This is a Class 1 exam

Lebanon Evangelical School for Boys and Girls

Lebanon Evangelical School

for Boys and Girls Loueizeh - Baabda

Stage Exam 02

19DEC2022

Do NOT write in this box. Your MARK will be placed here.

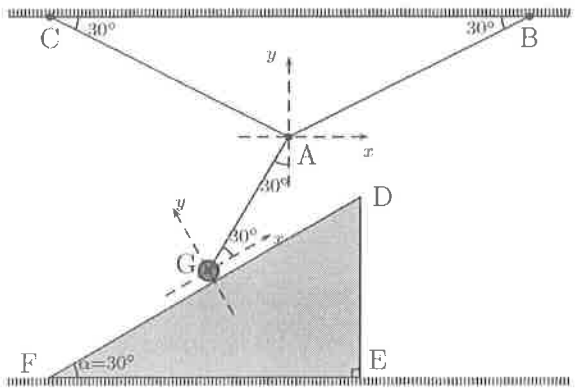
Subject :	Physics	
Class :	11S	
Teacher :	Mr. Ali Moukalled	
Duration :	1 hour	
Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Exercise1 (7.5 points)

Equilibrium of a suspended ball on an inclined plane

DOCUMENT – 1, shows a ball of mass $m = 1kg$ resting on a frictionless inclined plane that makes an angle $\alpha = 30°$ with the horizontal ground. Take $g = 10m/s^2$. The ball is held at rest by means of three strings fixing it to the ceiling.



DOCUMENT – 1

A- System Ball:

1. Calculate the weight of the ball, then represent $\vec{W}$ by a vector using a scale $1cm \rightarrow 5N$.
2. Name the forces acting on the ball. Then, write the condition of equilibrium.
3. Show that the tension in the string AG is $T_{AG} = 5.77N$ and the force applied by the inclined plane is $N = 5.77N$.

B- System Node A:

1. Three forces acting on A, name them, then determine the magnitude of each force.

Exercise2 (7.5 points)

Figure (2) shows a block (S) of mass $m = 1kg$. The block (S) is poising at rest at the point N on the frictionless inclined plane AB by means of a massless string, that joins it to the fixed point M. The inclined plane AB makes an angle $\alpha = 30°$ with the horizontal plane CD.

Given:

$NB = 2.5m$, $BC = 5m$, and $g = 10m/s^2$.

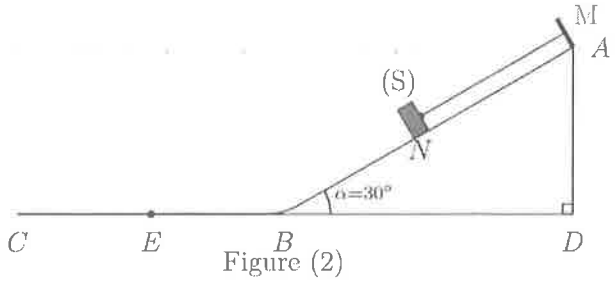


Figure (2)

1. At a certain instant taken as an origin of time $t_0 = 0$, the string holding (S) is cut; the block (S) descends on the inclined plane without initial velocity.

Turn the page

(a) Use Newton's second law to study the motion of (S) along the inclined plane, then determine the value of its acceleration.

(b) Calculate the time taken by (S) to reach point B at the bottom of the inclined plane.

(c) Deduce the value of the velocity of (S) as it passes through point B.

2. After covering point B, the block (S) continues its motion on the horizontal plane that consists of two parts $BE = 2.5m$ which is smooth, and $EC = 2.5m$ which is rough,

(a) Make the list of forces acting on (S) along the path BE.

(b) What is the nature of motion of (S) along BE. Justify.

(c) Deduce the velocity of (S) as it passes through the point E.

Exercise3 (5 points)

The coordinates of a particle (M) moving along a circular path of radius $R = 3m$ is given by:

$$x = 3\cos 8t \qquad y = 3\sin 8t \quad SI$$

1. (a) Determine the linear speed V and the angular velocity θ' of (M).

(b) Deduce the expression of the angular abscissa θ as a function of time, knowing that $\theta_0 = 0$.

2. (a) Calculate the angular abscissa of the particle at $t = \frac{\pi}{24}s$.

(b) Draw a figure, not to scale the velocity at $t = \frac{\pi}{24}s$.

(c) Refer to the figure to determine the angle between $\vec{V}$ at $t = \frac{\pi}{24}s$ and the positive x-axis.

GOOD LUCK

SE02/2022 2023/Physics/11S

Ex 1

$m = 1kg$, $\alpha = 30°$, $g = 10 m/s^2$

A- System Ball:

1) $W = m \times g$

$= 1 \times 10$

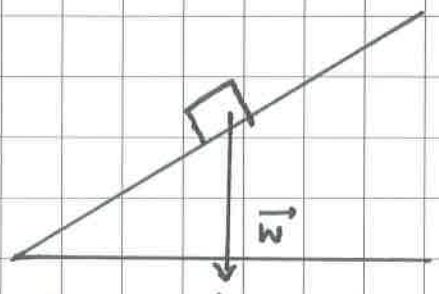
$= 10N$

$W = 10N$

1cm ⟶ 5N

? ⟶ 10N

? = 2cm



2) The forces acting on the Ball:

- $m\vec{g}$ (weight)
- $\vec{N}$ (normal)
- $\vec{T}$ (tension)

equilibrium: $\Sigma \vec{F}_{ext} = \vec{0}$

3) Due to the laws of equilibrium

$\Sigma \vec{F}_{ext} = \vec{0}$

$m\vec{g} + \vec{N} + \vec{T} = \vec{0}$

project along the x-axis

$-mg\sin\alpha + T\cos\beta = 0$

$T\cos\beta = mg\sin\alpha$

$T = \dfrac{10 \sin 30}{\cos 30}$

$\boxed{T = 5.77N}$

project along the y-axis

$$-mg\cos 30 + N + T\sin 30 = 0$$

$$N = +mg\cos 30 - T\sin 30$$
$$= 10\cos 30 - 5.77\sin 30$$

$$\boxed{N = 5.77N}$$

B- System Node A:

1) The forces acting on A $\begin{cases} \vec{T_1} \\ \vec{T_2} \\ \vec{T_3} \end{cases}$ (tensions)

Due to the law of equilibrium

$$\sum \vec{F}_{ext} = \vec{0}$$
$$\vec{T_1} + \vec{T_2} + \vec{T_3} = \vec{0}$$

project along the x-axis

$$-T_1\sin 30 + T_2\cos 30 - T_3\cos 30 = 0$$
$$-5.77 \times \frac{1}{2} + T_2\frac{\sqrt{3}}{2} - T_3\frac{\sqrt{3}}{2} = 0$$

$$-2.885 + \frac{T_2\sqrt{3}}{2} - \frac{T_3\sqrt{3}}{2} = 0$$

$$\frac{T_2\sqrt{3}}{2} = 2.885 + \frac{T_3\sqrt{3}}{2}$$

$$\boxed{T_2 = 3.33 + T_3}$$

project along the y-axis

$$-T_1\cos 30 + T_2\sin 30 + T_3\sin 30 = 0$$

$$-4.99 + T_2 \times \frac{1}{2} + T_3\left(\frac{1}{2}\right)$$

$$-4.99 + \left(3.33 + T_3\right)\frac{1}{2} + \frac{T_3}{2} = 0$$

$$-4.99 + 1.665 + \frac{T_3}{2} + \frac{T_3}{2} = 0$$

$$\boxed{T_3 = 3.325\,N} \Rightarrow \boxed{T_2 = 6.655\,N}$$

1.5

Exercise 2

$m = 1kg$, $\alpha = 30°$, $NB = 2.5m$, $BC = 5m$, $g = 10m/s^2$

1) $V_N = 0\,m/s$

a) Due to Newton's 2nd law

$$\sum \vec{F}_{ext} = m\vec{a}$$

$$+m\vec{g} + \vec{N} = m\vec{a}$$

project along the x-axis

$$+mg\sin\alpha = ma$$

$$a = g\sin\alpha$$

$$a = 10\sin 30$$

$$\boxed{a = +5\,m/s^2} > 0$$

1

b) $x = \frac{1}{2}at^2 + V_0t + x_0$

$$2.5 = 0.5(5)t^2$$

$$\boxed{t = 1s}$$

1.5

3

c) $V = at + V_0$

$V = 5(1)$

$V_B = 5\,m/s$ (1)

2) BE = 2.5m , No Friction

a) $\begin{cases} m\vec{g} \text{ (weight)} \\ \vec{N} \text{ (normal reaction)} \end{cases}$ (2)

b) (1) Due to Newton's 2nd law (2)

$\Sigma \vec{F}_{ext} = m\vec{a}$

$m\vec{g} + \vec{N} = m\vec{a}$

project along the x-axis

$0 = ma$

$\Rightarrow a = 0$ U.R.M

c) $V_B = V_E = 5\,m/s$ (1)

(4)

Ex3

$x = 3\cos 8t$

$y = 3\sin 8t$

1) (a) $\vec{V} = x'\vec{i} + y'\vec{j}$

$= -24\sin(8t)\vec{i} + 24\cos(8t)\vec{j}$

$V = 24 m/s$

$\theta' = \frac{V}{R} = \frac{V}{3} = \frac{24}{3} = 8 rad/s$

$\boxed{\theta' = 8 rad/s}$

b) $\theta = 8t + cte$

$\theta = 8t + \theta_0$

$\theta = 8t$

2) a) i) $\theta_{\pi/24} = 8(\pi/24) = \frac{\pi}{3} rad$

ii) Figure

iii) 150° with the +re x-axis