PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 84

Total Marks : 25

Max. Time : 25 min.

Topics : Work, Power and Energy, Wave on a String, Center of Mass, Projectile Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]

1. What is the minimum stopping distance for a vehicle of mass m moving with speed v along a level road. If the coefficient of friction between the tyres and the road is μ.

(A) $\frac{v^2}{2\mu g}$ (B) $\frac{2v^2}{\mu g}$ (C) $\frac{v^2}{\mu g}$ (D) none of these

2. The (x, y) coordinates of the corners of a square plate are (0, 0) (L, 0) (L, L) and (0, L). The edges of the plate are clamped & transverse standing waves are set up in it. If u (x, y) denotes the displacement of the plate at the point (x, y) at some instant of time, the possible expression for 'u' is : [a = positive constant]

(A) $a\cos\left(\frac{\pi x}{2L}\right)\cos\left(\frac{\pi y}{2L}\right)$ (B) $a\sin\left(\frac{\pi x}{L}\right)\sin\left(\frac{\pi y}{2L}\right)$

(C) $a\sin\left(\frac{\pi x}{L}\right)\sin\left(\frac{2\pi y}{L}\right)$ (D) $a\cos\left(\frac{2\pi x}{L}\right)\sin\left(\frac{\pi y}{L}\right)$

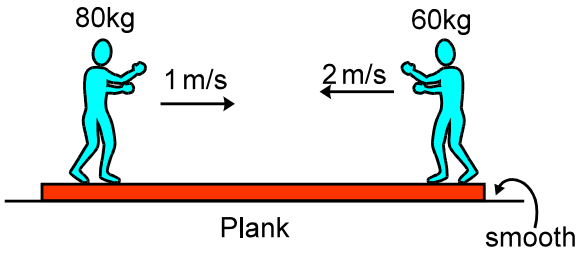
3. A chord attached about an end to a vibrating fork divides it into 6 loops, when its tension is 36 N. The tension at which it will vibrate in 4 loops is:

(A) 24 N (B) 36 N (C) 64 N (D) 81 N

4. A wire having a linear mass density 5.0×10^{-3} kg/m is stretched between two rigid supports with a tension of 450 N. The wire resonates at a frequency of 420 Hz. The next higher frequency at which the same wire resonates is 480 Hz. The length of the wire is

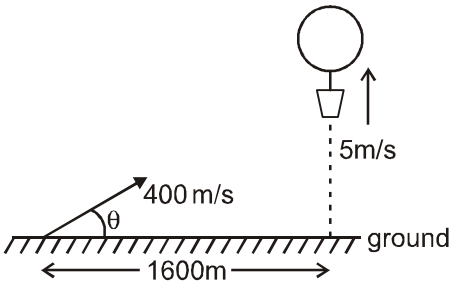
(A) 2.0 m (B) 2.1 m (C) 2.5 m (D) 3 m

5. Two men of masses 80 kg and 60 kg are standing on a wood plank of mass 100 kg, that has been placed over a smooth surface. If both the men start moving toward each other with speeds 1 m/s and 2 m/s respectively then find the velocity of the plank by which it starts moving.



COMPREHENSION

An observer having a gun observes a remotely controlled balloon. When he first noticed the balloon, it was at an altitude of 800 m and moving vertically upward at a constant velocity of 5m/s. The horizontal displacement of balloon from the observer is 1600 m . Shells fired from the gun have an initial velocity of 400 m/s at a fixed angle θ (sin θ = 3/5 and cos θ = 4/5). The observer having gun waits (for some time after observing the balloon) and fires so as to destroy the balloon. Assume g = 10m/s^2. Neglect air resistance.



6. The flight time of the shell before it strikes the balloon is
(A) 2sec (B) 5sec. (C) 10 sec (D) 15 sec

7. The altitude of the collision above ground level is
(A) 1250m (B) 1325m (C) 1075m (D) 1200m

8. After noticing the balloon, the time for which observer having gun waits before firing the shell is
(A) 50 sec. (B) 55 sec. (C) 60 sec. (D) 45 sec.

Answers Key

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1. (A) **2.** (C) **3.** (D) **4.** (C)

5. $-\frac{1}{6}$ m/sec. **6.** (B) **7.** (C)

8. (A)

Hint & Solutions

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1. $0^2 = V^2 - 2\mu g s$

$\Rightarrow s = \frac{V^2}{2\mu g}$. (A).

2. The possible expression will be one which gives zero displacement at x = 0, X = L, y = 0 and y = L.

3. For waves along a string :

$\upsilon \alpha \sqrt{T}$

$\Rightarrow \lambda \alpha \sqrt{T}$

Now, for 6 loops : $3\lambda_1 = L$

$\Rightarrow \lambda_1 = L/3$

& for 4 loops : $2\lambda_2 = L$

$\Rightarrow \lambda_2 = L/2$

$\Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{2}{3}$

$\Rightarrow T_2 = \frac{9}{4} x T_1 = \frac{9}{4} \times 36$

= 81 N. **Ans.**

4. Two consecutive frequencies are 420 Hz & 480 Hz. So the fundamental frequency will be 60 Hz.

$\therefore 60 = \frac{1}{2\times \ell} \sqrt{\frac{450}{5\times 10^{-3}}}$

$\Rightarrow \ell = 2.1$ m

5. Applying momentum conservation ;

(80) 1 + 60 (– 2) = (80 + 60 + 100) v

$v = \frac{-40}{240} = -\frac{1}{6}$ m/sec.

6. to 8 **(Easy)** The motion in the x-direction is a constant velocity motion. We find the flight time

$= \frac{1600\,m}{u_x}$

$\frac{1600}{400\cos\theta} = 5$ sec.

Flight time = 5sec.

7. **(Easy)** From the flight time, the initial velocity in the y-direction and the acceleration in the y-direction, we can calculate the altitude of the shell:

$$h = u_y t - \frac{1}{2} g t^2 = \frac{1200}{5} \times 5 - \frac{1}{2} \times 10 \times 25$$

$$= 1200 - 125 = 1075 \text{ m}$$

height = 1075m.

8. **(Easy)** After the waiting time plus the flight time, the balloon should reach the same altitude as the shell. Let t_w be the waiting time.

$$\therefore t_w + 5\text{sec} = \frac{1075 - 800}{5} \quad \text{or } t_w = 50 \text{ sec.}$$