Announcements

1. **Exam 1 starts Friday!**
   a. Available in Testing Center from Friday, Sept. 28 (opening time), up to Monday, Oct. 1 at 4:00 pm.
      i. If you pick up your exam after 4 pm, you'll have a late fee of unknown $$.
   b. Covers Ch. 2,3 (homeworks 1-5)
   c. Sample Exam 1 is posted on the web site and Sample Exam 1 Solutions also.
      i. Don't look at the solutions until you've *worked* the sample exam...or you won't find out where you are weak.
      → It's easy to fool yourself!
   d. There's a **3 hour time limit**
      i. Nearly all students will take at least 1.5 hours
      ii. Most will be done in 2 hours
2. Advice:
   a. "Cramming" doesn't help in physics. You need a fresh mind. Don't stay up late the night before.
   b. Take your time and space to draw diagrams, label. You should write by hand while you work on the exam, even though you will record your answers on a computer sheet.

Exam Formulas

To be given on exam
g=9.80 m/s^2

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

For constant *a*:

$$x = x_o + v_o t + \frac{1}{2}at^2$$

$$v^2 = v_o^{\,2} + 2a\left(x - x_o\right)$$

To be memorized (not an exhaustive list!)

Definition: $v_{ave} =< v >= \dfrac{\Delta x}{\Delta t}$

Definition: $a_{ave} =< a >= \dfrac{\Delta v}{\Delta t}$

For constant *a*:

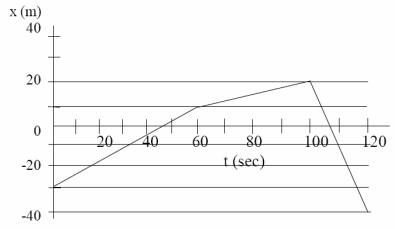
$v = v_o + at$ (reflects fact that $v(t)$ is a straight line when a is constant)

$v_{ave} =< v >= \dfrac{v_i + v_f}{2}$ (since *v* is linear when *a* is constant) the average must be halfway between the beginning and ending velocities)

Kinematic formula modifications for projectiles

How to fill in answers: example

A bicycle has an x(t) curve given in the figure below. Positive x means to the right. The displacement between 0 and 60 seconds is [1S] _____ m. At the time t=20 seconds, the bicycle is [2?] _____ 1) moving to the right 2) moving to the left 3) not moving .



[?] with choices means simple multiple choice.
[S] means bubble in a numerical answer: the **S**econd significant digit of the actual answer.

(These bubble sheets have 10 bubbles per question.)

Numerical answer examples

When e.g. [**11**S] _____ is displayed, in answer blank **11**…

- If the number itself is zero, mark 0
- For answers 3.872, -0.003872, or 3.872 x10^{-7} you would mark 8
- For the answer 5.072, you would mark 0.

Sometimes a range of answers is given (as in the homework). The correct answer is in that range. For example: [11S] _____ {4.88, 6.48}m/s.

- If you got 6.275, you would mark 2 (the second digit) for your answer.
- If you got 3.823, try again (out of range).

Keep four significant digits throughout your calculations; do not round up to less than four. When data is given, assume it has at least four significant digits. For example "15 meters" means 15.00 meters.

Additional Giudance

Dr Hess: "I suggest you write your **full answer** in the blank, and **circle** the 2nd digit, to help you transfer the correct digit to the form."

Question: What if you get 1.299? Do you put 2 or round up to 3?

Answer: we won't put that kind of an answer on the exam. So if you get one, it's incorrect.

Exam 1 - Review of important concepts

1. Trig: need to know how sin, cos, and tan work

2. Motion:
   a. Displacement
   b. Velocity and speed
   c. Acceleration (always in direction of force)
   d. How to interpret x(t), v(t) and a(t) graphs:
      i. slopes connect them
   e. Average vs. Instantaneous

3. Kinematic equations
   a. Take your time:
      i. Draw pictures, choose + direction
      ii. On picture, write given info
         1. Label numbers with variables
      iii. Write equations symbolically
      iv. Identify which equations will do the job
   b. Check your work with other kinematic eqns!

4. Free-fall
   a. Two sets of kinematic equations (x and y)
   b. $a_x = 0$
   c. Choose + direction. If + dir is up, use $a_y = -9.8\text{m/s}^2$. If +dir is down, use $a_y = +9.8\text{m/s}^2$.

5. Projectile motion
   a. Draw pictures, choose +directions
   b. Write kinematic equations for x and y
   c. Find x and y components of v_o from the angle
   d. Identify which coordinate info gives you the freefall time
   e. Find t
   f. Find other distances, etc.

6. Relative motion:
   a. One-dimension: it's easy to figure out, just add and subtract speeds
   b. 2-dimensions: draw **vectors**, and write the vector equation: $\mathbf{v}_{ac} = \mathbf{v}_{ab} + \mathbf{v}_{bc}$ then be sure your work (components) agrees with it.

Some HW problems (missed by many):

HW 1, Problem 2
Two cars travel in the same direction along a straight highway, one at a constant speed of 55 mph, and the other at 74.5 mph. (a) Assuming that they start at the same point, how much sooner does the faster car arrive at a destination 10 mi away? (b) How far must the faster car travel before it has a 15 min lead on the slower car?

HW 2, Problem 3

A tennis ball is thrown perpendicularly at a wall. Before striking the wall, the ball's velocity is 9.56 m/s (moving towards the right). After striking the wall, the ball rebounds in the opposite direction with a velocity equal to -832 m/s (moving towards the left). If the ball is in contact with the wall for 11.4 ms, what is the average acceleration of the ball while it is in contact with the wall? (Be sure to include the correct sign on the answer.)

HW 3, Problem 4

A model rocket is launched straight upward with an initial speed of 50.4 m/s. It accelerates with a constant acceleration of 1.97 m/s^2 until its engines stop at an altitude of 145 m. (a) What is the maximum height reached by the rocket (b) How long after lift-off does the rocket reach its maximum height? (c) How long is the rocket in the air?

HW 4, Problem 4

A river flows due east at 1.73 m/s. A boat cross the river from the south shore to the north shore by maintaining a constant velocity of 12.2 m/s due north relative to the water. What is (a) the magnitude and (b) the direction of the boat's velocity relative to shore? (c) If the river is 324 m wide, how far downstream has the boat moved by the time it reaches the north shore?

HW 5, Problem 4

A mountain climber is stranded on a ledge 28.2 m above the ground. Rescuers on the ground want to shoot a projectile to him with a rope attached to it. If the projectile is directed upward at an initial angle of 69.3° from a horizontal distance of 52.7 m, determine the initial speed the projectile must have in order to land on the ledge.

Sample Exam Problems

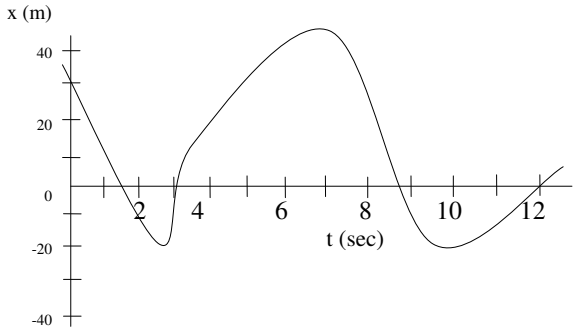
Problem 1. A girl is jumping on a trampoline. While she is above the trampoline in the air, going up, her acceleration is [1?]_____ 1) up 2) down 3) zero. At the top of her motion in the air, her acceleration is [2?]_____ 1) up 2) down 3) zero. Later, while in contact with the trampoline, she is going down and slowing, and her acceleration is [3?]_____ 1) up 2) down 3) zero. She jumps off the trampoline, and while she is going in an arc through the air forward and up, her acceleration will be [4?]_____ 1) up 2) down 3) zero 4) up and forward 5) down and forward 6) forward.

Problem 2. A motorist drives **north** for 30 **minutes** at 85 km/h and then stops for 15 minutes. He then turns **south**, traveling 130 km in 50 min. His average **velocity** was [5S]_____ km/hr in the direction [6?]_____ 1) north 2) south

Problem 3. A baseball hit straight up takes 5 seconds to reach its maximum height. The initial velocity of the ball was [7S]_____ m/s. The maximum height the ball reached was [8S]_____ {100, 131} m.

Problem 4. A car enters a 500 m long bridge at a speed of 20 m/s. It leaves the bridge at a speed of 55 m/s. The acceleration of the car was [9S] _____ m/s^2. The average velocity of the car while on the bridge was [10S] _____ m/s. The time the car was on the bridge was [11S] _____sec.

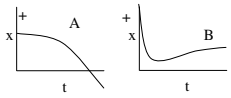
Problem 5. The graph shows the position of a ball being blown in a straight line by a variable wind. The number of times the ball stops between (and including) 0 and 12 seconds is [12?] _____(choose 0 to 9). The time mark (in seconds) closest to the time where the speed is the greatest is [13?]_____sec (choose an integer 0 to 9). At 6 seconds the ball is moving to the [14?]_____ 1) + direction 2) – direction 3) not moving. At 11 seconds the ball is moving to the [15]_____ 1) + direction 2) – direction 3) not moving. The average velocity between 0 and 12 seconds has magnitude [16S] _____ m/s and is in the [17?]_____ 1) + direction 2) – direction.

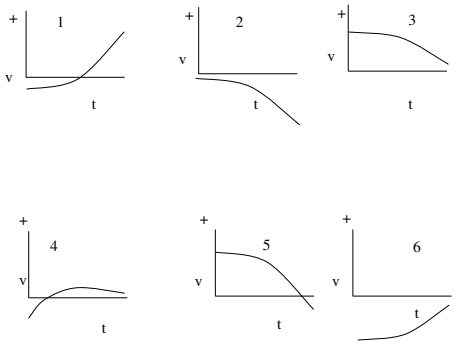


Problem 6. Cliff divers at Acapulco jump into the sea from a cliff 40 m high. At the level of the sea, a rock sticks out a horizontal distance of 5.5 m. If the divers jump off horizontally, they must have a horizontal initial velocity greater than [18S] _____ {1.81, 2.29} m/s to just miss the very edge of the rock (if they use the velocity you calculate they would just hit the edge of the rock). The divers are in the air [19S]_____ sec.

Problem 7. A car leaves Provo traveling north at 50 m/s. A truck leaves Provo 1800 seconds later traveling at 64 m/s. From the time the truck starts, it takes the truck [20S]_____ seconds to catch the car.

Problem 8.For the x(t) curve A shown to the right, the closest v(t) curve that describes its velocity is closest to curve [21?] _____ (choose 1-6 from curves below). For the x(t) curve B shown to the right, the closest v(t) curve that describes its velocity is closest to [22?] _____ (choose 1-6 from curves below). For curve 1 in the v(t) graphs below, the acceleration is [23?] _____ 1) always positive 2) always negative 3) positive then negative 4) negative then positive.





Problem 9. A place kicker kicks a football from a point 50 m from the goalposts, from the ground. When kicked, the ball leaves the ground with a speed of 35 m/s at an angle of 25^{o} above the horizontal. When it crosses the plane of the goalpost it is [24S]_____ {9.69, 12.5} m above the ground. The initial horizontal component of the velocity is [25S]_____ m/s.

Problem 10. The pilot of an airplane notes that the compass indicates a heading 30 degrees north of east (his direction relative to the air). The airplane's speed relative to the air is 150 km/h. If there is a wind of 50 km/h toward the north, the angle of the velocity of the airplane relative to the ground will be [26S] _____{43.6, 54.5} degrees north of east.