110 Fall 2025 Test 1B 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.

$V_{sphere} = \frac{4}{3}\pi R^3$	$V_{box} = LWH$	$V_{cyl} = \pi R^2 H$	$\rho = \frac{M}{V}$
$A_{sphere} = 4\pi R^2$	$V = (A_{base}) \times (height)$	$A_{circle} = \pi R^2$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
$C = 2\pi R$	$A_{rect} = LW$	$A_{CylSide} = 2\pi RH$	
$1609\underline{}$ 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	$5280\underline{}$ 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 = $1.602\underline{} \times 10^{-19}$ J
$1\text{ N} = 1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$	$1\text{ J} = 1\text{ N} \cdot \text{m}$	$1\text{ Pa} = 1 \frac{\text{N}}{\text{m}^2}$	
$x_f = x_i + v_{ix}t + \frac{1}{2}a_x t^2$	$v_{fx}^2 = v_{ix}^2 + 2a_x(\Delta x)$	$v_{fx} = v_{ix} + a_x t$	$r = \sqrt{x^2 + y^2}$
$\vec{A} \cdot \vec{B} = AB\cos\theta_{AB}$	$\left\|\vec{A} \times \vec{B}\right\| = AB\sin\theta_{AB}$	$\sin(A \pm B)$ $= \sin A \cos B \pm \cos A \sin B$	$\cos(A \pm B)$ $= \cos A \cos B \mp \sin A \sin B$
$\vec{v}_{ae} + \vec{v}_{eb} = \vec{v}_{ab}$	$\hat{r} = \cos\theta\,\hat{\imath} + \sin\theta\,\hat{\jmath}$	$\hat{\theta} = -\sin\theta\,\hat{\imath} + \cos\theta\,\hat{\jmath}$	
$a_{tan} = r\alpha$	$a_c = \frac{v^2}{r} = r\omega^2$	$\vec{a} = a_r\hat{r} + a_{tan}\hat{\theta}$	$\vec{a} = a_c(-\hat{r}) + a_{tan}\hat{\theta}$
$\Sigma\vec{F} = m\vec{a}$	$f \le \mu n$		

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:_____

For this question we will ignore units.

Two vectors are $\vec{C} = 4.00\hat{\imath} - 6.00\hat{\jmath}$ and $\vec{D} = -4.00\hat{\imath} + 5.00\hat{\jmath}$.

1a) Determine the magnitude of vectors $\vec{C}$ & $\vec{D}$. To reduce rounding errors, include a 4th digit on each number (but underline the 3rd sig fig).

**1b) Determine $\vec{C} \times \vec{D}$ in Cartesian form.

1c) Determine $\vec{C} \cdot \vec{D}$.

1d) Determine the angle between $\vec{C}$ and $\vec{D}$. Note: you are not allowed to use a protractor for this question.

1a	$\|\vec{C}\| = C =$ $\|\vec{D}\| = D =$
1b	
1c	
1d	

Two displacement vectors are $\vec{A} = 5.39$ m @ 21.8° east of south and $\vec{B} = (-9.97\hat{\imath} - 5.01\hat{\jmath})$ m.

2a) Write vector $\vec{A}$ in Cartesian form.

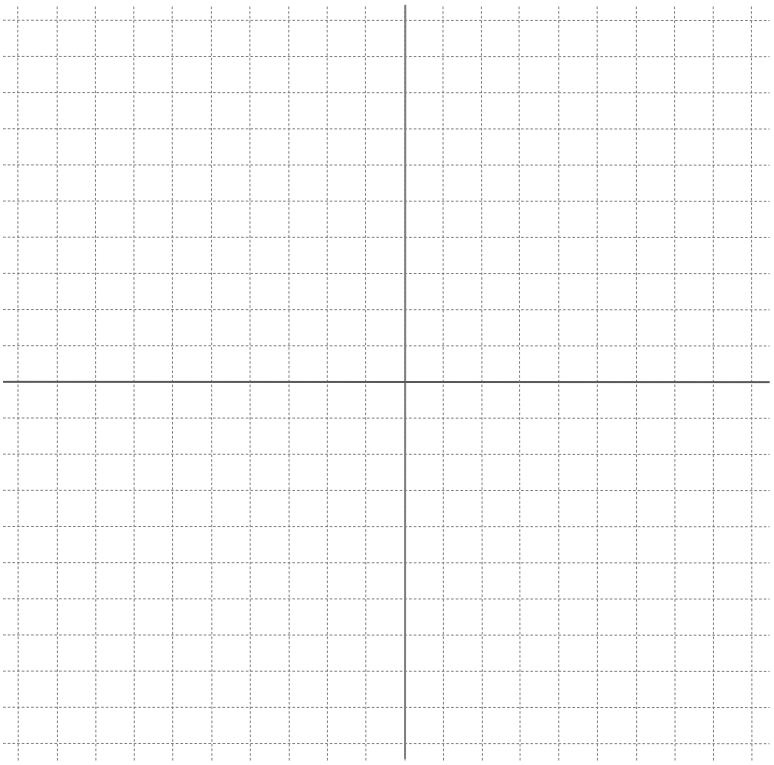
2b) Write vector $\vec{B}$ in polar form. In the box at right, include a sketch of $\vec{B}$, clearly labeling an angle for full credit.

**2c) Determine $\vec{R} = \vec{A} + \vec{B}$. Express $\vec{R}$ in polar form.
Include a sketch of $\vec{R}$, clearly labeling an angle for full credit.

**2d) Show graphical vector addition for $\vec{R} = \vec{A} + \vec{B}$.

- Clearly label each vector with a letter.
- Include an arrowhead on each vector to show direction.
- Your drawing should be within 5-10% of my drawing.

2a	
2b	
2c	
2d	Use grid provided below



A student determines a force with magnitude $F = 0.00003020$ N acts on a particle of mass $m = 40100000000$ g.
3a) Write F in *engineering notation* (using *appropriate prefix*) with *correct sig figs*.
3b) Write m in *engineering notation* (using *appropriate prefix*) with *correct sig figs*.

3a	
3b	

Several numbers are $A = 6.034$, $B = 5.968$, $C = 653$, $D = 7.7$, and $E = 50.50$.
Perform the following computations and write your final answers with correct sig figs AND proper *scientific* notation.
We are going by classic sig fig rules as discussed on the first day of class.
4a) Compute $x = A + D$.
4b) Compute $y = B \times D \times E$.
4c) Compute $z = \frac{B-A}{E}$.

4a	
4b	
4c	

Perform the requested conversions. It's probably easiest to answer in scientific notation.

5a) Convert $5.20 \times 10^5 \frac{\text{ft}}{\text{s}}$ to $\frac{\text{in}}{\text{hr}}$.

5b) Convert $0.0300\ \text{mi}^2$ to m^2.

5a	
5b	

A student shows you an equation for velocity as shown below.

$$v = A\frac{gx}{\rho} - Bt^2\sqrt{\frac{x}{\pi g}}$$

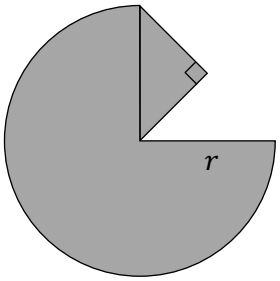
The symbols A and B are constants with unknown units. Assume g is the magnitude of acceleration due to gravity, x is distance, t is time, m is mass, v is velocity, and ρ is density.

6a) Determine the units (dimensions) of A. If A is unitless (dimensionless), state "no units".

6b) Determine the units (dimensions) of B. If B is unitless (dimensionless), state "no units".

6a	
6b	

A circular piece of metal has radius r. A quarter-circle piece of the metal is removed.
A second piece of metal, in the shape of a 45-45-90 triangle, is welded to the circular piece to form the combined shape shown at right.
The thickness (dimension *into the page*) of the combined shape is t.



**7a) Determine the *surface area* (top surface only) of combined shape as a decimal number with three sig figs times r^2.

**7b) This piece of metal is fabricated from aluminum with density $2.70\ \frac{\text{g}}{\text{cm}^3}$ using side length $r = 9.75\ \text{cm}$. The combined shape has total mass $0.222\ \text{kg}$. Determine the thickness t.

Answer in engineering notation with best choice of prefix.

7a	
7b	

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