PHYSICS 149 TEST 1 26 September, 2000

This 18-question test is worth 100 points, each question is weighted equally. Please fill out the answer sheet with soft lead pencil. Be sure to give your name, student ID #, date, Course #, Test 1, and SIGN the answer sheet. Be prepared to present your Student picture ID card when handing in your answer sheet. You may keep the sheets with the questions and your work.

Pick the nearest value for your answer (there may be slight roundoff errors).

Don't get hung up too long over any one question until you have tried all of them.

You are expected to bring your own sheet of equations and words explaining the equations. Here are a few possibly useful equations. You will need to know when they are valid and when they are not.

$g = 9.8\ m/s^2$ $G = 6.67 \times 10^{-11} Nm^2/kg^2$

$v = v_0 + a\,t$ for each vector component of v and a

$x = x_0 + v_0 t + \frac{1}{2} a t^2$ and ditto for y and z components

$v_x^2 - v_{0x}^2 = 2a(x - x_0)$ etc. average $v_x = \Delta x/\Delta t$ etc.

$x = x_0 + \frac{1}{2}(v_0 + v)t$ etc. average $a = \Delta v/\Delta t$ and etc. for each component

$x = r\cos(\theta)$ $y = r\sin(\theta)$ $\tan(\theta) = y/x$

1. An acceleration vector $\mathbf{A}_1$ points along the +x axis with magnitude 1200 m/s^2 . A second vector, $\mathbf{A}_2$, is added to $\mathbf{A}_1$ to get $\mathbf{C}$.
The resultant (sum) vector is $\mathbf{C} = \mathbf{A}_1 + \mathbf{A}_2 = -3200$ m/s^2 (it points along the -x direction). What is the x-component of the vector $\mathbf{C}$?

a) -2000 m/s^2
b) +2000 m/s^2
c) -4400 m/s^2
d) +4400 m/s^2
e) -2400 m/s^2

2. The vector $\mathbf{r}$ = 100 m in a direction 45° above the x-axis. Vector $\mathbf{R}$ = 200 m in a direction 45° below the x-axis. What is the **length** of the vector $\mathbf{C} = \mathbf{r} + \mathbf{R}$?
Draw a picture to help see the components.

a) 223.6 m
b) 212.1 m
c) 141.1 m
d) 70.7 m
e) -70.7 m

3. $\mathbf{r}$ = (100m, 0) ; $\mathbf{R}$ = (50m, 87m). What is the **direction** of $\mathbf{C} = \mathbf{r} + \mathbf{R}$, relative to the x-axis ?

a) 20°
b) 30°
c) 45°
d) 60°
e) 75°

4. A car is travelling with a velocity of +55 m/s. After the brakes are applied it takes a distance of 100m to reduce its speed to 5 m/s. What is the acceleration (assumed to have been constant)?

a) 0.50 m/s^2
b) 15 m/s^2
c) -15 m/s^2
d) -0.50 m/s^2
e) -50 m/s^2

5. Two dogs run towards each other, the first dog starting from x = 0 with speed 5 m/s, and the second dog starting from x = 150m with speed 7 m/s (directed towards the other dog)). What is the **net displacement** of the **second** dog when they meet (i.e. how far and in what direction did the second dog move). Hint: figure out how long it took for the dogs to meet, then calculate where they are, etc.

a) 62.5m
b) 87.5m
c) -62.5m
d) -87.5m
e) 75m

6. A sprinter accelerates from rest to 13 m/s in a time of 2.3 seconds. What is her acceleration (assumed constant)?

a) 29.9 m/s^2
b) 0.033 m/s^2
c) 0.177 m/s^2
d) 5.65 m/s^2
e) 11.3 m/s^2

7. A skier, starting from rest, reaches a speed of 10.0 m/s while going down a slope for 6.0 seconds. How far does he travel in that time? (Hint: first calculate his constant acceleration, then use that answer plus the other given information.)

a) 16.6 m
b) 36.0 m
c) 18.0 m
d) 30.0 m
e) 80.0 m

8. A ball is dropped from rest from a tower (acceleration = $a = -g = -9.8\ m/s^2$). How far (magnitude only) does the ball travel between 3 seconds and 5 seconds after it is released?

a) 9.8 m
b) 44.1 m
c) 122.5 m
d) 19.6 m
e) 78.4 m

9. A climber rises at 0.2 m/s and her horizontal component of motion is 0.8 m/s. How fast is she climbing up along the slope?

a) 1.0 m/s
b) 0.60 m/s
c) 0.82 m/s
d) 1.13 m/s
e) 0.50 m/s

10. In the above example, what is the angle of the slope she is climbing (relative to the horizontal)?

a) 14°
b) 76°
c) 25°
d) 45°
e) 30°

11. A ball is thrown exactly sideways from a point 8m above level ground, with speed 12 m/s. When does the ball hit the ground? Hint: concentrate on the accelerated y motion.

a) 2.56 s
b) 4.90 s
c) 0.64 s
d) 1.00 s
e) 1.28 s

12. In the above example, how fast is the ball going when it hits? (The 2-D speed, not just either of the velocity components.)

a) 11.2 m/s
b) 12.5 m/s
c) 17.3 m/s
d) 24.5 m/s
e) 35.0 m/s

13. A boat with water speed 9.5 m/s aims directly across a river which is 0.75 km wide. The river flows at 2.1 m/s so that the boat's path relative to the riverbed is somewhat diagonal. How long, **in minutes**, does it take the boat to cross the river?
(Note that the downstream component of the boat's velocity has nothing to do with its crossing the river.)

a) 5.95
b) 1.32
c) 2.64
d) 0.66
e) 3.88

14. In the above example, how far is the boat (diagonal distance) from its starting point when it reaches the opposite bank? (Use the crossing time in seconds to calculate the downstream drift, etc. etc.)

a) 750m
b) 166m
c) 768m
d) 584m
f) 1061m

15. A ball is launched from ground level in a direction 30 degrees above the ground. It takes the ball 10 seconds to reach maximum height. What was the ball's initial y-component of velocity?

a) 98 m/s
b) 49 m/s
c) 196 m/s
d) 980 m/s
e) 490 m/s

16. How long does it take the ball in the preceding example to fall back to level ground? (Try **not** to use any equations to get this answer.)

a) 12 s
b) 15 s
c) 20 s
d) 25 s
e) 30 s

17. How far away from the launch point does the ball hit (the "Range")? Be careful with the trig you use to get from v_{oy} to v_{ox}, if you solve for the answer using the results of questions 15 and 16.

a) 3.40 km
b) 3.00 km
c) 2.60 km
d) 2.20 km
e) 1.80 km

18. A ball is launched at 45 degrees above the horizontal. It hits the ground 150 m away after 5.53 seconds. What is the launching **speed** of the ball (not just one component of the velocity). Hint: first work out v_{ox} from the distance and time given. Knowing that, you can calculate the speed directly in one step. An alternative method is to use the range formula, but that's more complicated.

a) 27.1 m/s
b) 54.2 m/s
c) 830 m/s
d) 38.3 m/s
e) 11.2 m/s