110 Fall 2025 Test 3C Once the exam has officially started, remove the top sheet. The remaining sheets comprise your exam. It is each student's individual responsibility to ensure the instructor has received her or his completed exam. Any exams not received by the instructor earn zero points. Smart watches, phones, or other devices (except scientific calculators) are not permitted during the exam.

$V_{sphere} = \frac{4}{3}\pi R^3$	$V_{box} = LWH$	$V_{cyl} = \pi R^2 H$	$\rho = \frac{M}{V}$
$A_{sphere} = 4\pi R^2$	$V = (A_{base}) \times (height)$	$A_{circle} = \pi R^2$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
$C = 2\pi R$	$A_{rect} = LW$	$A_{CylSide} = 2\pi RH$	
$1609\underline{9}$ m = 1 mi	12 in = 1 ft	60 s = 1 min	1000 g = 1 kg
2.54 cm = 1 in	1 cc = 1 cm^3 = 1 mL	60 min = 1 hr	100 cm = 1 m
1 cm = 10 mm	1 yard = 3 ft	3600 s = 1 hr	1 km = 1000 m
1 furlong = 220 yards	5280 ft = 1 mi	24 hrs = 1 day	1 rev = 2π rad = 360°
$g = 9.8 \frac{\text{m}}{\text{s}^2}$	$G = 6.67 \times 10^{-11} \frac{\text{N} \cdot \text{m}^2}{\text{kg}^2}$	$P_0 = 1.0 \times 10^5$ Pa	1 eV = 1.602×10^{-19} J
$1\ \text{N} = 1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$	$1\ \text{J} = 1\ \text{N} \cdot \text{m}$	$1\ \text{Pa} = 1 \frac{\text{N}}{\text{m}^2}$	
$x_f = x_i + v_{ix}t + \frac{1}{2}a_x t^2$	$v_{fx}^2 = v_{ix}^2 + 2a_x(\Delta x)$	$v_{fx} = v_{ix} + a_x t$	$r = \sqrt{x^2 + y^2}$
$\vec{A} \cdot \vec{B} = AB\cos\theta_{AB}$	$\lVert\vec{A} \times \vec{B}\rVert = AB\sin\theta_{AB}$	$\sin(A \pm B)$ $= \sin A \cos B \pm \cos A \sin B$	$\cos(A \pm B)$ $= \cos A \cos B \mp \sin A \sin B$
$\vec{v}_{ae} + \vec{v}_{eb} = \vec{v}_{ab}$	$\hat{r} = \cos\theta\,\hat{\imath} + \sin\theta\,\hat{\jmath}$	$\hat{\theta} = -\sin\theta\,\hat{\imath} + \cos\theta\,\hat{\jmath}$	
$a_{tan} = r\alpha$	$a_c = \frac{v^2}{r} = r\omega^2$	$\vec{a} = a_r\hat{r} + a_{tan}\hat{\theta}$	$\vec{a} = a_c(-\hat{r}) + a_{tan}\hat{\theta}$
$\Sigma\vec{F} = m\vec{a}$	$f \le \mu n$		

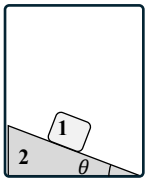
Prefix	Abbreviation	$10^?$		Prefix	Abbreviation	$10^?$
Giga	G	10^9		milli	m	10^{-3}
Mega	M	10^6		micro	μ	10^{-6}
kilo	k	10^3		nano	n	10^{-9}
centi	c	10^{-2}		pico	p	10^{-12}
				femto	f	10^{-15}

$\text{M} = \frac{\text{units of}}{\text{mass}} = \text{kg}$ $\quad \text{L}^2 = \frac{\text{units of}}{\text{area}} = \text{m}^2$ $\quad \text{T} = \frac{\text{units of}}{\text{time}} = \text{s}$ $\quad \frac{\text{L}}{\text{T}^2} = \frac{\text{units of}}{\text{acceleration}} = \frac{\text{m}}{\text{s}^2}$

$\text{L} = \frac{\text{units of}}{\text{length}} = \text{m}$ $\quad \text{L}^3 = \frac{\text{units of}}{\text{volume}} = \text{m}^3$ $\quad \frac{\text{L}}{\text{T}} = \frac{\text{units of}}{\text{velocity}} = \frac{\text{m}}{\text{s}}$ $\quad \frac{\text{L} \cdot \text{M}}{\text{T}^2} = \frac{\text{units of}}{\text{force}} = \frac{\text{kg} \cdot \text{m}}{\text{s}^2} = \text{N}$

Name:_____

An inclined plane with angle $\theta = 23.4°$ and mass m_2 rests on the floor of an elevator.
A block of mass m_1 is placed on top of the inclined plane.
The system is inside an elevator which accelerates *downwards* with rate $\frac{g}{6}$.
Friction is present between the block and the incline.

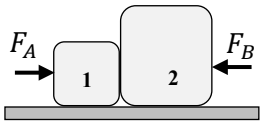


****1a) Draw FBDs and write force equations for mass 1. Clearly label your work and include a coordinate system to earn full credit.

***1b) Determine the minimum coefficient of friction to prevent block 1 from sliding down the plane. **Answer as a number with three sig figs in the appropriate box.**

1b	

Two blocks are initially at rest on a table.
For now, assume negligible friction exists between the two blocks and the table.
Anna pushes to the right on block 1 with force magnitude F_A.
Bob pushes to the left on block 2 with force magnitude F_B.
Assume the force exerted by block 2 on block 1 has magnitude F_1.
Assume the force exerted by block 1 on block 2 has magnitude F_2.



2a) If we observe the blocks moving with **constant <u>speed</u>** *to the right*, which best describes the relationship between F_A & F_B? Circle the best answer.

$F_A > F_B$	$F_A = F_B$	$F_A < F_B$	Impossible to determine without more info

2b) If we observe the blocks moving with **constant <u>speed</u>** *to the right*, which of the following is true?

$F_1 > F_2$	$F_1 = F_2$	$F_1 < F_2$	Impossible to determine without more info

2c) If we observe the blocks moving with **constant <u>acceleration</u>** *to the right*, which best describes the relationship between F_A & F_B? Circle the best answer.

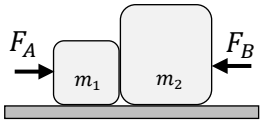
$F_A > F_B$	$F_A = F_B$	$F_A < F_B$	Impossible to determine without more info

2d) If we observe the blocks moving with **constant <u>acceleration</u>** *to the right*, which of the following is true?

$F_1 > F_2$	$F_1 = F_2$	$F_1 < F_2$	Impossible to determine without more info

2e) Assume the action force of an action reaction pair is the weight of block 1. **Write a sentence describing the associated reaction force. Include the object exerting the force, the type of force (e.g., frictional gravitational, normal, tension, etc), the direction of the force and the object on which the force is exerted.

********2e) Now suppose friction is non-negligible between block 1 & the floor. Assume friction is negligible between block 2 & the floor. Assume the blocks accelerate to the right. Draw FBDs for each block individually and write a set of force equations for each block. Label things well to earn credit.



***2g) Determine the magnitude of force F_A is the following assumptions are made.
Answer as a decimal number with three sig figs times $\boldsymbol{mg}$.

- The system accelerates to the right at rate $\frac{g}{3}$.
- Assume $\mu_s = \mu_k = 0.111$ between block 1 & the floor.
- Let $m_2 = 2m$ & $m_1 = m$.
- Assume $F_B = 3.75mg$.

2g	

A block of mass $3m$ is on an incline of angle $\theta = 13.33°$.
Negligible friction is present between $3m$ & the incline.
A light, inextensible string attaches mass $3m$ to mass m over a pulley of negligible mass and negligible axle friction.
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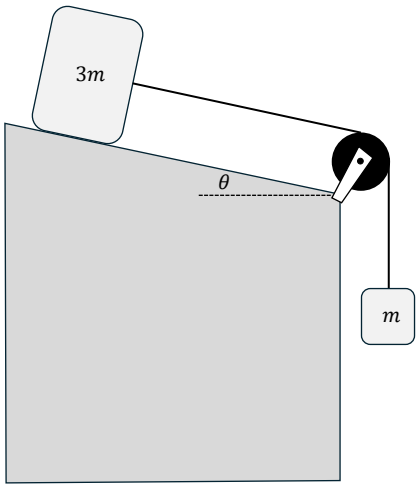
3a) Determine the acceleration (magnitude) of mass m after the blocks are released from rest. **Answer as a decimal number with 3 sig figs times g.**

3b) Determine the tension (magnitude) after the blocks are released from rest. **Answer as a decimal number with 3 sig figs times mg.**



3a	
3b	