq_2}{2}\right]$ (2) $\frac{1}{4\pi\epsilon_0}\left[\frac{Qq_1}{8}-\frac{Qq_1}{2}\right]$

(3) $\frac{1}{4\pi\epsilon_0}\left[\frac{Qq_2}{2}+\frac{Qq_2}{10}\right]$ (4) $\frac{1}{4\pi\epsilon_0}\left[\frac{Qq_2}{2}-\frac{Qq_2}{10}\right]$

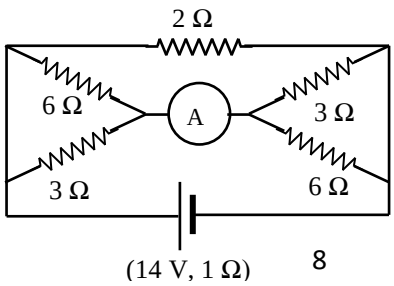
(5) $\frac{1}{4\pi\epsilon_0}\left[\frac{Qq_1}{8}-\frac{Qq_2}{8}\right]$

43. The internal resistance of the dry cell in the given circuit is r and its electro motive force (emf) is E. The external resistance (R) is 4 Ω. When its switch 'S' is open the ideal voltmeter reads 10 V while 'S' is closed its reading is 8 V. What would be the value of the internal resistance of the cell?



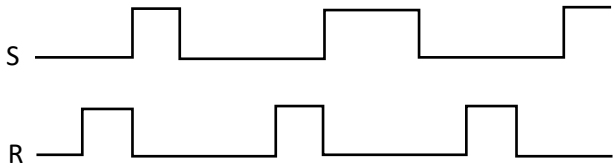
(1) 0.05 Ω (2) 0.1 Ω (3) 0.5 Ω (4) 1.5 Ω (5) 1 Ω

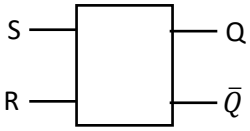
44. What is the correct reading of the given ideal ammeter in the given diagram of resistor system?



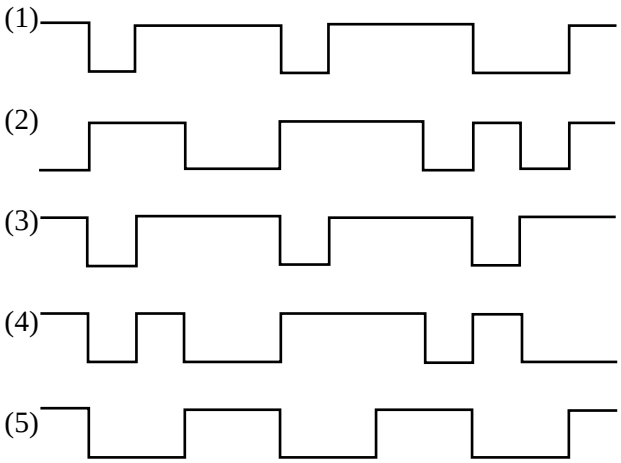
(1) 2.0 A (2) 2.5 A (3) 3.5 A (4) 4 A (5) 6.0 A

45. The timing diagrams of input signals for S and R input terminals of S-R flip-flop are given below.

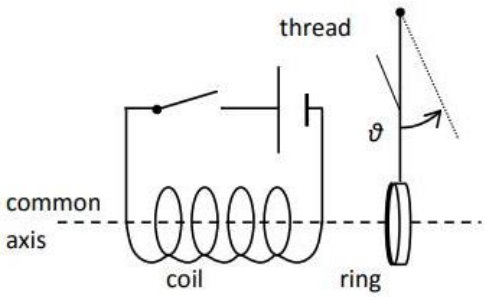


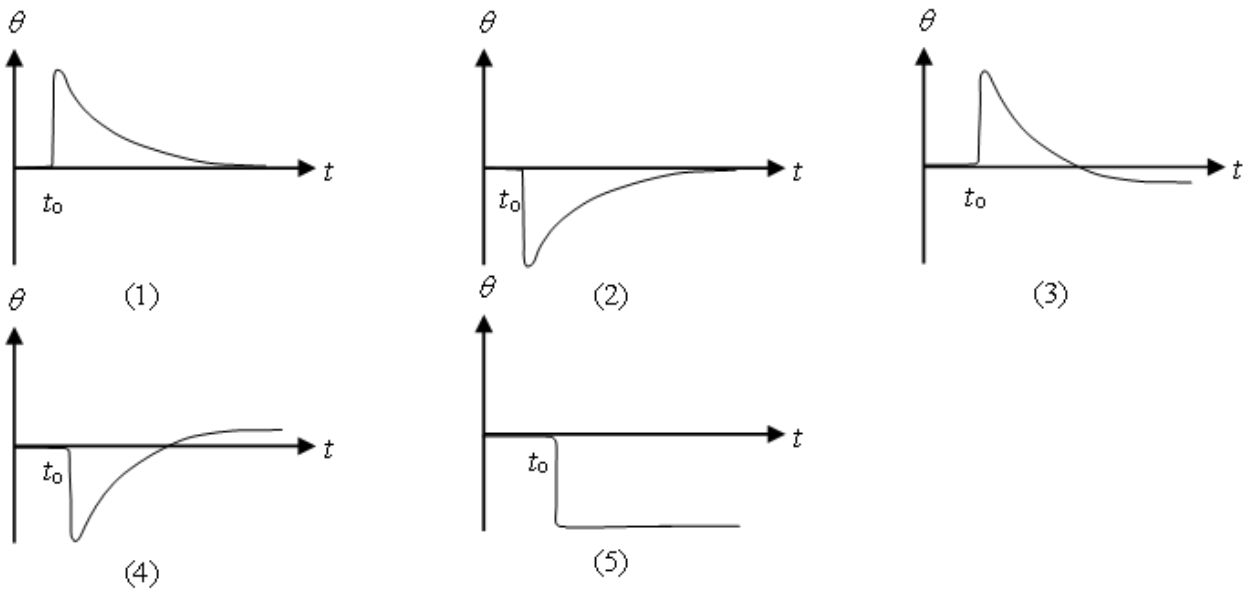


Which of the following diagrams correctly represent the output signal *Q*?

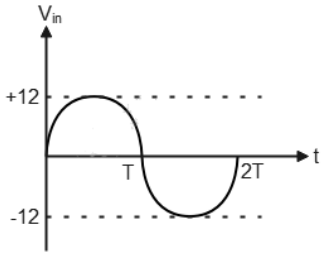


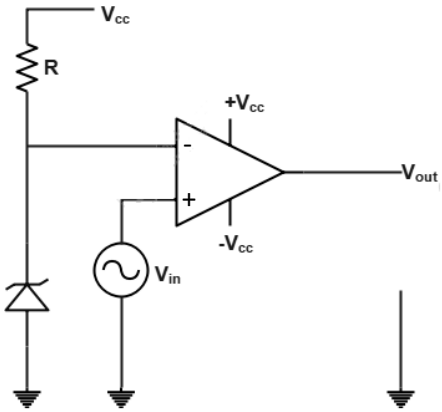
46. A soft iron ring hangs vertically from a thread and has its axis aligned with a coil. The current in the coil is switched on at time t_0. Which of the following graphs shows a possible variation of the angular displacement that the thread makes with the vertical, ϑ, with time?



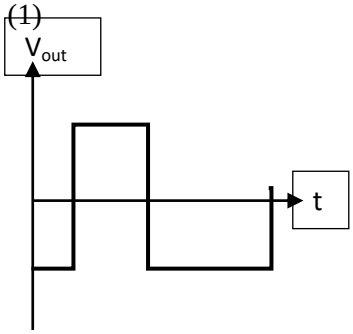


47. Given below is a voltage comparison circuit with operational amplifier (Op-Amp). The Zener voltage (V_z) of the Zener diode is 3V. When the input signal V_{in} is given to non – inverted input, what would be the output signal from the following.

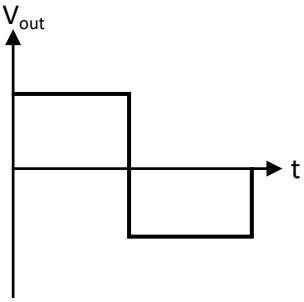




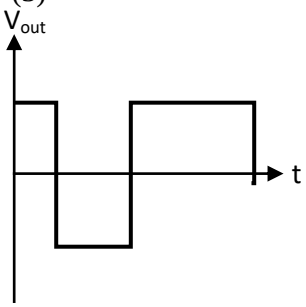
(1)



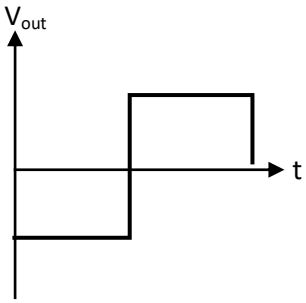
(2)



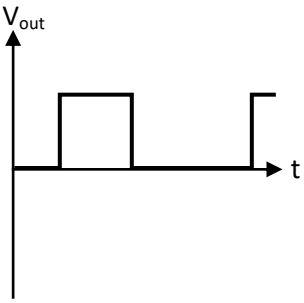
(3)



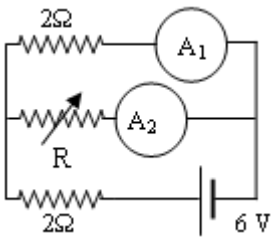
(4)

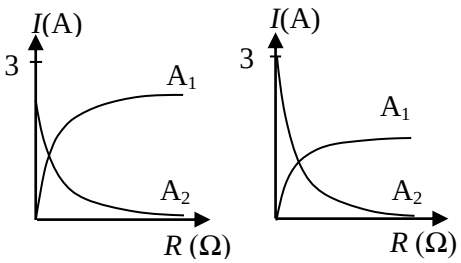


(5)



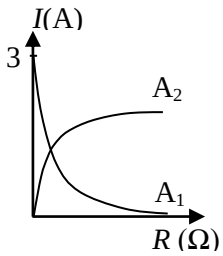
48. In the given circuit, A_1 and A_2 are ideal ammeters. R is a variable resistor. When changing the resistance of R from zero to infinity the readings of ammeters A_1, A_2 *(I)* changes with the resistor value (R). Which of the following graphs best represent it?



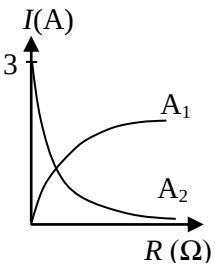


(1)

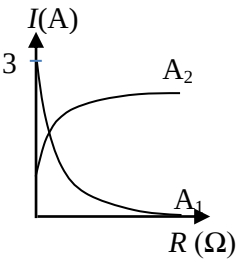
(2)



(3)

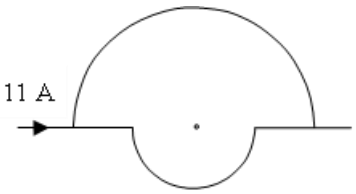


(4)



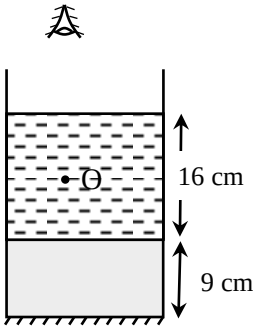
(5)

49. Two semicircular conducting coil loops of radius r and 2r are connected as shown in the diagram. 11 A current is also supplied to the system. Loops are made of same material. What is the value and the direction of the magnetic flux density of the circuit at the common center?
(Take as $\pi = 3$)



(1) In to the paper $5\mu_0 / 8r$ (2) Out of the paper $7\mu_0 / 8r$
(3) In to the paper $7\mu_0 / 8r$ (4) Out of the paper $7\mu_0 / 4r$
(5) In to the paper $17\mu_0 / 8r$

50. In the glass cylinder given in the diagram has glass bottom of thickness 9 cm. A plane mirror is connected to bottom of it. Water is poured in to it. Its water height is 16 cm. A pointing object 'O' is in 8 cm below the water surface. When observing 'O' from the right above it in air, what are the distances for the two bright images from the water surface? (The refractive indices of water and glass relative to air are 4/3 and 3/2 respectively.)



(1). 6 cm, 24 cm (2). 6 cm, 27 cm (3). 6 cm, 30 cm
(4). 12 cm, 27 cm (5). 12 cm, 30 cm