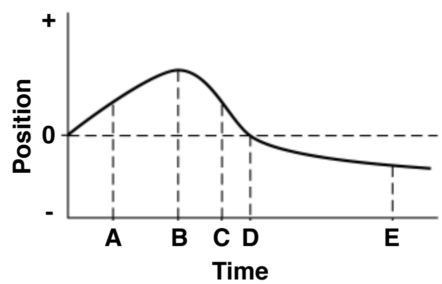
Name

PH105 Exam 1

Instructions

1. Answer all questions.
2. Record your responses on a scantron sheet.
3. On your scantron sheet, be sure to bubble in your **full name and CWID**.

1. The graph in the figure shows the position of an object as a function of time. The letters A-E represent particular moments of time. At which moment shown (A, B, etc.) is the **speed** of the object the greatest?



2. 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) It takes the heavier object 5 times longer to reach the bottom of the incline than the lighter object.
B) The two objects reach the bottom of the incline at the same time.
C) It takes the lighter object 10 times longer to reach the bottom of the incline than the heavier 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 heavier object 10 times longer to reach the bottom of the incline than the lighter object.

3. 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) 147 m B) 293 m C) 586 m D) 1130 m

4. As part of an exercise program, a woman walks south at a speed of 2.00 m/s for 60.0 minutes. She then turns around and walks north a distance 3000 m in 25.0 minutes. What is the woman's average velocity during her entire motion?

A) 0.824 m/s south B) 1.93 m/s south C) 2.00 m/s south D) 1.79 m/s south E) 800 m/s south

5. Referring to the previous question, what is the woman's average speed during her entire motion?

A) 0.824 m/s B) 1.93 m/s C) 2.00 m/s D) 1.79 m/s E) 800 m/s

6. A car accelerates from 10.0 m/s to 30.0 m/s at a rate of 3.00 m/s^2. How far does the car travel while accelerating?

A) 133 m B) 399 m C) 80.0 m D) 226 m

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7. Two objects are dropped from a bridge, an interval of 1.0 s apart, and experience no appreciable air resistance. As time progresses, the DIFFERENCE in their speeds

A) decreases at first, but then stays constant.
B) increases.
C) remains constant.
D) increases at first, but then stays constant.
E) decreases.

8. A car is 200 m from a stop sign and traveling toward the sign at 40.0 m/s. At this time, the driver suddenly realizes that she must stop the car. If it takes 0.200 s for the driver to apply the brakes, what must be the magnitude of the constant acceleration of the car after the brakes are applied so that the car will come to rest at the stop sign?

A) 4.17 m/s^2 B) 2.89 m/s^2 C) 3.89 m/s^2 D) 3.42 m/s^2 E) 2.08 m/s^2

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

A) 4.6 m/s^2 B) 13 m/s^2 C) -13 m/s^2 D) 2.9 m/s^2

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

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

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

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

12. A 1000.0 kg car is moving at 15 km/h. If a 2000.0 kg truck has 18 times the kinetic energy of the car, how fast is the truck moving?

A) 63 km/h B) 54 km/h C) 45 km/h D) 36 km/h

13. A ball is thrown directly upward and experiences no air resistance. Which one of the following statements about its motion is correct?

A) The acceleration of the ball is downward while it is traveling up and upward while it is traveling down.
B) The acceleration of the ball is upward while it is traveling up and downward while it is traveling down.
C) The acceleration is downward during the entire time the ball is in the air.
D) The acceleration of the ball is downward while it is traveling up and downward while it is traveling down but is zero at the highest point when the ball stops.

14. A test rocket is fired straight up from rest with a net acceleration of 20.0 m/s^2. After 4.00 s the motor turns off, but the rocket continues to coast upward with no appreciable air resistance. What maximum elevation does the rocket reach?

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A) 487 m B) 327 m C) 160 m D) 408 m E) 320 m

15. How much energy is needed to change the speed of a 1600 kg sport utility vehicle from 15.0 m/s to 40.0 m/s?

A) 10.0 kJ B) 40.0 kJ C) 1.10 MJ D) 20.0 kJ E) 0.960 MJ

16. A 2.3 kg object traveling at 6.1 m/s collides head-on with a 3.5 kg object traveling in the opposite direction at 4.8 m/s. If the collision is **perfectly elastic**, what is the final speed of the 2.3 kg object?

A) 4.3 m/s B) 3.8 m/s C) 6.6 m/s D) 0.48 m/s E) 7.1 m/s

17. A shell explodes into two pieces, one piece 25 times heavier than the other. If any gas from the explosion has negligible mass, then

A) the momentum change of the lighter piece is 25 times as great as the momentum change of the heavier piece.
B) the momentum change of the heavier piece is 25 times as great as the momentum change of the lighter piece.
C) the kinetic energy change of the lighter piece is 25 times as great as the kinetic energy change of the heavier piece.
D) the momentum change of the lighter piece is exactly the same as the momentum change of the heavier piece.
E) the kinetic energy change of the heavier piece is 25 times as great as the kinetic energy change of the lighter piece.

18. In a perfectly ELASTIC collision between two perfectly rigid objects

A) the kinetic energy of the system is conserved, but the momentum of the system is not conserved.
B) the momentum of each object is conserved.
C) both the momentum and the kinetic energy of the system are conserved.
D) the momentum of the system is conserved but the kinetic energy of the system is not conserved.
E) the kinetic energy of each object is conserved.

19. In an INELASTIC collision between two objects

A) the momentum of each object is conserved.
B) the kinetic energy of the system is conserved, but the momentum of the system is not conserved.
C) the momentum of the system is conserved but the kinetic energy of the system is not conserved.
D) the kinetic energy of each object is conserved.
E) both the momentum and the kinetic energy of the system are conserved.

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

21. 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? It is not known whether the collision was elastic or not.

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

22. You are standing on a skateboard, initially at rest. A friend throws a very heavy ball towards you. You can either catch the object or deflect the object back towards your friend (such that it moves away from you with the same speed as it was originally thrown). What should you do in order to MINIMIZE your speed on the skateboard?

A) Deflect the ball.
B) Catch the ball.
C) Your final speed on the skateboard will be the same regardless whether you catch or deflect the ball.

23. 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) $0.00v$ B) $0.800v$ C) $1.20v$ D) $0.900v$ E) $10.0v$

24. On the earth, when an astronaut throws a 0.250 kg stone vertically upward, it returns to his hand a time T later. On planet X he finds that, under the same circumstances, the stone returns to his hand in $2T$. In both cases, he throws the stone with the same initial velocity and it feels negligible air resistance. The acceleration due to gravity on planet X (in terms of g) is

A) $g/\sqrt{2}$ B) $g/2$ C) $2g$ D) $g/4$ E) $g\sqrt{2}$

25. 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) 16 m B) 13 m C) 18 m D) 26 m E) 10 m

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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