İzmir Kâtip Çelebi University
Department of Engineering Sciences
Phy101 Physics I
Midterm Examination
November 02, 2026 10:20 – 11:50
Good Luck!

NAME-SURNAME:

SIGNATURE:

ID:

DEPARTMENT:

INSTRUCTOR:

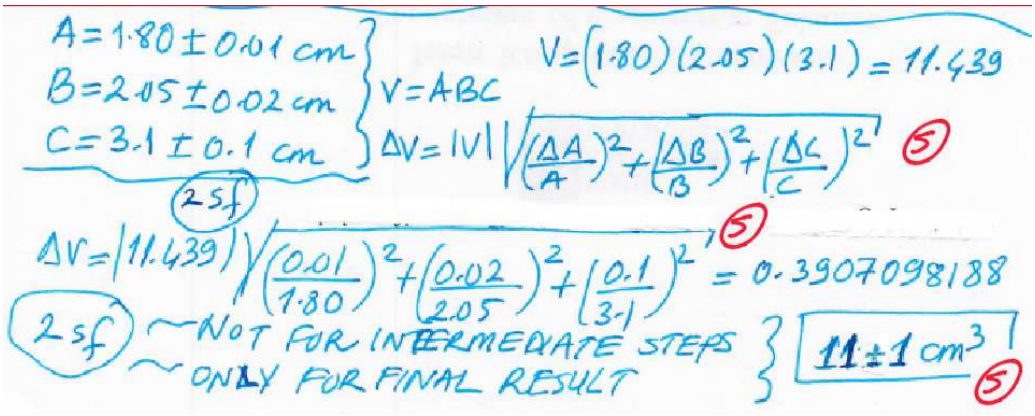
DURATION: 90 minutes

◇ **Answer all the questions.**
◇ **Write the solutions explicitly and clearly. Use the physical terminology.**
◇ **You are allowed to use Formulae Sheet.**
◇ **Calculator is allowed.**
◇ **You are not allowed to use any other electronic equipment in the exam.**

Question	Grade	Out of
1A		15
1B		20
2		15
3		15
4		20
5		15
TOTAL		100

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1. A) The sides of a small rectangular box are measured to be $1.80 \pm 0.01\ cm$, $2.05 \pm 0.02\ cm$, and $3.1 \pm 0.1\ cm$ long. Calculate its volume and uncertainty in cubic centimeters.



B) Three vectors are given as:

$$\vec{A} = \hat{i} - 5\hat{k}, \quad \vec{B} = 3\hat{i} - 2\hat{j}, \quad \vec{C} = 5\hat{i} + \hat{j} + \hat{k}$$

Find:

i $\vec{A} \cdot (\vec{B} + \vec{C})$,

ii $\vec{A} \cdot (\vec{B} \times \vec{C})$,

iii The angle between $\vec{A}$ and $\vec{B}$,

iv The angle between $\vec{A}$ and $\vec{A} \times \vec{B}$,

v If a particle's initial position vector is expressed by $\vec{A}$ and its final position vector by $\vec{C}$, calculate the displacement $\vec{d}$.

i. $\vec{A}.(\vec{B}+\vec{C})$ should be scalar

$\vec{B}+\vec{C} = 8\hat{i}-\hat{j}+\hat{k} \rightsquigarrow \vec{A}.(\vec{B}+\vec{C}) = 8-0-5 = 3$ (3)

ii. $\vec{A}.(\vec{B}\times\vec{C})$ should be scalar (2)

$\vec{B}\times\vec{C} = (B_y C_z - B_z C_y)\hat{i} + (B_z C_x - B_x C_z)\hat{j} + (B_x C_y - B_y C_x)\hat{k}$

$= ((-2)(1) - (0)(1))\hat{i} + ((0)(5) - (3)(1))\hat{j} + ((3)(1) - (-2)(5))\hat{k}$ (2)

$= -2\hat{i} - 3\hat{j} + 13\hat{k}$ (1)

$\rightsquigarrow \vec{A}.(\vec{B}\times\vec{C}) = -2 - 0 - 65 = -67$ (2)

iii. $\vec{A}.\vec{B} = |\vec{A}||\vec{B}|\cos\theta \rightsquigarrow |\vec{A}| = \sqrt{1^2+(-5)^2} = 5.10$

$|\vec{B}| = \sqrt{3^2+(-2)^2} = 3.61$ (2)

$\rightsquigarrow 3 = 5.10 \times 3.61 \times \cos\theta$ (2) $\vec{A}.\vec{B} = 3+0+0 = 3$

$\rightsquigarrow \cos\theta = \frac{3}{5.10 \times 3.61} = 0.16 \rightsquigarrow \theta = \cos^{-1} 0.16 = 80.6°$ (1)

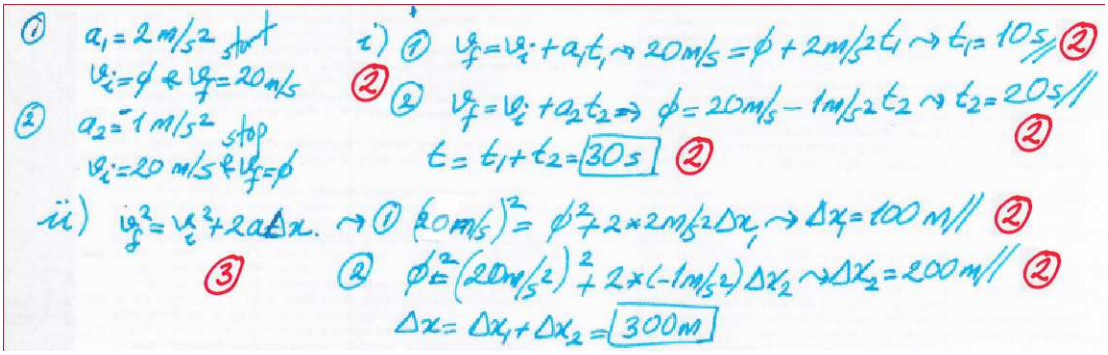
iv. $\vec{A}$ and $\vec{A}\times\vec{B}$ is perpendicular

$\rightsquigarrow 90°$ (5)

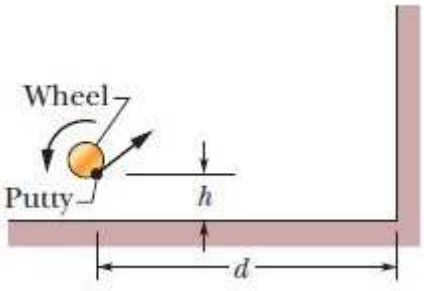
2. An electric vehicle starts from rest and accelerates at a rate of 2.0 m/s^2 in a straight line until it reaches a speed of 20 m/s. The vehicle then slows at a constant rate of 1.0 m/s^2 until it stops.

   i How much time elapses from start to stop?

   ii How far does the vehicle travel from start to stop?



3. In Figure, an object (putty in the figure) moves in uniform circular motion as it rides at a radius of 20.0 cm on the edge of a wheel rotating counterclockwise with a period of 5.00 ms.



The object then happens to fly off the edge at angle of 30° with horizontal axis. It leaves the edge at a height of $h = 1.20\ m$ from the floor and at a distance $d = 2.50\ m$ from a wall. At what height on the wall does the object hit?

$T = \frac{2\pi R}{v} = 5\times10^{-3}\,s$ (2) $\rightarrow v = \frac{2\pi R}{T} = \frac{2\pi\, 20\times10^{-2}\,m}{5\times10^{-3}\,s} \simeq 251\,m/s$

$a = \frac{v^2}{R}$ & $R = 20\times10^{-2}\,m$

rotates ccw

$\theta = 30°$ & $h = 1.2m$ & $d = 2.5m$

(2) (0,0) v_0 θ h H T d FLOOR

(1) $y = y_0 + v_{0y}t - \frac{1}{2}gt^2$ (2)

(2) $x = x_0 + v_{0x}t$ (2)

(2) $x - x_0 = d = 2.5m$ (3)

$\rightarrow t = \frac{2.5m}{251m/s\,\cos 30} = 0.012s$

(1) $y - y_0 = H - h = v_0 \sin\theta\, t - \frac{1}{2}gt^2$

$H - h = 251m/s\,\sin 30\,(0.012s) - \frac{1}{2}\,9.8m/s^2\,(0.012s)^2 \Rightarrow 1.44m$ (2)

$\Rightarrow H = 1.44m + 1.2m = \boxed{2.64m}$ (2)

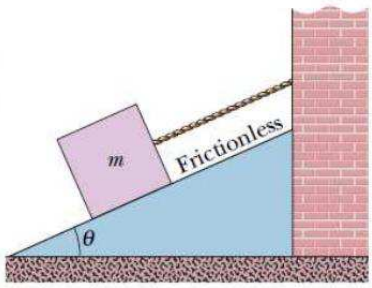
4. In Figure, let the mass of the block be 8.5 kg and the angle be 30°.

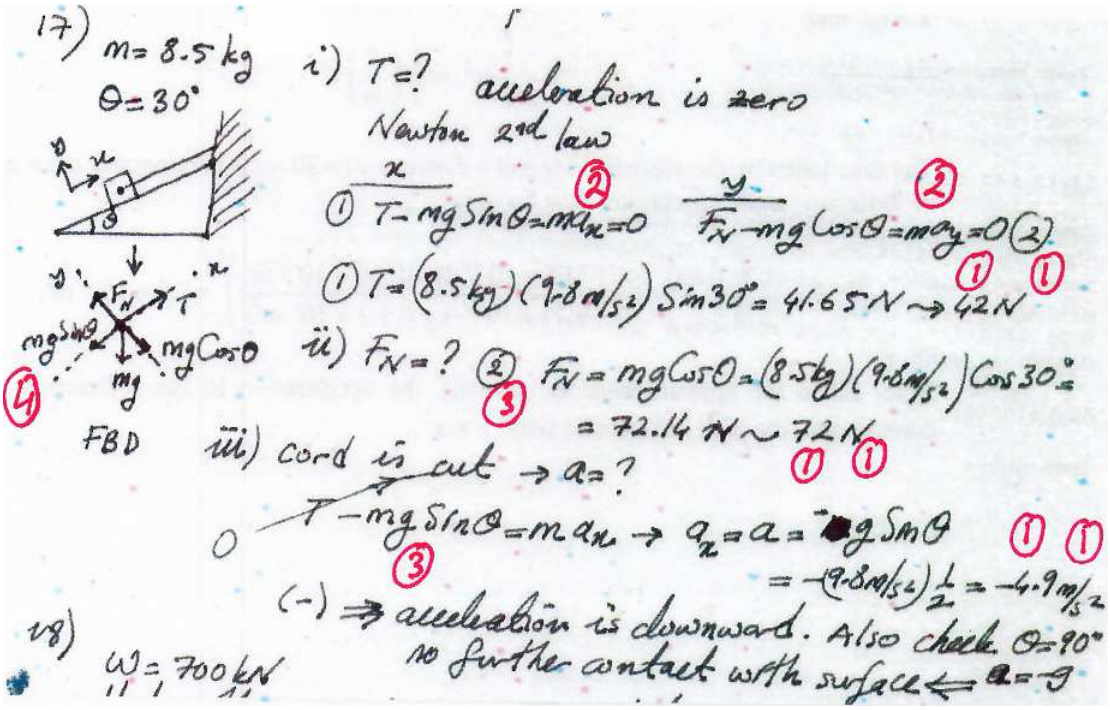
Find

i the tension in the cord,

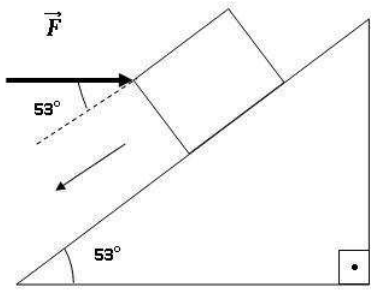
ii the normal force acting on the block,

iii If the cord is cut, find the magnitude of the resulting acceleration of the block.



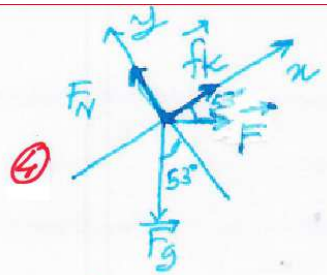


5. The block shown below moves down at a constant speed. If the block has a mass of 26 kg and the coefficients of kinetic (μ_k) and static (μ_s) frictions are 0.3 and 0.4, respectively;



i Draw free body diagram for the block,

ii Determine the magnitude of applied force.

i) 

ii) Equations of motion
Newton's 2nd Law
$\Sigma F_x = ma_x$ & $\Sigma F_y = ma_y$
1 mass 2 directions: 2 eqns

$\rightarrow$ ① x: $f_k + F\cos 53 - mg\sin 53 = ma_x = 0$ ② constant speed $a_x = 0$

② y: $F_N - F\sin 53 - mg\cos 53 = ma_y = 0$ ② no motion at y $a_y = 0$

③ $f_k = \mu_k F_N$ ②

$\rightsquigarrow$ ② $\rightsquigarrow$ $F_N = F\sin 53 + mg\cos 53$

② & ③ $\rightsquigarrow$ $\mu_k(F\sin 53 + mg\cos 53) + F\cos 53 - mg\sin 53 = 0$

$F = \dfrac{mg\sin 53 - \mu_k mg\cos 53}{\mu_k \sin 53 + \cos 53}$ ③ $= \dfrac{26\,kg\sin 53 - (0.3)26\,kg(9.8\,m/s^2)\cos 53}{(0.3)\sin 53 + \cos 53}$ (9.8 m/s² ↓)

$\approx 187.2\,N$

① ①