110 Fall 2019 Test 2A 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	$5280\underline{}$ 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 J = 1 N · 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}

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

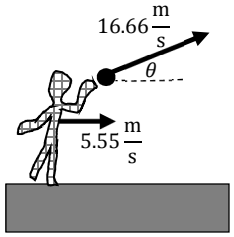
[L] = length = m [L^3] = volume = m^3 $\left[\frac{L}{T}\right]$ = velocity = $\frac{m}{s}$ $\left[\frac{L \cdot M}{T^2}\right]$ = force = $\frac{kg \cdot m}{s^2}$ = N

NAME: _____

An athlete throws a ball while she is running to the right at a speed of $5.55\frac{\text{m}}{\text{s}}$.

The ball leaves her hand travelling at $16.66\frac{\text{m}}{\text{s}}$ (relative to the earth) angle at $\theta = 22.2°$.

*****1) What direction did she *aim* (relative to her body) while throwing the ball?
Sketch the direction and include a numerical value for the angle.



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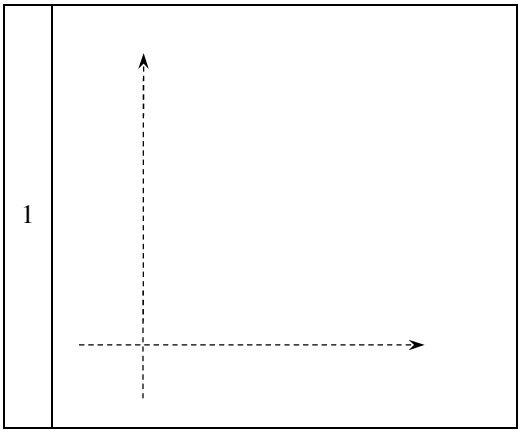
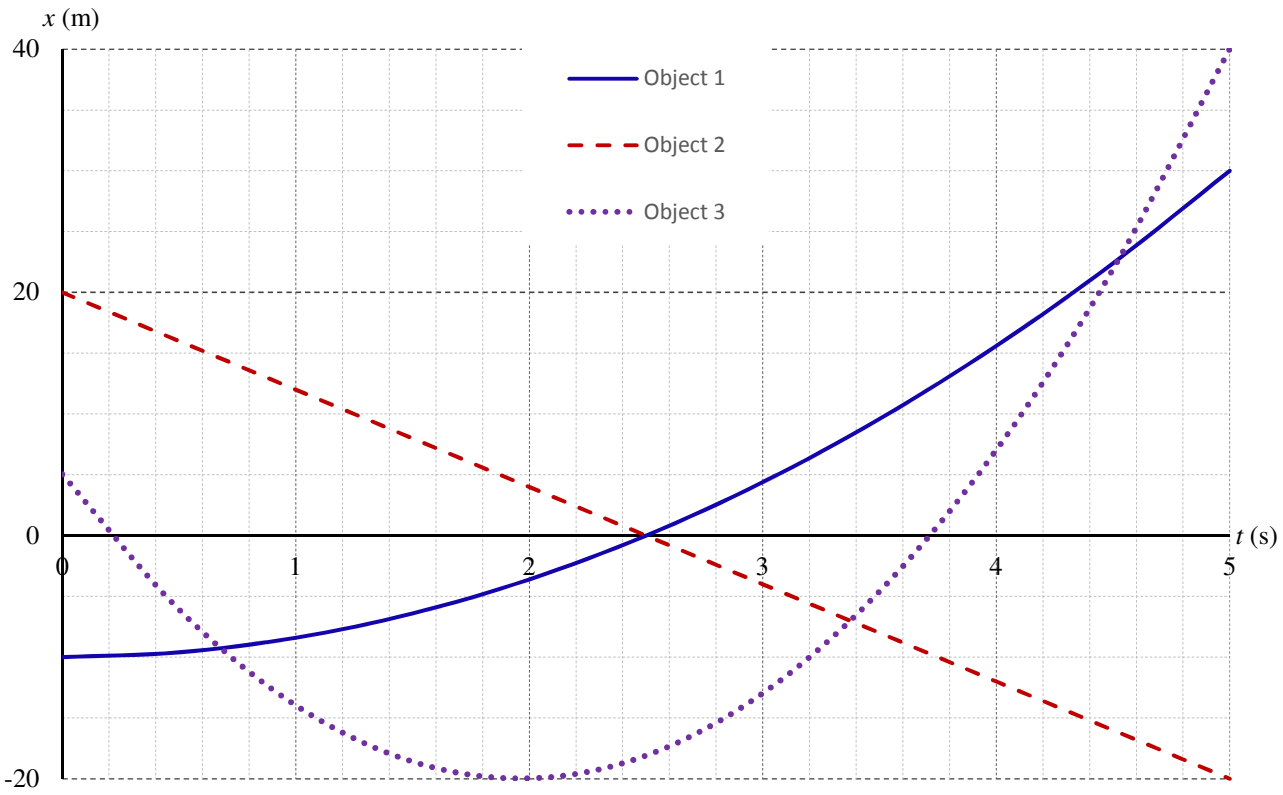




The plot above shows the objects' positions versus time.
For this question assume positive (or negative) implies $+\hat{\imath}$ (or $-\hat{\imath}$) as needed to reduce clutter.

2a) Which object is (or objects are) *initially moving to the right*? Circle the best answer.

1 only	2 only	3 only	None of them
1 & 2	2 & 3	1 & 3	All of them

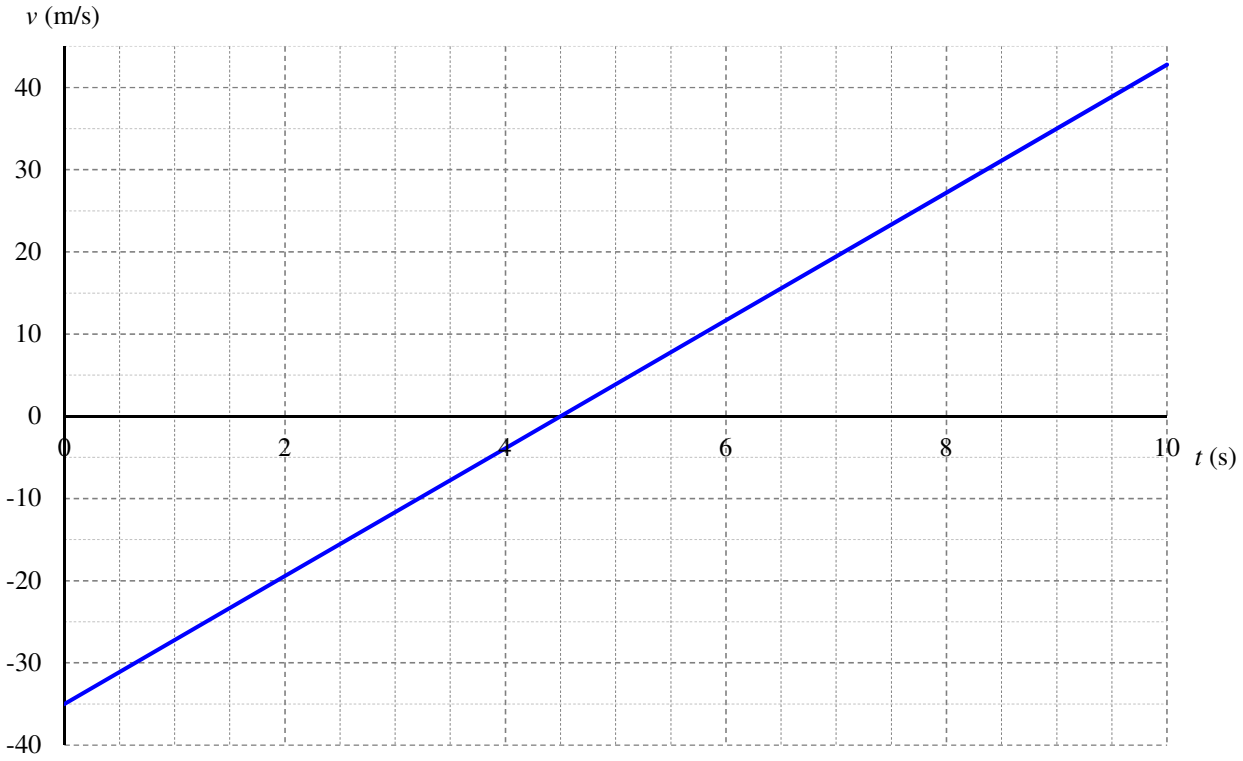
2b) Which object has (or objects have) non-zero, positive *acceleration*? Circle the best answer.

1 only	2 only	3 only	None of them
1 & 2	2 & 3	1 & 3	All of them

**2c) Rank distance traveled by the objects (from largest to smallest) during the entire 5.0 s time interval shown. Clearly indicate any ties.

2d) Which is *moving fastest* at $t = 4.0$ s? Circle the best answer.

1 only	2 only	3 only	None of them
1 & 2	2 & 3	1 & 3	All of them

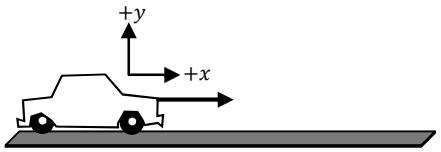


The questions below refer to an object moving in one dimension.
The plot above shows the object's velocity versus time.
For this question assume positive (or negative) answers imply $+\hat{\imath}$ (or $-\hat{\imath}$) as needed to reduce clutter.

**3a) Determine acceleration at $t = 4.5$ s.
**3b) Determine displacement over the full 10.0 second interval shown.

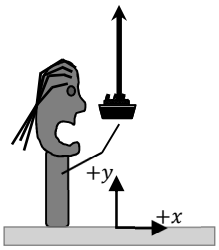
3a	
3b	

A car is travelling to the right with speed v.
**4a) Determine what acceleration is required to *reduce* the speed by 11.2% in distance d. When you get to your final answer, simplify all numerical factors into a single number with 4 sig figs times whatever variables remain.
**4b) How much time is required for the car to reach this final speed?
When you get to your final answer, simplify all numerical factors into a single number with 4 sig figs times whatever variables remain.



4a	
4b	

Lacy B throws an object upwards. The object is released distance d above the ground.
For question 5, answer using the coordinate system shown.



5a) When the ball reaches max height, is the object's *velocity* positive negative or zero?
Circle the best answer.

Positive	Negative	Zero	Impossible to determine without more info

5b) Just before the object impacts the ground, is the object's *displacement* positive, negative or zero?
Circle the best answer.

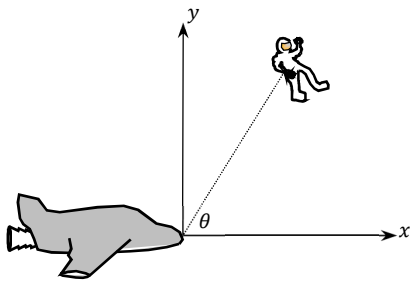
Positive	Negative	Zero	Impossible to determine without more info

5c) Just before the object impacts the ground, is the object's *speed* positive negative or zero?
Circle the best answer.

Positive	Negative	Zero	Impossible to determine without more info

An astronaut is initially 3.33 m from the nose of her ship at angle $\theta = 66.6°$.
She initially moves with speed $1.11\frac{\text{m}}{\text{s}}$ to the *left*.
She accelerates *upwards* at $4.44\frac{\text{m}}{\text{s}^2}$.

6a) How much time elapses before she crosses the y-axis?
6b) How far is she from the origin as it crosses the y-axis?
**6c) How fast is she moving as it crosses the y-axis?
6d) What direction is she moving as it crosses the y-axis?
Sketch the answer and label an angle in your sketch.



6a	
6b	
6c	
6d	

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