PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 75

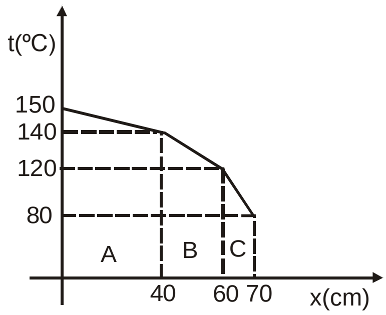
Total Marks : 27

Max. Time : 28 min.

Topics : Heat, Center of Mass, Magnetic Effect of Current and Magnetic Force on Charge/current, Rotation, Geometrical Optics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. The graph shown gives the temperature along an x axis that extends directly through a wall consisting of three layers A, B and C. The air temperature on one side of the wall is 150°C and on the other side is 80°C. Thermal conduction through the wall is steady. Out of the three layers A, B and C, thermal conductivity is greatest of the layer



(A) A
(B) B
(C) C
(D) Thermal conductivity of A = Thermal conductivity of B.

2. Which of the following statements is true concerning the elastic collision of two objects ?
(It is given that no net external force acts on the system of two object; and the objects do not exert force on each other except during collision)

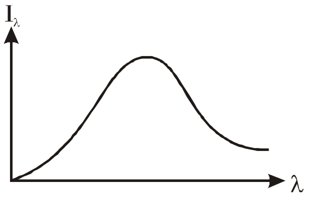
(A) No net work is done on any of the two objects, since there is no external force on the system of given two object.
(B) The net work done by the first object on the second is equal to the net work done by the second on the first.
(C) The net work done by the first object on the second is exactly the opposite of the net work done by the second on the first.
(D) The net work done on the system depends on the angle of collision.

3. Choose the correct statements :

(A) For a closed surface, the surface integration $\oint \vec{B}.\vec{ds}$ is always zero, where $\vec{B}$ is magnetic field

(B) A current carrying circular loop is in a uniform external magnetic field and is free to rotate about its diametrical axis will be in stable equilibrium when flux of total magnetic field (external field + field due to the loop itself) is maximum.

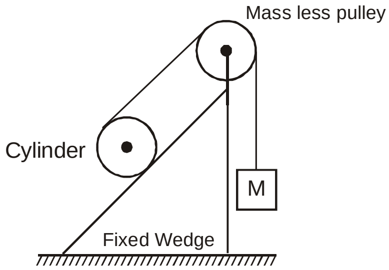
(C)



Spectral energy distributed graph of a black body is shown in figure. If temperature (in K) of the black body is doubled and surface area is halved, the area under the graph will be eight times.

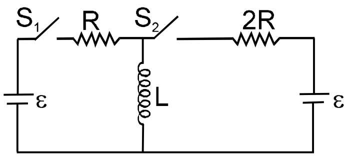
(D) In keplers III law, $\frac{T^2}{R^3}$ depends on the mass of the Sun, around which a planet is revolving.

4. A cylinder and a variable mass M are arranged on a fixed wedge using a light string and a massless pulley. There is enough friction between cylinder and the wedge to prevent any slipping.



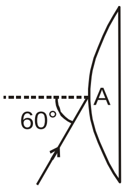
(A) Only one value of M is possible for which cylinder can remain in equilibrium.
(B) There is a range of value of M for which cylinder can remain in equilibrium.
(C) For a certain value of M, the cylinder starts to roll up the plane. In this situation, magnitude of friction force on the cylinder by the wedge will be greater than tension in the string
(D) For a certain value of M, the cylinder starts to roll down the plane. In this situation, magnitude of friction force on the cylinder by the wedge will be greater than tension in the string

5. In the circuit shown S_1 & S_2 are switches. S_2 remains closed for a long time and S_1 open. Now S_1 is also closed. Just after S_1 is closed, find the potential difference (V) across R and $\frac{di}{dt}$ (with sign) in L.



COMPREHENSION

Figure shows a plano-convex lens of refractive index $\sqrt{3}$ placed in air. The maximum thickness of the lens is 3 mm and its aperture diameter is 8 mm. Point A lies on the curved surface on the principal axis. A light ray is incident at the point A as shown in the figure making 60° with the normal.



6. The angle of deviation caused by the lens is :
(A) 60° (B) 30° (C) 0° (D) 15°

7. The lateral displacement of the light ray in passing through the lens is :
(A) 3 mm (B) $3\sqrt{3}$ mm (C) $\sqrt{3}$ mm (D) Zero

8. The focal length of the lens if treated as a thin lens is :
(A) $\frac{5}{12}$ cm (B) $\frac{5}{24}$ cm (C) $\frac{25}{12}(\sqrt{3}+1)$ cm (D) $\frac{5}{24}(\sqrt{3}+1)$ cm

Answers Key

1. (A)	**2.** (C)	**3.** (A)(B) (D)	**4.** (A) (D)
5. $\frac{\varepsilon}{3}$	**6.** (C)	**7.** (C)	**8.** (C)

Hints & Solutions

1. Rate of heat transfer is same through all walls

$$\frac{K_1.A.(10)}{40\,cm} = \frac{K_2A(20)}{20\,cm} = \frac{K_2\,A(40)}{10\,cm}$$

$$\Rightarrow \frac{K_1}{4} = K_2 = 4K_3 \Rightarrow K_1 = 4K_2 = 16\,K_3\,.$$

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$$\Rightarrow \frac{K_1}{4} = K_2 = 4K_3 \Rightarrow K_1 = 4K_2 = 16\,K_3\,.$$

2. For the elastic collision, total kinetic energy is constant.
If we consider both the colliding bodies as system, then net work done on the system is zero (By work energy theorem)

$K_1 + K_2 = K'_1 + K'_2$ .... (1)

K is kinetic energy of object before the collision and K' is kinetic energy of object after the collision
In general masses of both the objects are different, So speed of each object becomes different after collision $K_1 \neq K'_1$ and $K_2 \neq K'_2$
By work energy theorem

$W_1 = K'_1 - K_1$ .... (2)

$W_2 = K'_2 - K_2$ .... (3)

From (1), (2) and (3)

$W_1 \neq 0,\quad W_2 \neq 0$

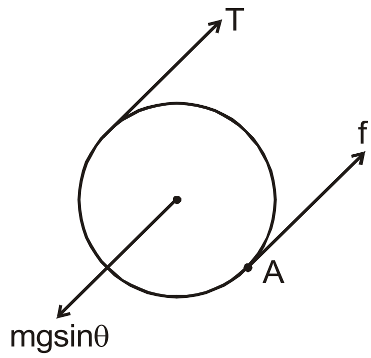
$W_1 + W_2 = 0$

$W_1 = - W_2$

i.e. the work done by the first object on the second object is exactly the opposite of the work done by the second object on the first object.

3. **A, B, D**

4. The F.B.D. of cylinder is as shown. In equilibrium $\Rightarrow$
T = Mg = tension in string
In equilibrium, net force on cylinder is zero
$\therefore$ Torque is same about any axis.
$\Rightarrow$ Torque on cylinder about any point is zero.
$\tau_A = Mg\,2R - mg\sin\theta\,R = 0$

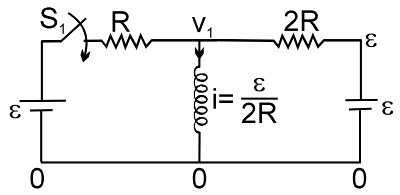


$\therefore M = \frac{m \sin\theta}{2}$ Hence for only one value of M cylinder can remain in equilibrium.

$\Rightarrow$ A is true, B is false

When the cylinder rolls up the incline, sense of rotation of cylinder about center of mass is clockwise. Hence T > f. $\Rightarrow$ C is false.
When the cylinder rolls down the incline, sense of rotation of cylinder about center of mass is anticlockwise. Hence T < f. $\Rightarrow$ D is True.

5. When S_2 is closed current in inductor



remains, $i = \frac{\varepsilon}{2R}$

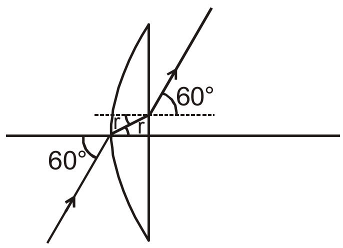
$$\therefore \frac{\varepsilon - V_1}{R} + \frac{\varepsilon - V_1}{2R} = \frac{\varepsilon}{2R} \qquad \left(V_1 = \frac{2\varepsilon}{3}\right)$$

$\therefore$ Potential difference

$$(V) = \varepsilon - \frac{2\varepsilon}{3} = \frac{\varepsilon}{3} \textbf{ Ans.}$$

And $\quad L\frac{di}{dt} = \frac{2\varepsilon}{3} \quad \frac{di}{dt} = + \frac{2\varepsilon}{3L}$ **Ans.**

6. From ray diagram it is clear that ray emerges out of lens parallel to itself. Hence the angle of deviation caused by the lens is 0°.



7. From snells law at first interface

$\sin 60 = \sqrt{3}\ \sin r$ or $r = 30°$

Since the emergent ray is parallel to initial incident ray, the portion of lens used for refraction can be assumed as slab

Hence lateral displacement

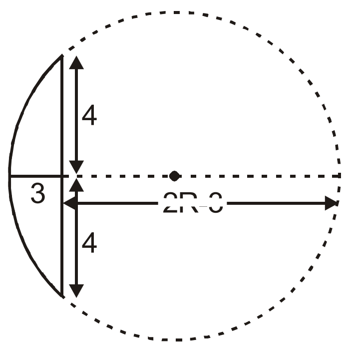
$$= t\frac{\sin(i-r)}{\cos r} = 3\frac{\sin(60-30)}{\cos 30} = \sqrt{3}\ \text{mm.}$$

8. If R denotes radius of curvature of curved surface, then from above figure

$3 \times (2R - 3) = 4 \times 4$

or $R = \frac{25}{6}$ mm

From the formulae of focal length for plano-convex lens



$$f = \frac{R}{\mu - 1} = \frac{25}{6(\sqrt{3}-1)} = \frac{25}{6(\sqrt{3}-1)} \times \left(\frac{\sqrt{3}+1}{\sqrt{3}+1}\right)$$

$$= \frac{25}{12}(\sqrt{3}+1)\ \text{cm}$$