DPP - 2

1. $\vec{F} = (4\hat{i} - 3\hat{j})N$

$\vec{F}net = \sqrt{4^2 + (-3)^2} = 5\ N$

$m = 1\ kg$

$a = \frac{F}{m} = 5m/s^2$

2. $N = mgcos37° + 40sin37.$

$= 100 \times \frac{4}{5} + 40 \times \frac{3}{5}$

$N = 80 + 24 = 104\ N$

In $Y -$ direction

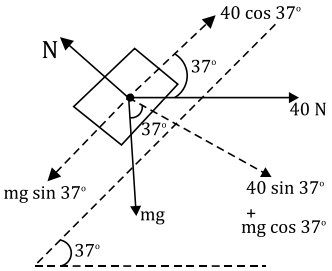
$mgsin37° - 40cos37° = ma$

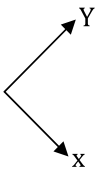
$100 \times \frac{3}{5} - 40 \times \frac{4}{5} = 10a$

$60 - 32 = 10a$

$28 = 10a$

$a = 2.8\ m/s^2$





3. $\tan\theta = \frac{1}{\sqrt{x^2-1}}$

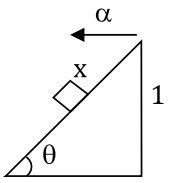
If wedge/ Incline reference $F \cdot B \cdot D$ of block

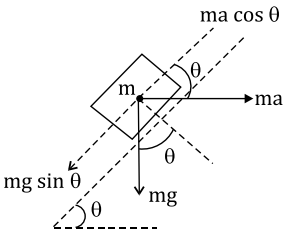
$mgsin\,\theta = macos\,\theta$

$\tan\theta = \frac{a}{g}$

$a = gtan\,\theta$

$= \frac{g}{\sqrt{x^2 - 1}}.$



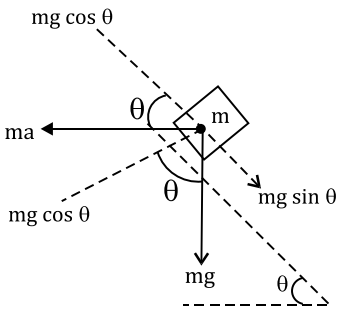


4. In wedge reference [non-Inertial frame]

F.B.D of block

$macos\,\theta = mgsin\,\theta$

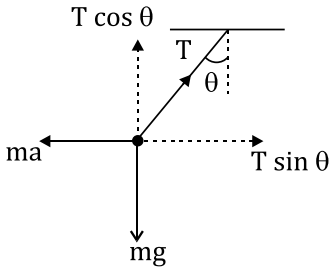
$a = gtan\,\theta$



5. frame of train [non- Inertial frame]

$T\cos\theta = mg$ (i)

$T\sin\theta = ma$ (ii)



(ii) / (i)

$\tan\theta = \frac{a}{g}$

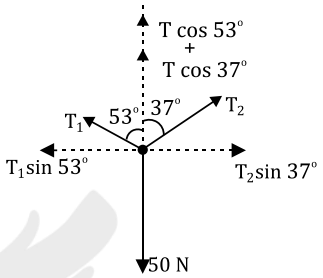
$\theta = \tan^{-1}\left(\frac{a}{g}\right)$

$(i)^2 + (ii)^2$

$\Rightarrow\ T^2\cos^2\theta + T^2\sin^2\theta = m^2g^2 + m^2a^2$

$T = m\sqrt{g^2 + a^2}$

6. $T_1\sin 53^\circ = T_2\sin 37^\circ$



$T_1 \times \frac{4}{5} = T_2 \times \frac{3}{5} \Rightarrow T_1 = \frac{3T_2}{4}$

$4T_1 = 3T_2$

$T_1\cos 53^\circ + T_2\cos 37^\circ = 50$

$T_1 \times \frac{3}{5} + T_2 \times \frac{4}{5} = 50$

$3T_1 + 4T_2 = 250$

$3 \times \frac{3T_2}{4} + 4T_2 = 250$

$25T_2 = 1000\ T_1 = \frac{3 \times 40}{4}$

$T_2 = 40\ N,\ T_1 = 30\ N$

7. Let us draw the free body diagrams of C and A.

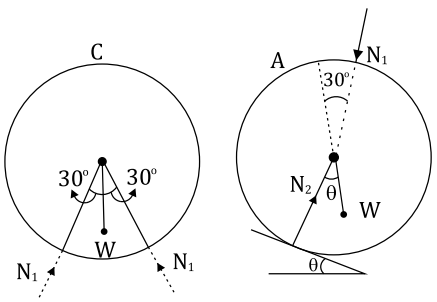
W = Weight of each sphere

N_2 = Normal reaction between A and inclined plane

N_1 = Normal reaction between A and C

N_1 = Normal reaction between B and C.

Free body diagram of C



Resolving vertically $2N_1\cos 30° = W$

$\Rightarrow N_1 = \frac{W}{\sqrt{3}}$

When the arrangement is on the point of collapsing, the reaction between A and B is zero.

Free body diagram of A

Resolving horizontally and vertically

$N_2\sin\theta = N_1\sin 30°$

$\Rightarrow N_2\sin\theta = \frac{W}{2\sqrt{3}}$

$N_2\cos\theta = W + N_1\cos 30° = \frac{3W}{2}$

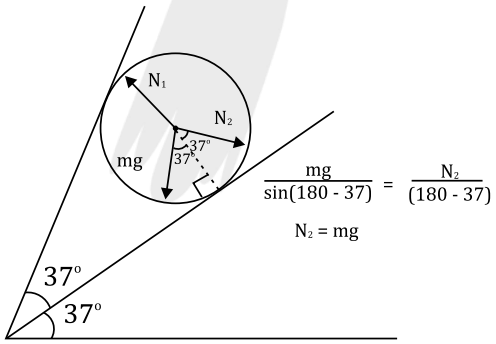
Dividing (2) by (3), we get

$\tan\theta = \frac{1}{3\sqrt{3}}$

$\Rightarrow \theta = \tan^{-1}\left(\underbrace{\frac{1}{3\sqrt{3}}}_{\text{Q9 solution}}\right)$

Hence, the correct answer is (C).

8.



$\frac{mg}{\sin(180 - 37)} = \frac{N_2}{(180 - 37)}$

$N_2 = mg$

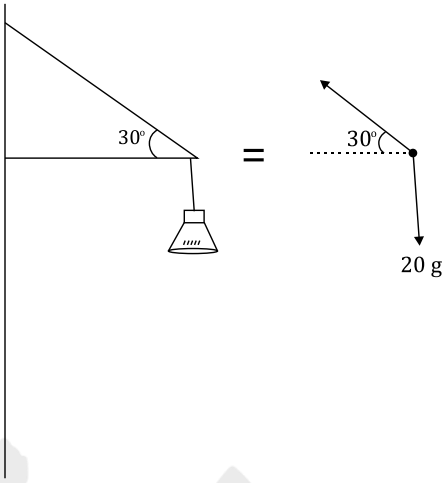
9. $T\sin 30 = 20\ g$

$T \times \frac{1}{2} = 20\ g$

$T = 40\ g$

$T = 40 \times 9.8$

$T = 392\ N$



10. $T\cos 30 = 392 \times \sqrt{\frac{3}{3}}$

$= 196\sqrt{3}\ N$

$= 339.472\ N$

$\simeq 339\ N$ right

11. Zero