PHYSICS

# DPP

DAILY PRACTICE PROBLEMS

# DPP No. 36

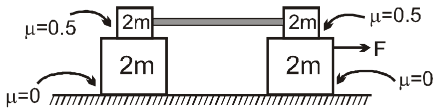
**Total Marks : 29**

**Max. Time : 31 min.**

**Topics : Friction, Work, Power and Energy, Relative Motion**

| Type of Questions | | M.M., Min. |
|---|---|---|
| Single choice Objective ('–1' negative marking) Q.1 to Q.4 | (3 marks, 3 min.) | [12, 12] |
| Multiple choice objective ('–1' negative marking) Q.5 | (4 marks, 4 min.) | [4, 4] |
| Comprehension ('–1' negative marking) Q.6 to Q.8 | (3 marks, 3 min.) | [9, 9] |

**1.** Consider the arrangement shown in figure. Friction coefficient for all the surfaces are shown in the figure and the rod connecting two upper blocks is horizontal.




What is the minimum value F so that the rear two blocks start sliding with each other :

(A) 100 N (B) 50 N

(C) 150 N (D) For all values of F both the rear blocks will move together

**2.** A chain is held on a frictionless table with L/4 hanging over. Knowing total mass of the chain is M and total length is L, the work required to slowly pull hanging part back to the table is :

(A) $\frac{MgL}{16}$ (B) $\frac{MgL}{8}$ (C) $\frac{MgL}{32}$ (D) $\frac{MgL}{24}$

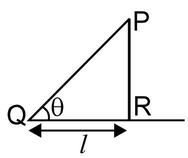
**3.** An object is moving along a straight line path from P to Q under the action of a force $\vec{F} = (4\hat{i} - 3\hat{j} + 2\hat{k})$ N. If the co-ordinate of P & Q in metres are (3, 2, –1) & (2, –1, 4) respectively. Then the work done by the force is:

(A) – 15 J (B) + 15 J (C) 1015 J (D) $(4\hat{i} - 3\hat{j} + 2\hat{k})$

**4.** A bucket tied to a string is lowered at a constant acceleration of g/4. If the mass of the bucket is M and is lowered by a distance d, the work done by the string on bucket will be (assume the string to be massless)

(A) (1/4) mg d (B) (–3/4) mgd (C) (– 4/3) mgd (D) (4/3) mgd

**5.** PQ is a smooth inclined plane whose angle θ can be varied in such a way that point Q remains fixed and P can move on a vertical line PR. A particle slides from rest from point P at different value of θ time for descent from P and Q is noted. The following statement (s) is /are correct about the time of descent :




(A) the minimum time of descent is $2\sqrt{\ell / g}$

(B) the time descent is minimum at $\theta = 90^0$

(C) the time of descent decreases continuously as θ is increased

(D) the time of descent first decreases then increases.

**COMPREHENSION**

Rain is falling with a velocity $(-4\hat{i} + 8\hat{j} - 10\hat{k})$. A person is moving with a velocity of $(6\hat{i} + 8\hat{j})$ on the ground.

**6.** Find the velocity of rain with respect to man and the direction from which the rain appears to be coming.

**7.** The speed with which the rain drops hit the person is :

(A) 10 m/s (B) $10\sqrt{2}$ m/s (C) $\sqrt{180}$ m/s (D) $\sqrt{360}$ m/s

**8.** The velocity of man w.r.t. rain is :

(A) $-6\hat{i} - 8\hat{j}$ (B) $4\hat{i} - 8\hat{j} + 10\hat{k}$ (C) $-10\hat{i} - 10\hat{k}$ (D) $10\hat{i} + 10\hat{k}$

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# Answers Key

## DPP NO. - 36

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

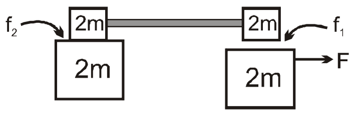
**6.** $(-10\hat{i} - 10\hat{k})$ rain appears to come 45° with ˆ

**7.** (B) **8.** (D)

# Hint & Solutions

## DPP NO. - 36

**1.** Given system can accelerate in rightward direction




$f_2 < f_1$ so all three blocks A, B, C will move with same acceleration for all value of F.

**2.** $W_{ext} = -W_g$

$$= -\left(\frac{M}{4}\right)g\left(-\frac{L}{8}\right) = \frac{MgL}{32}.$$

**3.** $P\overline{Q}$ = (2 -3) ˆ + (-1 -2) $\hat{j}$ (4 - (-1) ˆ

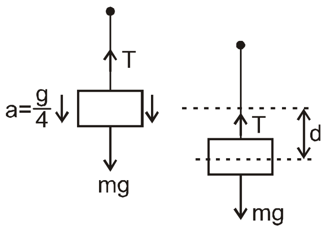
$\overline{F}.P\overline{Q} = -4 + 9 + 10 =$ **15 J**

**4.** Let tension in string be T, then work done by tension

$T = -Td$

Applying newton's second law on the bucket

$mg - T = m\left|\frac{g}{a}\right|$




or T = mg

∴ required work done = – mg d

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**5.** $\frac{\ell}{\cos\theta} = 0 + \frac{1}{2}(g\sin\theta).\ t^2$

$$t = \sqrt{\frac{2\ell}{g\sin\theta.\cos\theta}} = \sqrt{\frac{4\ell}{g\sin 2\theta}}$$

t will be minimum if sin2θ = maximum.

θ = 45°

$$t_{min} = 2\sqrt{\frac{\ell}{g}}$$

Since as θ increases from 0 to 45° t decreases

and as θ increases 45° to 90° t increases

**6. to 8** $V_{rm} = V_r - V_m = (-10\hat{i} - 10\hat{k})$

**Ans.** $(-10\hat{i} - 10\hat{k})$ rain appears to come 45° with $\hat{}$.

**7.** $V_m = \sqrt{10^2 + 10^2} = 10\sqrt{2}$ m/sec.

**8.** $V_{mr} = -V_{rm} = 10\hat{} + 10\hat{}$

**6.** (A) $W_{CL} + W_f = \Delta KE \quad \therefore \quad W_{CL} = \Delta KE - W_f$

(a) During accelerated motion negative work is done against friction and there is also change is kinetic energy. Hence net work needed is +ve.

(b) During uniform motion work is done against friction only and that is +ve.

(c) During retarded motion, the load has to be stopped in exactly 50 metres. If only friction is considered then the load stops in 12.5 metres] which is less than where it has to stop.

Hence the camel has to apply some force so that the load stops in 50m (>12.5 m).

Therefore the work done in this case is also +ve.

**7.** $W_{CL}|_{accelerated\ motion} = \Delta KE - W_{friction}$ where $W_{CL}$ is work done by camel on load.

$$= \left[\frac{1}{2}mv^2 - 0\right] - [-\mu_k mg.50] = 1000\left[\frac{125}{2}\right]$$

similarly, $W_{CL}|_{retardation} = \Delta KE - W_{friction}$

$$\left[0 - \frac{1}{2}mv^2\right] - [-\mu_k mg.50] = 1000\left[\frac{75}{2}\right]$$

$$\therefore \frac{W_{CL}|_{accelerated\ motion}}{W_{CL}|_{retarded\ motion}}$$

$$= \frac{125}{75} = \frac{5}{3}$$

$\Rightarrow$ 5 : 3

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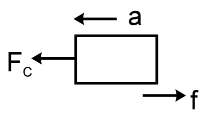
**8.** Maximum power = $F_{max} \times V$

Maximum force applied by camel is during the accelerated motion.




We have $V^2 - U^2 = 2as$

$25 = 0^2 + 2 . a . 50$

$a = 0.25\ m/s^2$ ; for accelerated motion

$\therefore\ F_C - f = ma$

$\therefore\ F_C = \mu mg + ma = 0.1 \times 1000 \times 10$

$+ 1000 \times 2.5$

$= 1000 + 250 = 1250$ N

This is the critical point just before the point where it attains maximum velocity of almost 5 m/s.

Hence maximum power at this point is = 1250 × 5

= 6250 J/s.

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