110 Fall 2023 Test 1A 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.

$V_{sphere} = \frac{4}{3}\pi R^3$	$V_{box} = LWH$	$V_{cyl} = \pi R^2 H$	$\rho = \frac{M}{V}$
$A_{sphere} = 4\pi R^2$	$V = (A_{base}) \times (height)$	$A_{circle} = \pi R^2$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
$C = 2\pi R$	$A_{rect} = LW$	$A_{CylSide} = 2\pi RH$	
$160\underline{9}\ \text{m} = 1\ \text{mi}$	$12\ \text{in} = 1\ \text{ft}$	$60\ \text{s} = 1\ \text{min}$	$1000\ \text{g} = 1\ \text{kg}$
$2.54\ \text{cm} = 1\ \text{in}$	$1\ \text{cc} = 1\ \text{cm}^3 = 1\ \text{mL}$	$60\ \text{min} = 1\ \text{hr}$	$100\ \text{cm} = 1\ \text{m}$
$1\ \text{cm} = 10\ \text{mm}$	$1\ \text{yard} = 3\ \text{ft}$	$3600\ \text{s} = 1\ \text{hr}$	$1\ \text{km} = 1000\ \text{m}$
$1\ \text{furlong} = 220\ \text{yards}$	$528\underline{0}\ \text{ft} = 1\ \text{mi}$	$24\ \text{hrs} = 1\ \text{day}$	$1\ \text{rev} = 2\pi\ \text{rad} = 360°$
$g = 9.8\ \frac{\text{m}}{\text{s}^2}$	$G = 6.67 \times 10^{-11} \frac{\text{N} \cdot \text{m}^2}{\text{kg}^2}$	$P_0 = 1.0 \times 10^5\ \text{Pa}$	$1\ \text{eV} = 1.60\underline{2} \times 10^{-19}\ \text{J}$
$1\ \text{N} = 1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$	$1\ \text{J} = 1\ \text{N} \cdot \text{m}$	$1\ \text{Pa} = 1\ \frac{\text{N}}{\text{m}^2}$	
$x_f = x_i + v_{ix}t + \frac{1}{2}a_x t^2$	$v_{fx}^2 = v_{ix}^2 + 2a_x(\Delta x)$	$v_{fx} = v_{ix} + a_x t$	$r = \sqrt{x^2 + y^2}$
$\vec{A} \cdot \vec{B} = AB \cos\theta_{AB}$	$\lVert \vec{A} \times \vec{B} \rVert = AB \sin\theta_{AB}$	$\sin(A \pm B)$ $= \sin A \cos B \pm \cos A \sin B$	$\cos(A \pm B)$ $= \cos A \cos B \mp \sin A \sin B$
$\vec{v}_{ae} + \vec{v}_{eb} = \vec{v}_{ab}$	$\hat{r} = \cos\theta\,\hat{\imath} + \sin\theta\,\hat{\jmath}$	$\hat{\theta} = -\sin\theta\,\hat{\imath} + \cos\theta\,\hat{\jmath}$	
$a_{tan} = r\alpha$	$a_c = \frac{v^2}{r} = r\omega^2$	$\vec{a} = a_r\hat{r} + a_{tan}\hat{\theta}$	$\vec{a} = a_c(-\hat{r}) + a_{tan}\hat{\theta}$
$\Sigma\vec{F} = m\vec{a}$	$f \leq \mu n$		

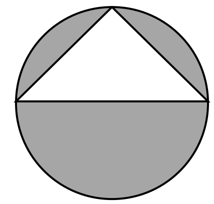
Prefix	**Abbreviation**	**$10^?$**		**Prefix**	**Abbreviation**	**$10^?$**
Giga	G	10^9		milli	m	10^{-3}
Mega	M	10^6		micro	μ	10^{-6}
kilo	k	10^3		nano	n	10^{-9}
centi	c	10^{-2}		pico	p	10^{-12}
				femto	f	10^{-15}

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

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

Name:____

A circular plate of diameter D and thickness t has a right triangular hole cut from it as shown in the figure. To be clear, you may assume the hypotenuse of the triangle is exactly the same length as the diameter for this question. The mass of the plate is m (after the triangular hole has been cutout).



*****1) Determine plate density in terms of a number with 3 sig figs times a simplified expression involving $D, t, \& m$.

1	

Suppose a physics function is given by

$$F = \frac{at^3}{3mk^2} - \frac{bv^2}{at}$$

In this equation we are assuming a is acceleration, t is time, m is mass, v is speed, and F is force. Assume k & b are positive constants.

***2) Determine the units appropriate for k. Answer in terms of a simplified expression involving kg, m, and/or s.

2	

x_i (m)	x_f (mm)	t (s)
7.00×10^{-1}	680	0.000400

For this page you can indicate rounding digits using the underbar as was shown in the lectures & solutions (i.e. $90\underline{0}0$).

A student records various data as shown in the table at right. Furthermore, you are told a physics equation is given by

$$\Delta x = \frac{1}{2}at^2 \quad \text{where} \quad \Delta x = x_f - x_i$$

2a) Write x_i in *engineering* notation.
2b) How many sig figs are assumed for x_i?
2c) Write x_f in *scientific* notation.
2d) How many sig figs are assumed for x_f?
2e) Write t in *engineering* notation *using the best choice of prefix*.
2f) How many sig figs are assumed for t?
****2g) Determine acceleration (a) from the given data table.
Your answer for this part should include the following:

- Correct sig figs
- *Engineering* notation *with best choice of prefix*

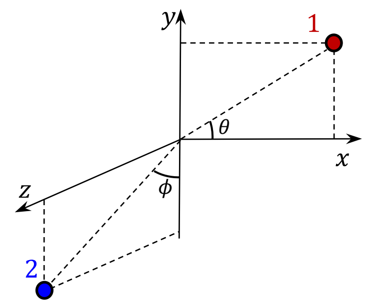
2a	
2b	
2c	
2d	
2e	
2f	
2g	

Assume a physics equation states $\vec{M} = \vec{r} \times \vec{P}$.
You are told $\vec{r} = \left(7.50\hat{\jmath} - 5.00\hat{k}\right)$ m.
Also, we know $\vec{P} = (-3.33\hat{\imath} - 4.44\hat{\jmath})$ kg $\cdot \frac{\text{m}}{\text{s}^2}$.

**3a) Determine the *magnitude* of $\vec{r}$.
**3b) Determine $\hat{r}$ in Cartesian form.
**3c) Determine the angle between $\vec{r}$ & $\vec{P}$.
***3d) Determine $\vec{M}$. Answer in Cartesian form **with components in the standard order.**

3a	
3b	
3c	
3d	

Two points are shown on a 3D coordinate system at right (figure not to scale).
To be clear, point 1 lies in the xy-plane while point 2 lies in the yz-plane.
Angles are $\theta = 33.3°$ and $\phi = 22.2°$.
Points 1 & 2 are 7.00 m & 8.00 m from the origin respectively.
An object travels in three straight line displacements: first from the origin to point 1, then from point 1 to point 2, and finally it returns to the origin.



**4a) Write the *first* displacement in Cartesian form.
**4b) Write the *final* displacement in Cartesian form.
***4c) Determine the *magnitude* of the *second* displacement.

4a	
4b	
4c	

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