PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 16

Total Marks : 32

Max. Time : 33 min.

Topics : Electrostatics, Fluid, Circular Motion, Work, Power and Energy, Sound Wave, String Wave, Geometrical Optics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.8 to Q.10	(3 marks, 3 min.)	[9, 9]

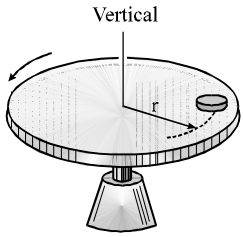
1. Four positive charges $(2\sqrt{2}-1)$ Q are arranged at corner of a square. Another charge q is placed at the centre of the square. Resultant force acting on each corner is zero If q is

(A) – 7Q/4 (B) – 4Q/7 (C) -Q (D) None

2. A vessel contains oil (density = 0.8 gm/cm^3) over mercury (density = 13.6 gm/cm^3). A uniform sphere floats with half its volume immersed in mercury and the other half in oil. The density of the material of sphere in gm/cm^3 is:

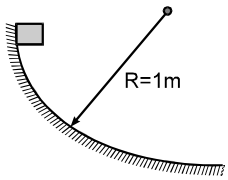
(A) 3.3 (B) 6.4 (C) 7.2 (D) 12.8

3. A small coin of mass 40 g is placed on the horizontal surface of a rotating disc. The disc starts from rest and is given a constant angular acceleration α = 2 rad/s^2. The coefficient of static friction between the coin and the disc is μ_s = 3/4 and coefficient of kinetic friction is μ_k = 0.5. The coin is placed at a distance r = 1 m from the centre of the disc. The magnitude of the resultant force on the coin exerted by the disc just before it starts slipping on the disc is : (Take g = 10 m/s^2)



(A) 0.2 N (B) 0.3 N (C) 0.4 N (D) 0.5 N

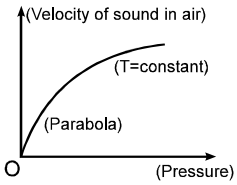
4. A block of mass 1 kg slides down a curved track that is one quadrant of a circle of radius 1m. Its speed at the bottom is 2 m/s. The work done by frictional force is : (g = 10 m/s^2)

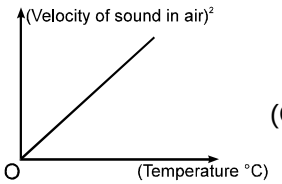


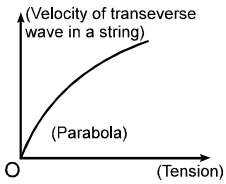
(A) 8 J (B) – 8 J

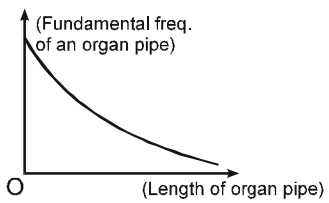
(C) 4 J (D) – 4 J

5. Which of the following is/ are correct.

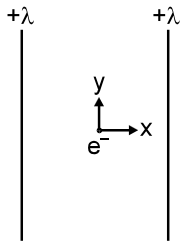
(A)


(B)


(C)


(D)


6. An electron is placed just in the middle between two long fixed line charges of charge density $+\lambda$ each. The wires are in the xy plane (Do not consider gravity)

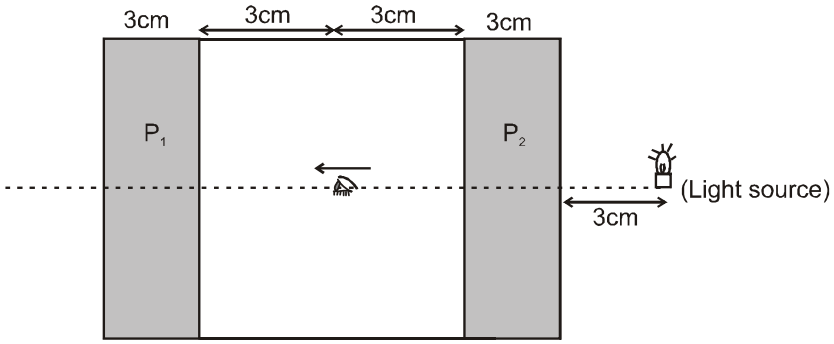


(A) The equilibrium of the electron will be unstable along x-direction
(B) The equilibrium of the electron will be stable along y-direction
(C) The equilibrium of the electron will be neutral along y-direction
(D) The equilibrium of the electron will be stable along z-direction

7. The ratio of the intensities of the mechanical waves propagating in the same medium $Y_1=10\sin(\omega t - kx)$ and $Y_2= 5[\sin(\omega t - kx) + \sqrt{3}\cos(kx - \omega t)]$ is

COMPREHENSION

There is an insect inside a cabin eying towards a thick glass plate P_1. Insect sees the images of light source across the glass plate P_1 ouside the cabin. Cabin is made of thick glass plates of refractive index $\mu = \frac{3}{2}$ and thickness 3 cm. Insect is eying from the middle of the cabin as shown in figure. (glass plates are partially reflective and consider only paraxial rays)



8. At what distance (from eye of insect) will the eye see first image?
(A) 5 cm (B) 7 cm (C) 9 cm (D) 14 cm

9. At what distance (from eye of insect) will the eye see second image?
(A) 11 cm (B) 13 cm (C) 16.5 cm (D) 18 cm

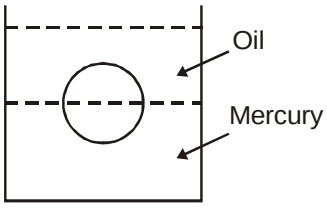
10. Number of image seen by insect ?
(A) 2 (B) 4 (C) 8 (D) ∞

Answers Key

1. (A) **2.** (C) **3.** (D) **4.** (B) **5.** (C)
6. (A), (C), (D) **7.** 1:1 **8.** (D) **9.** (D)
10. (D)

Hints & Solutions

2. (C)



Weight = Buoyant force

$$V\rho_m g = \frac{V}{2}\rho_{Hg} g + \frac{V}{2}\rho_{oil}$$

$$r_m = \frac{\rho_{Hg} + \rho_{oil}}{2} = \frac{13.6 + 0.8}{2}$$

$$= \frac{14.4}{2} = 7.2$$

3. The friction force on coin just before coin is to slip will be :

$f = \mu_s mg$

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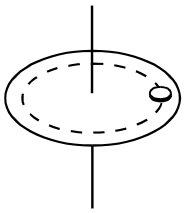
Normal reaction on the coin ; $N = mg$

The resultant reaction by disk to the coin is



$$= \sqrt{N^2 + f^2}$$

$$= \sqrt{(mg)^2 + \mu_s^2 (mg)^2}$$

$$= mg\sqrt{1 + \mu^2}$$

$$= 40 \times 10^{-3} \times 10 \times \sqrt{1 + \frac{9}{16}} = \mathbf{0.5\ N}$$

4. Applying work–energy theorem,

$\Sigma W_{\text{all forces}} = \Delta K.E.$

$W_g + W_N + W_f = \Delta K.E.$

$\Rightarrow \quad (1 \times 10 \times 1) + 0 + W_f$

$= \frac{1}{2}(1)[(2)^2 - (0)^2]$

$10 + W_f = 2$

$W_f = -8J.$

5. Velocity of sound in air $(V) = \sqrt{\frac{\gamma RT}{M}}$

$\Rightarrow \quad V^2 \alpha T$ (in kelvin)

not $V^2 \alpha T$ (in ^0C)

Hence (B) is incorrect.

Velocity of transverse wave in a string :

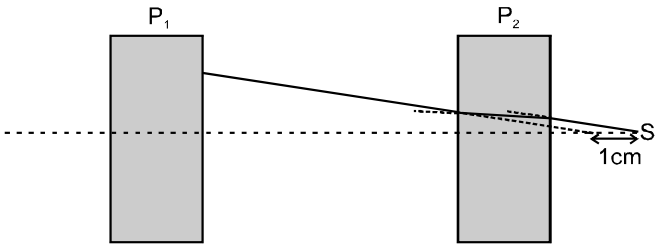
$V = \sqrt{\frac{T}{\mu}} = V^2 \alpha T$

Hence (C) is a correct graph.

6. If we displace the electron slightly toward x direction, it will thrown away toward right.
So eql. is unstable along x direction.
If we displace the electron slightly towards y direction, No extra force will act. So eql. is neutral along y axis
If we displace the electron toward z direction, it will be attracted and try to come to eql. positron.
So eql. is stable along z direction.

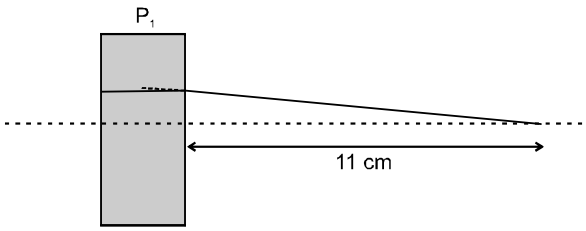
7. **[Ans. 1:1]**

8. As it is posible only when, when light reflects from P_1 after refraction from the plate P_2 of light coming from light source.



First image will form due to reflection from the right surface of P_1 . As light ray is falling on P_1 from 11 cm so it will form image at 11 cm in left. So, distance of first image from insect is 11 + 3 = 14 cm.

9. Second image will form due to reflection on left surface of P_1.



For left surface of P_1 light seems to coming from the

distance = $\frac{33}{2}$ + 3 = $\frac{39}{2}$ cm

So, light seems to coming from $\frac{45}{2}$ cm from right surfaces of P_1 .

So, final position of second image will be

= $\frac{\frac{45}{2}}{\frac{3}{2}}$ = 15 cm.

So, distance of second image from insect = 18 cm.

10. Due to multiple reflections infinite image will be formed