You Didn't Follow directions!

$\frac{73}{86}$

03/10/2021

SP'21 PHYS-230

TEST 1

NAME :- SHREYAS SRI NIVASA

PALOMAR ID :- 012551187

Q1. Ans: $v(t) = a t e^{wt^2}$

(a) Velocity (v) = m/s.

$(a \times sec) \cdot e^{w \times s^2}$ [$\because t = sec$]

$\left(\frac{m}{sec^2} \times sec\right) e^{\frac{1}{s^2} \times s^2}$

$= \frac{m}{sec} \cdot e^1$ [where e is constant]

$\therefore$ The unit of a = m/s^2 4/4

& the unit of w = $1/s^2$

(b) $v(t) = a t e^{wt^2}$

$\frac{dx}{dt} = a t e^{wt^2}$ [$\because V = dx/dt$]

$\Rightarrow dx = a t e^{wt^2} dt$

$\Rightarrow \int dx = a \int_0^t t e^{wt^2} dt$

P.T.O

$$x(t) = a\int_0^{t^2} e^{wy}\,\frac{dy}{2}$$

$t^2 = y$
$2t\,dt = dy$
$t\,dt = \frac{dy}{2}$

$t=0,\ y=0$
$t=t,\ y=t^2$

$$x(t) = \frac{a}{2}\left(\frac{e^{wy}}{w}\right)_0^{t^2}$$

$$x(t) = \frac{a}{2w}\left(e^{wt^2} - e^0\right)$$

$$x(t) = \frac{a}{2w}\left(e^{wt^2} - 1\right)$$ 8/8

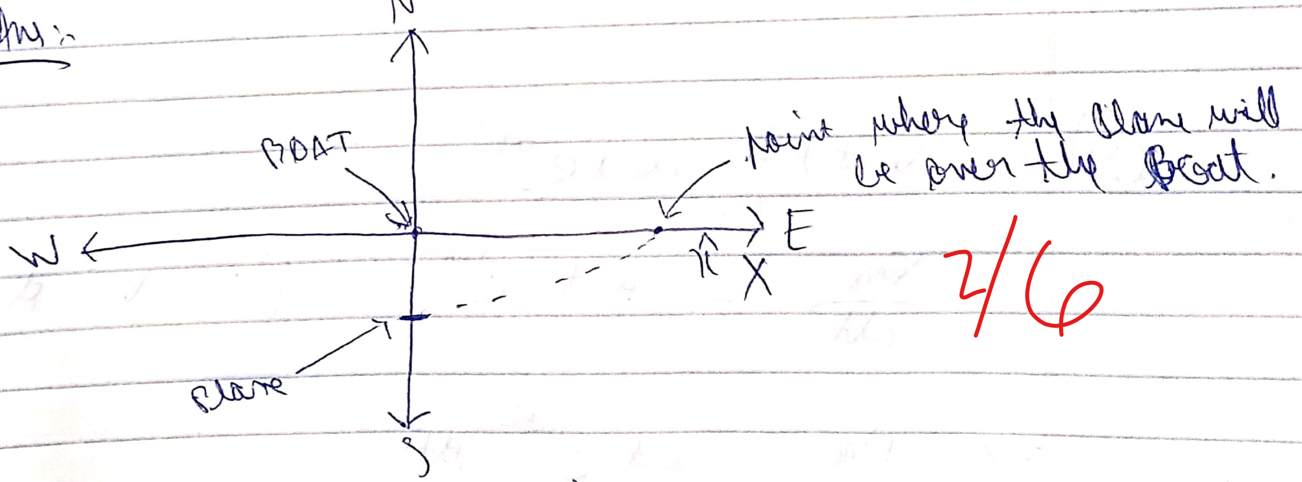
(c) $$v(t) = a t e^{wt^2}$$

$$\vec{a}(t) = \frac{dv}{dt} = a\left[t\, e^{wt^2}(w \times 2t) + e^{wt^2}(1)\right]$$

$$\vec{a}(t) = a e^{wt^2}\left(t(2wt) + 1\right)$$

$$\vec{a}(t) = a e^{wt^2}\left(2wt^2 + 1\right)$$ 8/8

Q2. Ans:



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Velocity of Plane, $\vec{V}_p = 39\,\hat{x}$ m/s

Velocity of Wind, $\vec{V}_w = -25\,\hat{x} + 15\,\hat{y}$ m/s

P.T.O

(3)

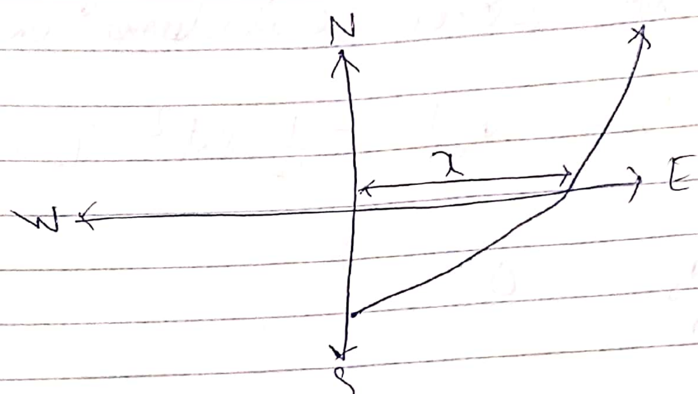
Resultant velocity of the plane due to wind,

$$\vec{V}_p = \vec{V}_{p} + \vec{V}_w$$

$$= (39-25)\hat{x} + (0+15)\hat{y}$$

$$\vec{V}_p = V_{px}\hat{x} + V_{py}\hat{y}$$

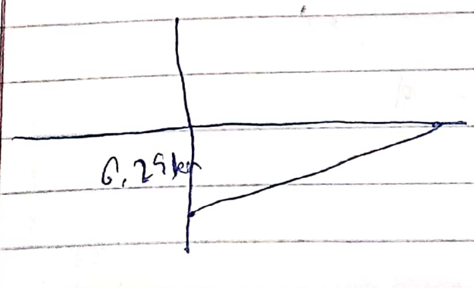
$$= (14\hat{x} + 15\hat{y})\ m/s$$



Trajectory of Plane

Velocity of Boat, $\vec{V}_B = (V_x\hat{x})\ m/s$

(a) Only x could be the shortest distance, since Time taken (when plane will be over the boat) = Time taken by plane to cover 6.25 km distance in Y direction.



In Y direction, velocity of Plane, $V_{py} = 15\ m/s$

$$t = \frac{d}{v} = \frac{6250\ m}{15\ m/s} = 416.67s$$

In the time A, distance travelled by plane in X direction,

$$X = V_{px} \times A = (14 \times 416.67)\ m$$
$$= 5833.33\ m$$
$$= \underline{5.83\ km}$$

(b) To intersect the path of the plane the boat has to cover x distance in time A.

$$\therefore\ S = v_0 t + \frac{1}{2} a t^2 \quad [\because \text{3rd equation of motion}]$$

Initial velocity $V_0 = 0$

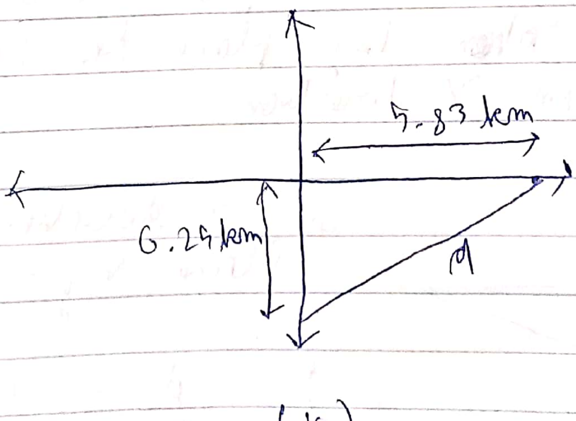
$$\therefore\ x = 0 + \frac{1}{2} a t^2$$

$\vec{a}$ is a vector.

$$\therefore\ a_B = \frac{2x}{A^2}$$

$$a_B = \underline{0.672\ m/s^2} \text{ in x direction}$$

(c)



(7)

P.T.O

~~d~~ = Total distance covered by plane,

$$d = \sqrt{(5.83)^2 + (6.25)^2}$$

$$= \underline{8.547 \text{ km}}$$

Q3. Ans:- (a) Free body diagram (F.B.D) for block 1 :-

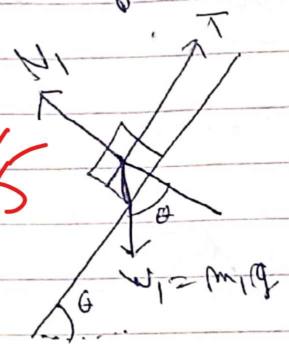
Forces acting on M_1 :-

(i) Gravitational force, $W_1 = m_1 g$

(ii) Contact force i.e. normal force = N_1

(iii) Tension force = T

Coordinate system?



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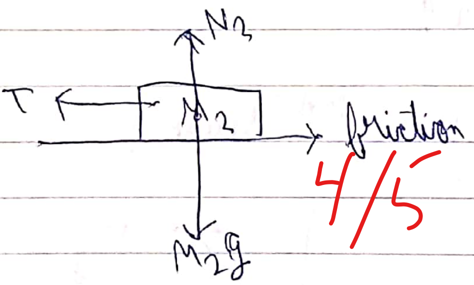
(b) F.B.D. for block 2 :-



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Forces acting on M_2 :-

(i) $W_2 = M_2 g$

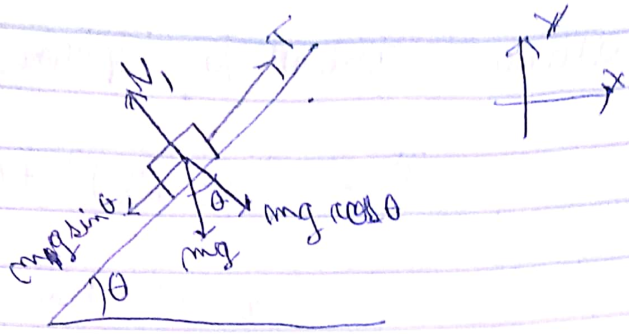
(ii) N_2 = normal force on M_2 due to support.

(iii) Tension force (T)

(iv) friction = f

P.T.O

(c)



For equilibrium,

From Newton's 2^{nd} law,

$$\Sigma F_x = 0$$

$$T - m_1 g \sin\theta = 0$$

$$\boxed{T = m_1 g \sin\theta} \rightarrow (1)$$

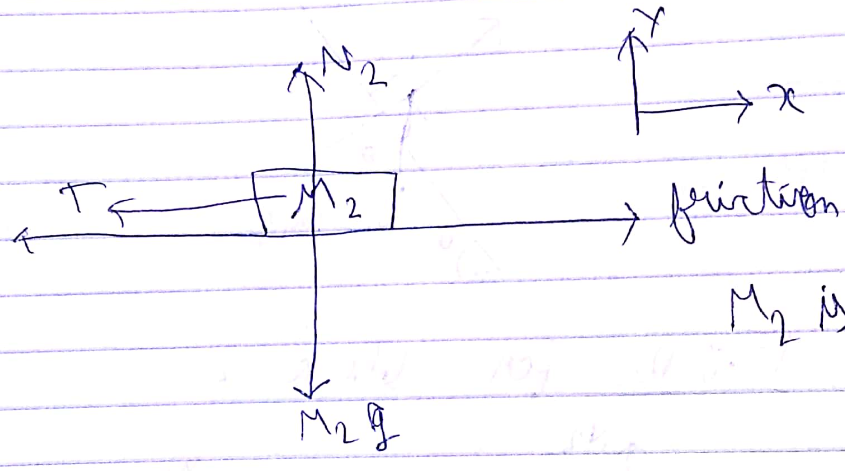
10/10

$$\Sigma F_y = 0$$

$$N_1 - mg\cos\theta$$

$$\boxed{N_1 = mg\cos\theta} \quad -(2)$$

(d)



M_2 is in equilibrium

From Newton's 2^{nd} law :- 10/10

$\Sigma F_x = 0$	$\Sigma F_y = 0$
$T - \text{friction} = 0$	$N_2 - M_2 g = 0$
$T = \text{friction}$	$N_2 = M_2 g$

P.T.O

Here T = static friction

Static friction = $M_1 g \sin\theta$

$f_{static} = M_1 g \sin\theta$

1/4

Q 4. Ans: (a) The particle is speeding up, during the intervals from ~~2s~~ 1.5 to 3 s & from 5s to 6 s respectively, since acceleration is positive in these intervals. $10s < t < 12s$

(b) The particle is slowing down during the interval from 8s to ~~12~~ 10 s, since 1/2 acceleration is negative.

(c) The particle is in constant motion during the time interval from 3s to 5s & from 6s to 8 s respectively, since there is no change in speed. 4/4

(d) At $t = 1.5s$ & $t = 10s$, the speed is zero, since the particle is on the x-axis at these points, which means that y is 0. 2/2

(e) Area of v-t graph = $10 \times 1 \times 1 + 0.5$ 2/6

$= 10.5\ m$

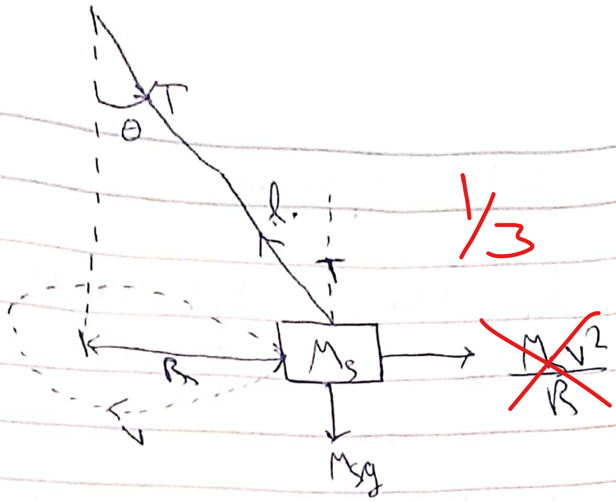
$\Delta x_{4-12} = 6.5\ m$

∴ The Displacement from 4s to 12s is 10.5 m

Q 5. Ans- (a) Free body diagram (F.B.D) of rubber stopper :-

b) 0/3

P.T.O



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Coordinate Sys. ?

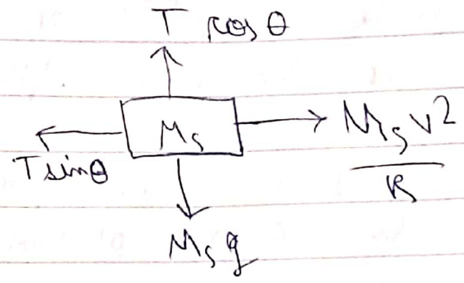
(c) Tension in the string = Weight of the hanging block

$= \frac{234}{1000}\ kg \times 9.8\ m/s^2$

$= 2.29\ N$

6/6

(d) $R = l \sin\theta$



Balancing vertical forces :-

$T \cos\theta = M_s g = 0.145 \times 9.8$

$2.29 \cos\theta = 1.421$

$\cos\theta = 0.620$

$\theta = \cos^{-1}(0.620)$

$\theta = 51.65^\circ$

Balancing Horizontal forces :-

P.T.O

$$T \sin\theta = \frac{M_s v^2}{R} = \frac{M_s v^2}{l \sin\theta}$$

$\therefore$ speed of the rubber stopper, $v = \sqrt{\frac{T \sin^2\theta \times l}{M_s}}$

6/6

$$= \sqrt{\frac{2.29 \times \sin^2(51.65) \times 0.75}{0.145}}$$

$$v = \underline{\underline{2.699\ m/s}}$$