PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 54

Total Marks : 22

Max. Time : 23 min.

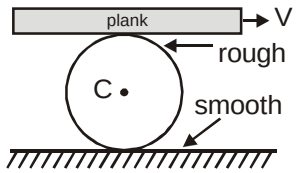
Topics : Center of Mass, Rotation, Current Electricity, Capacitor, Gravitation, Electrostatics

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks, 3 min.)**	**[9, 9]**
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]**

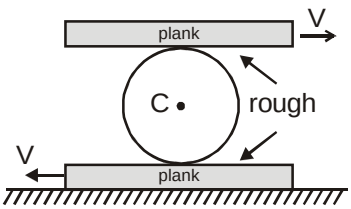
1. A projectile of range R bursts at its highest point in two fragments. Both pieces at the time of bursts have the velocity in the horizontal direction. The heavier is double the mass of the lighter. Lighter fragment falls at $\frac{R}{2}$ horizontal distance from the point of projection in the opposite side of projection. The distance, where other part falls, from point of projection.

(A) $\frac{7R}{4}$ (B) $\frac{5R}{4}$ (C) $\frac{8R}{4}$ (D) $\frac{6R}{4}$

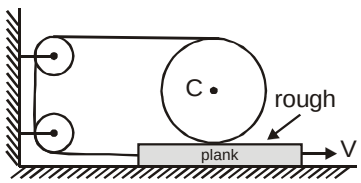
2. There are four arrangements of a cylinder and a plank as shown in the figures. Some surfaces are smooth and some are rough as indicated. There is no slipping at each rough surface. String always remanse tight. The plank and/or centre of cylinder are given a horizontal constant velocity as shown in each of the situations. Using this information fill in the blanks.

(i) 

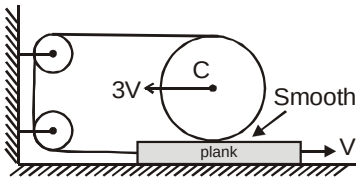
The speed of center of mass of the cylinder is _____.

(ii) 

The angular velocity of the cylinder is _____.

(iii) 

The speed of center of mass of the cylinder is _____ .

(iv) 

The angular velocity of the cylinder is _____ .

(a) V (b) V/R (c) 2V/R (d) 4V/R

(e) cannot be determined from the given information

(f) Zero.

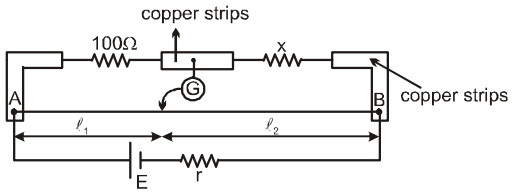
(A) (i) d (ii) b (iii) f (iv) c

(B*) (i) e (ii) b (iii) f (iv) c

(C) (i) e (ii) d (iii) f (iv) c

(D) (i) e (ii) b (iii) f (iv) a

3. In a practical wheat stone bridge circuit as shown, when one more resistance of 100 Ω is connected in parallel with unknown resistance 'x', then ratio ℓ_1/ℓ_2 become '2'. ℓ_1 is balance length. AB is a uniform wire. Then value of 'x' must be:



(A) 50 Ω (B) 100 Ω (C) 200 Ω (D) 400 Ω

4. A parallel plate capacitor (without dielectric) is charged and disconnected from a battery. Now a dielectric is inserted between the plates. The electric force on a plate of the capacitor will:

(A) decrease (B) increase

(C) remain same (D) depends on the width of the dielectric.

5. Assuming that the law of gravitation is of the form $F = \frac{GMm}{r^3}$ and attractive. A body of mass m revolves in a circular path of radius r around a fixed body of mass M. Find on what power of r will the square of time period depend.

COMPREHENSION

Gravitational force is conservative and medium independent force. Its nature is attractive. Gravitational field and gravitational potential are related as.

$E_g = -\frac{\partial V}{\partial r}$ where E_g is component of gravitational field along 'r'. Since gravitational force is attractive so gravitational potential will always be zero or negative assuming potential to be zero at large distance. With help of above discussions answer the following questions.

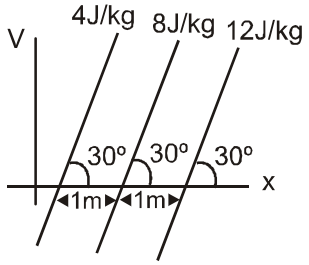
6. A person brings mass of 1 kg from infinity to a point 'A'. Initially the mass was at rest but it moves with speed 2 m/s as it reaches A. If the work done by the person on the mass is – 3J. The potential of A is :

(A) – 3 J/kg (B) + 3 J/kg (C) – 5 J/kg (D) 5 J/kg

7. The gravitational potential inside a hollow sphere of mass M (uniformly distributed), radius R at a distance r from the centre is-

(A) zero (B) $-\frac{GM}{r}$ (C) $-\frac{GM}{R}$ (D) $-\frac{GM}{r^2}$

8. Gravitational potential V/s x graph is shown. The magnitude of field intensity is equal to



(A) 8 N/kg (B) 4 N/kg

(C) 6 N/kg (D) 2 N/kg

Answers Key

1.	(A)	**2.**	(B)	**3.**	(B)	**4.**	(C)
5.	04	**6.**	(C)	**7.**	(C)	**8.**	(A)

Hints & Solutions

1. At highest point

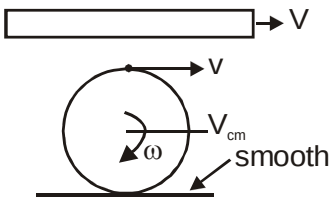
$$mu = \frac{2m}{3} v - 2u \frac{m}{3}$$

$$mu + \frac{2u}{3} = \frac{2}{3} v$$

$$\Rightarrow \quad v = \frac{5u}{2}$$

$$\text{total horizontal distance} = \frac{5}{2}\frac{R}{2} + \frac{R}{2} = \frac{7R}{4}$$

2. (i)



$V_{cm} + \omega R = V$
$V_{cm} = V - \omega R$

ω depends on value of friction between plank & cylinder, hence V_{cm} is undetermined.

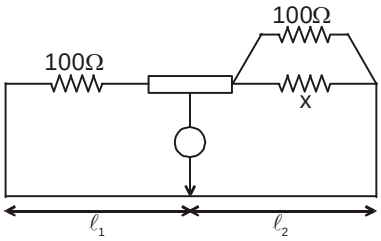
(ii) $\omega = \frac{2v}{2R} = \frac{V}{R}$ (iii) $\omega = \frac{2V}{2R} = \frac{V}{R}$

$V_{cm} = 0$

(iv) $\omega_{A/C} = \frac{3V - V}{R} = \frac{2V}{R} \Rightarrow \omega = \frac{2V}{R}$

3. $\because$ wheat stone bridge is in balanced condition

So $\dfrac{100}{\ell_1} = \dfrac{\dfrac{100x}{100+x}}{\ell_2}$



$\because \quad \dfrac{\ell_1}{\ell_2} = 2$

$\Rightarrow x = 100\ \Omega$

5. As gravitational force provides centripetal force

$$\frac{mv^2}{r} = \frac{GMm}{r^3}$$

i.e., $\quad v^2 = \dfrac{GM}{r^2}$

So that $\quad T = \dfrac{2\pi r}{v} = 2\pi r\sqrt{\dfrac{r^2}{GM}}$

$\therefore \quad T^2 \propto r^4$

Ans. 4

6. $V_A + \dfrac{1}{2} \times 1 \times (2)^2 = -3$

$V_A = -5$ Ans. (C)

7. $-\dfrac{GM}{R}$ Ans. (C)

8. $E_x = -\dfrac{\partial V}{\partial x} = -\dfrac{4}{1}$

$E_z = -\dfrac{4-8}{1/\sqrt{3}} = 4\sqrt{3}$

$|\bar{E}| = \sqrt{E_x^2 + E_z^2} = \sqrt{64} = 8$ N/kg Ans. (A)