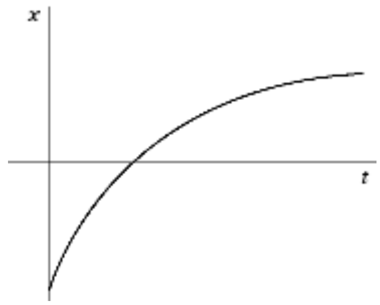
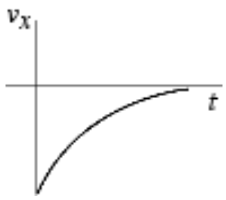
PH105–007 Exam 1

Name____________________________________

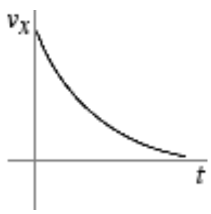
1) The figure shows the graph of the position x as a function of time for an object moving in the straight line (the x–axis). Which of the following graphs best describes the velocity along the x–axis as a function of time for this object?



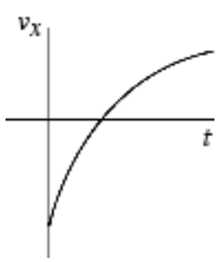
A)



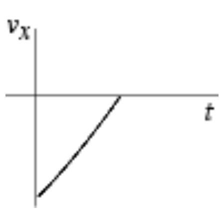
B)



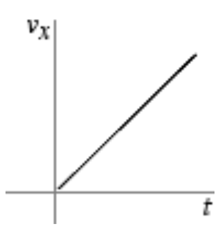
C)



D)



E)



2) The velocity of an object is given by the expression $v(t) = 3.00\ \text{m/s} + (4.00\ \text{m/s}^3)t^2$, where t is in seconds. Determine the position of the object as a function of time if it is located at $x = 1.00$ m at time $t = 0.000$ s.

A) $(3.00\ \text{m/s})t + (1.33\ \text{m/s3})t^3$
B) $(4.00\ \text{m/s})t$
C) $(4.00\ \text{m/s})t + 1.00$ m
D) 1.33 m
E) $1.00\ \text{m} + (3.00\ \text{m/s})t + (1.33\ \text{m/s}^3)t^3$

3) Suppose that an object is moving with constant nonzero acceleration. Which of the following is an accurate statement concerning its motion?

A) A graph of its velocity as a function of time is a horizontal line.
B) In equal times its speed changes by equal amounts.
C) A graph of its position as a function of time has a constant slope.
D) In equal times it moves equal distances.
E) In equal times its velocity changes by equal amounts.

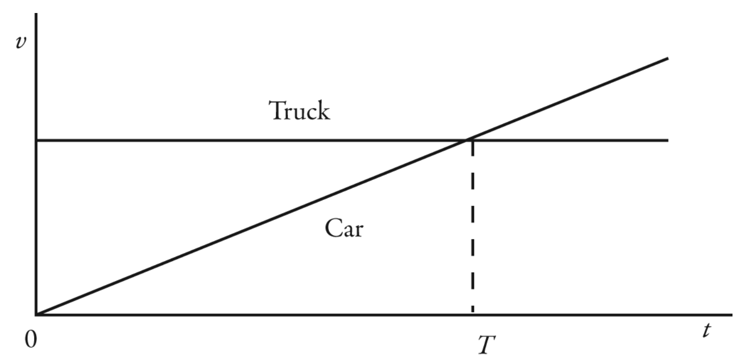
4) The position of an object as a function of time is given by $x = bt^2 - ct$, where $b = 2.0\ \text{m/s}^2$ and $c = 6.7$ m/s, and x and t are in SI units. What is the instantaneous velocity of the object when $t = 2.2$?

A) 2.3 m/s
B) 1.7 m/s
C) 2.1 m/s
D) 2.7 m/s

5) If the fastest you can safely drive is 65 mi/h, what is the longest time you can stop for dinner if you must travel 541 mi in 9.6 h total?

A) 1.0 h
B) 1.3 h
C) 1.4 h
D) You can't stop at all.

6) The motions of a car and a truck along a straight road are represented by the velocity–time graphs in the figure. The two vehicles are initially alongside each other at time $t = 0$. At time T, what is true about these two vehicles since time $t = 0$?



A) The truck will have traveled further than the car.
B) The car will have traveled further than the truck.
C) The car will be traveling faster than the truck.
D) The truck and the car will have traveled the same distance.

7) An object is moving with constant non–zero acceleration along the +x–axis. A graph of the velocity in the x direction as a function of time for this object is
A) a vertical straight line.
B) a parabolic curve.
C) a horizontal straight line.
D) a straight line making an angle with the time axis.

8) Two objects have masses m and $5m$, respectively. They both are placed side by side on a frictionless inclined plane and allowed to slide down from rest.
A) The two objects reach the bottom of the incline at the same time.
B) It takes the heavier object 5 times longer to reach the bottom of the incline than the lighter object.
C) It takes the heavier object 10 times longer to reach the bottom of the incline than the lighter object.
D) It takes the lighter object 5 times longer to reach the bottom of the incline than the heavier object.
E) It takes the lighter object 10 times longer to reach the bottom of the incline than the heavier object.

9) The position of an object is given by $x = at^3 - bt^2 + ct$, where $a = 4.1\ \text{m/s}^3$, $b = 2.2\ \text{m/s}^2$, $c = 1.7\ \text{m/s}$, and x and t are in SI units. What is the instantaneous acceleration of the object when $t = 0.7$ s?
A) $-13\ \text{m/s}^2$ B) $13\ \text{m/s}^2$ C) $2.9\ \text{m/s}^2$ D) $4.6\ \text{m/s}^2$

10) A child on a sled starts from rest at the top of a 15° slope. If the trip to the bottom takes 15.2 s how long is the slope? Assume that frictional forces may be neglected.
A) 1130 m B) 586 m C) 293 m D) 147 m

11) A speeding car is traveling at a constant 30.0 m/s when it passes a stationary police car. If the police car delays for 1.00 s before starting, what must be the magnitude of the constant acceleration of the police car to catch the speeding car after the police car travels a distance of 300 m?
A) $1.45\ \text{m/s}^2$ B) $3.70\ \text{m/s}^2$ C) $6.00\ \text{m/s}^2$ D) $7.41\ \text{m/s}^2$ E) $3.00\ \text{m/s}^2$

12) An object starts from rest at time $t = 0.00$ s and moves in the +x direction with constant acceleration. The object travels 12.0 m from time $t = 1.00$ s to time $t = 2.00$ s. What is the acceleration of the object?
A) $-12.0\ \text{m/s}^2$ B) $8.00\ \text{m/s}^2$ C) $24.0\ \text{m/s}^2$ D) $4.00\ \text{m/s}^2$ E) $-4.00\ \text{m/s}^2$

13) A dragster starts from rest and travels 1/4 mi in 6.70 s with constant acceleration. What is its velocity when it crosses the finish line?
A) 269 mi/h B) 135 mi/h C) 296 mi/h D) 188 mi/h

14) A car accelerates from 10.0 m/s to 30.0 m/s at a rate of $3.00\ \text{m/s}^2$. How far does the car travel while accelerating?
A) 133 m B) 399 m C) 226 m D) 80.0 m

15) Two identical objects A and B fall from rest from different heights to the ground and feel no appreciable air resistance. If object B takes TWICE as long as object A to reach the ground, what is the ratio of the heights from which A and B fell?
A) $h_A/h_B = 1/4$ B) $h_A/h_B = 1/8$ C) $h_A/h_B = 1/\sqrt{2}$ D) $h_A/h_B = 1/2$

16) To determine the height of a flagpole, Abby throws a ball straight up and times it. She sees that the ball goes by the top of the pole after 0.50 s and then reaches the top of the pole again after a total elapsed time of 4.1 s. How high is the pole above the point where the ball was launched? (You can ignore air resistance.)

A) 26 m B) 10 m C) 16 m D) 18 m E) 13 m

17) A 480-kg car moving at 14.4 m/s hits from behind a 570-kg car moving at 13.3 m/s in the same direction. If the new speed of the heavier car is 14.0 m/s, what is the speed of the lighter car after the collision, assuming that any unbalanced forces on the system are negligibly small?

A) 19.9 m/s B) 13.6 m/s C) 5.24 m/s D) 10.5 m/s

18) Two objects of the same mass move along the same line in opposite directions. The first mass is moving with speed v. The objects collide, stick together, and move with speed $0.100v$ in the direction of the velocity of the first mass before the collision. What was the speed of the second mass before the collision?

A) $1.20v$ B) $0.900v$ C) $10.0v$ D) $0.800v$ E) $0.00v$

19) In a collision between two objects having unequal masses, how does magnitude of the impulse imparted to the lighter object by the heavier one compare with the magnitude of the impulse imparted to the heavier object by the lighter one?

A) The heavier object receives a larger impulse.
B) The lighter object receives a larger impulse.
C) Both objects receive the same impulse.
D) The answer depends on the ratio of the masses.
E) The answer depends on the ratio of the speeds.

20) Two ice skaters push off against one another starting from a stationary position. The 45.0-kg skater acquires a speed of 0.375 m/s. What speed does the 60.0-kg skater acquire? Assume that any other unbalanced forces during the collision are negligible.

A) 0.500 m/s B) 0.000 m/s C) 0.281 m/s D) 0.750 m/s E) 0.375 m/s

Power	**Prefix**	**Abbreviation**
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T

$$g = |\vec{\mathbf{a}}_{\text{free fall}}| = 9.81\,\text{m/s}^2 \quad \text{near earth's surface}$$

$$0 = ax^2 + bx^2 + c \Longrightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$1\,\text{J} = 1\,\text{kg}\cdot\text{m}^2/\text{s}^2 \; = 1\,\text{N}\cdot\text{m}$$

$$\Delta\vec{\mathbf{r}} = \vec{\mathbf{r}}_f - \vec{\mathbf{r}}_i$$

$$d \equiv |x_1 - x_2|$$

$$b \equiv |\vec{\mathbf{b}}| = |b_x| \quad \text{one dimension}$$

$$\vec{\mathbf{r}} = x\,\hat{\boldsymbol{\imath}} \quad \text{one dimension}$$

$$\vec{\mathbf{b}} = b_x\,\hat{\boldsymbol{\imath}} \quad \text{one dimension}$$

$$\text{speed} = v = |\vec{\mathbf{v}}|$$

$$\vec{\mathbf{v}}_{av} \equiv \frac{\Delta\vec{\mathbf{r}}}{\Delta t}$$

$$\vec{\mathbf{v}} = \lim_{\Delta t\to 0}\frac{\Delta\vec{\mathbf{r}}}{\Delta t} \equiv \frac{d\vec{\mathbf{r}}}{dt}$$

$$a_{x,av} \equiv \frac{\Delta v_x}{dt}$$

$$a_x = \lim_{\Delta t\to 0}\frac{\Delta v_x}{\Delta t} \equiv \frac{dv_x}{dt} = \frac{d}{dt}\left(\frac{dx}{dt}\right) = \frac{d^2x}{dt^2}$$

$$x_f = x_i + v_{x,i}\Delta t + \frac{1}{2}a_x\,(\Delta t)^2$$

$$v_{x,f} = v_{x,i} + a_x\Delta t$$

$$x(t) = x_i + v_{x,i}t + \frac{1}{2}a_x t^2$$

$$v_x(t) = v_{x,i} + a_x t$$

$$v_{x,f}^2 = v_{x,i}^2 + 2a_x\Delta x$$

$$\Delta\vec{\mathbf{p}} = \vec{\mathbf{0}} \quad \text{isolated system}$$

$$\vec{\mathbf{p}}_f = \vec{\mathbf{p}}_i \quad \text{isolated system}$$

$$\vec{\mathbf{p}} \equiv m\vec{\mathbf{v}}$$

$$m_u = -\frac{\Delta v_{s,x}}{\Delta v_{u,x}}m_s$$

$$\vec{\mathbf{J}} = \Delta\vec{\mathbf{p}}$$

$$v_{1f} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)v_{i1} + \left(\frac{2m_2}{m_1 + m_2}\right)v_{2i} \quad \text{1D elastic}$$

$$v_{2f} = \left(\frac{2m_1}{m_1 + m_2}\right)v_{1i} + \left(\frac{m_2 - m_1}{m_1 + m_2}\right)v_{2i} \quad \text{1D elastic}$$

$$\Delta E = 0 \quad \text{isolated system}$$

$$K = \frac{1}{2}mv^2$$

$$\vec{v}_{12} = \vec{\mathbf{v}}_2 - \vec{\mathbf{v}}_1 \quad \text{relative velocity}$$

$$v_{12} = |\vec{\mathbf{v}}_2 - \vec{\mathbf{v}}_1| \quad \text{relative speed}$$