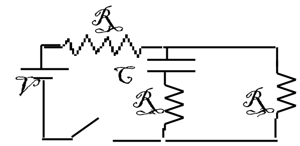
**Syllabus:** Kinematics, Laws of Motion & Friction, Work, Power & Energy, Circular Motion, Electrostatics, Capacitor, Current Electricity, Magnetism, Electromagnetic Induction, Ray Optics, Wave Optics, Photo Electric Effect, X-ray, Atomic Physics.

# PHYSICS

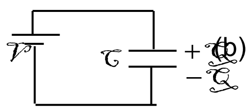
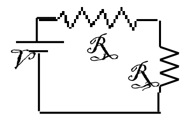
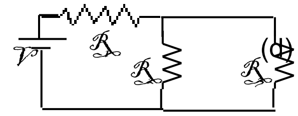
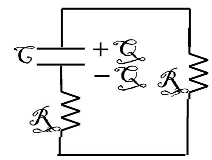
## Section I

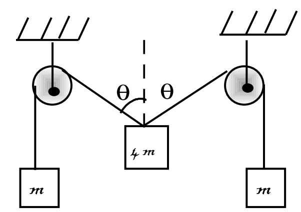
Straight objective type

*This section contains 8 multiple-choice questions numbered 1 to 8. Each question has 4 choices (A), (B), (C) and (D), out of which **only ONE** is correct.*



1. Consider the shown circuit. The capacitor is unchanged when the switch is closed at time t = 0. Which of the circuit given in options is equivalent to the shown circuit as t approaches infinity?

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

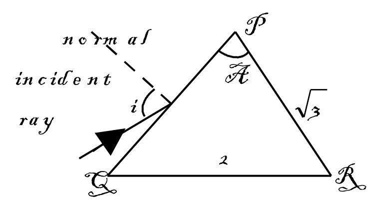


2. In the figure shown, the pulleys and strings are massless. The acceleration of the block of mass 4m just after the system is released from rest is ($\theta = \sin^{-1}\frac{3}{5}$)

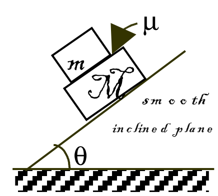
(a) $\frac{2g}{5}$ downward (b) $\frac{2g}{5}$ upwards (c) $\frac{5g}{11}$ upwards (d) $\frac{5g}{11}$ downwards

3. During a rainy day, rain is falling vertically with a velocity 2m/s. A boy at rest starts his motion with a constant acceleration of 2m/s$^2$ along a straight road. Find the rate at which the angle of the axis of umbrella with vertical should be changed so that the rain always falls parallel to the axis of the umbrella.

(a) $\frac{1}{1+t^2}$ (b) $\frac{2}{1+t^2}$ (c) $\frac{1}{2+t^2}$ (d) $\frac{1}{1+2t^2}$

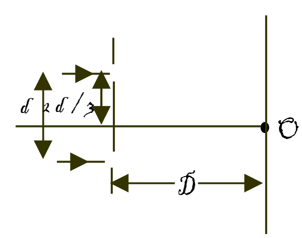


4. A prism of angle A and refractive index 2 is surrounded by medium of refractive index $\sqrt{3}$. A ray is incident for side PQ at an angle of incidence i ($0 \le I \le 90^0$) as shown. The refracted ray is then incident on side PR of prism. The minimum angle A of prism for which ray incident on side PQ does not emerge out of prism from side PR (for any value of i) is
(a) $30^0$ (b) $45^0$ (c) $60^0$ (d) $120^0$

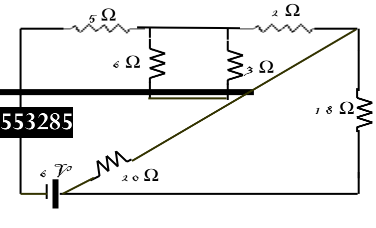


5. A block of mass m is placed on a bigger block of mass M, which in turn is placed on smooth fixed inclined plane. The inclined plane makes an angle θ with horizontal. The two block system is released from rest as shown. The coefficient of friction between both the blocks is μ (μ < tanθ). Then just after both the blocks are released from rest, the magnitude of acceleration of block of mass M is

(a) zero (b) $g \sin\theta$ (c) $g\sin\theta - \mu g\cos\theta$ (d) $\frac{\mu m g\cos\theta + Mg\sin\theta}{M}$



6. In the figure shown if a parallel beam of white light is incident on the plane of the slits then the distance of the nearest white spot on the screen from O is: [ assume d << D, λ << d ]
(a) 0 (b) d/2 (c) d/3 (d) d/6



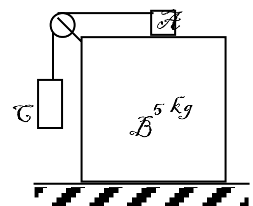
7. In the circuit shown, the cell of emf 6V is ideal. The resistor in which the power dissipated is greatest is
(a) 5 Ω (b) 3 Ω (c) 9 Ω (d) 18 Ω

8. Two point objects are placed on principal axis of a thin converging lens. One is 20 cm from the lens and other is on the other side of lens at a distance of 40 cm from the lens. The images of both objects coincide. The magnitude of focal length of lens is
(a) $\frac{80}{3}$ cm (b) $\frac{40}{3}$ cm (c) 40 cm (d) $\frac{20}{3}$ cm

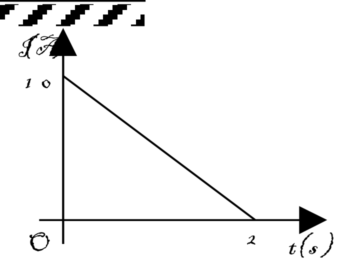
**Section – II**
Straight Objective Type (More than one options may be correct) **(+4, 0)**

9. A parallel plate capacitor of capacitance 10 μF is connected to a cell of emf 10 Volt and fully charged. Now a dielectric slab (k = 3) of thickness equal to the gap between the plates, is completely filled in the gap keeping the cell connected. During the filling process.
(a) the increase in charge on the capacitor is 200 μC.
(b) the heat produced is zero
(c) energy supplied by the cell = increase in stored potential energy + work done on the person who is filling the dielectric slab.
(d) energy supplied by the cell = increase in stored potential energy + work done on the person who is filling the dielectric slab + heat produced.

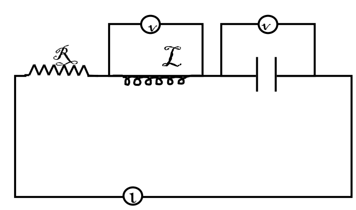
10. All the blocks shown in the figure are at rest. The pulley is smooth and the strings are light. Coefficient of friction at all the contacts is 0.2. A frictional of 10N acts between A and B. The block A is about to slide on block B. The normal reaction and frictional force exerted by the ground on the block B is
(a) The normal reaction exerted by the ground on the block B is 110N
(b) The normal reaction exerted by the ground on the block B is 50N
(c) The frictional force exerted by the ground on the block B is 20N
(d) The frictional force exerted by the ground on the block B is zero




11. A variable current flows through a 1Ω resistor for 2 seconds. Time dependence of the current is shown in the graph.
(a) Total charge flown through the resistor is 10 C
(b) Average current through the resistor is 5A
(c) Total heat produced in the resistor is 50J
(d) Maximum power during the flow of current is 100 W



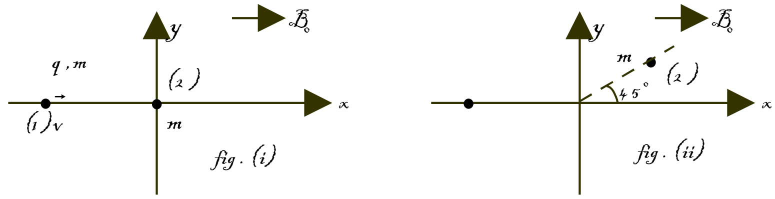

12. In the circuit shown, resistance R = 100Ω, inductance $L = \frac{2}{\pi}$ H and capacitance $C = \frac{8}{\pi}$ μF are connected in series with an ac source of 200 volt and frequency 'f'. if the reading of the hot wire voltmeters $V_1$ and $V_2$ are same then:
(a) f = 125 H (b) f = 250 π Hz
(c) current through R is 2A (d) $V_2 = V_2$ = 1000 volt




**Section III**
*This section contains 2 paragraphs $C_{13-15}$ ,and $C_{16-18}$ . Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

**$C_{13-15}$: Paragraph for Question Nos. 13 – 15**

A particle (1) having positive charge q and mass m is moving along x-axis with a velocity $\vec{v} = v_0\hat{i}$ in space having uniform and constant magnetic field $\vec{B} = B_0\hat{i}$ where $v_0$ and $B_0$ are positive constants. At time t = 0 second, the moving particle (1) strikes another stationary uncharged particle (2) of mass m lying at origin, as shown in figure (i). The collision is perfectly elastic and the uncharged particle (2) after collision moves along a straight line (in x-y plane) making an angle $45^0$ with positive x-axis, as shown in figure (ii). Assume that there is no transfer of charge between the particles during collision.




13. The time period of revolution of charged particle (after t = 0 second) is

(a) $\frac{2\pi m}{qB_0}$ (b) $\frac{2\sqrt{2}\pi m}{qB_0}$ (c) $\frac{\pi m}{\sqrt{2}qB_0}$ (d) None of these

14. The minimum time after t = 0, at which the charged particle touches x-axis is

(a) $\frac{\pi m}{\sqrt{2}qB_0}$ (b) $\frac{2\sqrt{2}\pi m}{qB_0}$ (c) $\frac{2\pi m}{qB_0}$

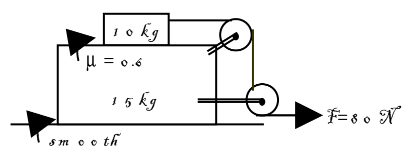
(d) After t = 0 charged particle does not touch x – axis.

15. The minimum time after t = 0, at which velocity of both particles are parallel is

(a) $\frac{\pi m}{qB_0}$ (b) $\frac{\sqrt{2}\pi m}{qB_0}$ (c) $\frac{\pi m}{2\sqrt{2}qB_0}$ (d) Velocities of both cannot be parallel.

**$C_{16-18}$: Paragraph for Question Nos. 16 – 18**

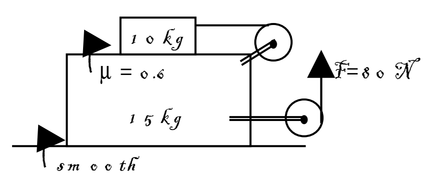
A block of mass 15 kg is placed over a frictionless horizontal surface. Another block of mass 10 kg is placed over it, that is connected with a light string passing over two pulleys fastened to the 15 kg block. A force F = 80 N is applied horizontally to the free end of the string. Friction coefficient between two blocks is 0.6. The portion of the string between 10 kg block and the upper pulley is horizontal. Pulley, string & connecting rods are massless. (Take g = 10 m/s$^2$)




16. The magnitude of accelerations of the 10 kg, 15 kg block are :
(a) 3.2 m/s$^2$, 3.2 m/s$^2$ (b) 2.0 m/s$^2$, 4.2 m/s$^2$
(c) 1.6 m/s$^2$, 16/3 m/s$^2$ (d) 0.8 m/s$^2$ , 2. 0 m/s$^2$

17. If applied force F = 120 N, then magnitude of acceleration of 15 kg block will be :
(a) 8 m/s$^2$ (b) 4 m/s$^2$ (c) 3.2 m/s$^2$ (d) 4.8 m/s$^2$

18. Continuing with the situation, if the force F = 80 N is directed vertically as shown in the given figure, the accelerations of the 10 kg, 15 kg block will be:
(a) 2 m/s$^2$ towards right and 4/3 m/s$^2$ towards left
(b) 2 m/s$^2$ towards left and 16/5 m/s$^2$ towards right
(c) 6 m/s$^2$ towards left and 4 m/s$^2$ towards right
(d) 16/5 m/s$^2$ towards right and 2/3 m/s$^2$ towards right

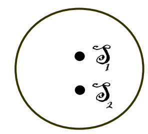



**Section IV**

Matching type: Multiple matching may be there. **(+8/ 0)**

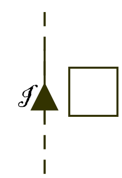
*This section contains 2 questions. And the questions contains statements given in two columns which have to be matched. Statements (a, b, c, d) in **Column I** have to be matched with Statements (p, q, r, s) in **Column II**.*

19. Two coherent point sources of light having wavelength $\lambda$ are separated by a distance d. A circle is drawn in space surrounding both the point sources as shown. The plane of circle contains both the point sources. The distance d between both the sources is given in **Column-I** and the total number of corresponding points of maximum intensity and minimum intensity on the periphery of the shown circle are given in **Column – II.** Match each situation of **Column-I** with the results in **Column-II**.



| **Column-I** | **Column-II** |
|---|---|
| (a) d = 99.4 $\lambda$ | (p) 398 points of maximum intensity |
| (b) d = 99.6 $\lambda$ | (q) 400 points of maximum intensity |
| (c) d = 100 $\lambda$ | (r) 396 points of maximum intensity |
| (d) d = 100.4 $\lambda$ | (s) 400 points of minimum intensity |

20. A square loop of conducting wire is placed near a long straight current carrying wire as shown. Match the statements in **column-I** with the corresponding results in **column-II**



| **Column-I** | **Column-II** |
|---|---|
| (a) If the magnitude of current I is increased | (p) Induced current in the loop will be clockwise |
| (b) If the magnitude of current I is decreased | (q) Induced current in the loop will be anticlockwise |
| (c) If the loop is moved away from the wire | (r) wire will attract the loop |
| (d) If the loop is moved towards the wire | (s) wire will repel the loop |