DO NOT TURN THIS PAGE!!!!!

Name: KEY

Physics 2A
Fall 2016
Exam 1

<u>MAKE SURE TO SHOW ALL WORK IN COMPLETE DETAIL. NO CREDIT WILL BE GIVEN IF NO WORK IS SHOWN. EXPRESS ALL ANSWERS IN SI UNITS.</u>

1. Briefly answer the following short-answer questions ***<u>without any mathematical definitions</u>***: (2 pts each)

    a) How do you find the displacement graphically?

    The area under graph of V vs.t

    b) List two things that happen to a vector when you multiply it by a scalar?

    1. Changes the length of vector
    2. Changes the direction of vector

    c) What is a reference frame?

    A coordinate system used to describe the motion of an object

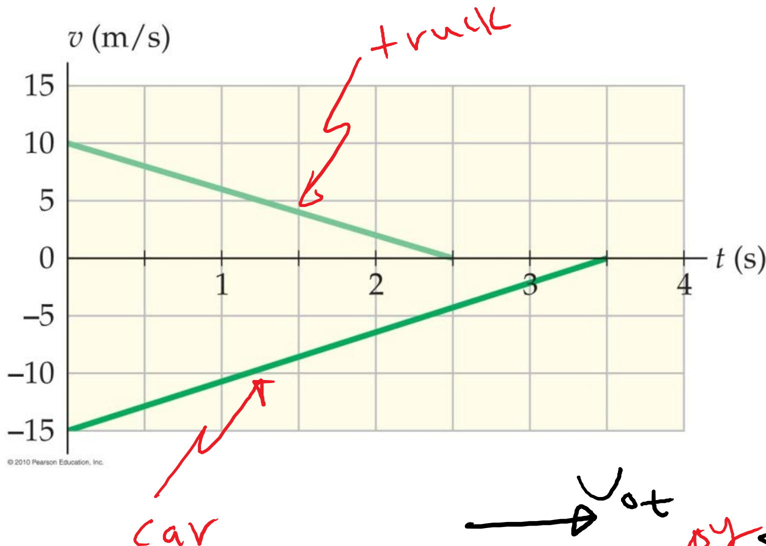
    d) List one factor that influences the value of gravity on surface of earth.

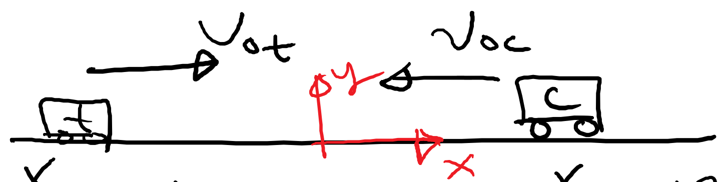
    Altitude, latitude, local earth density

    e) What does acceleration measure?

    A measure of how the velocity of an object changes

2. A car and a truck are heading directly toward one another on a straight and narrow street, but they avoid a head-on collision by simultaneously applying their brakes at t = 0. It is also given that at t = 0 the car is at x = 20 m and the truck is at x = - 40 m. (10 pts)
   a) Explain which graph corresponds to the motion of the car and truck.
   b) Calculate the acceleration of each car.
   c) Using the graph calculate the separation between the cars when they have come to a stop. *<u>DO NOT USE THE AREA UNDER GRAPH TO ANSWER THIS QUESTION</u>*





a) See graph →

$X_{ot} = -40\,m$

$V_{ot} = 10\,\frac{m}{s}$

$X_{oc} = +20\,m$

$V_{oc} = -15\,\frac{m}{s}$

b) $a_c = \text{slope} = \frac{15}{3.5} = \boxed{4.3\,\frac{m}{s^2}}$

$a_t = \frac{-10}{2.5} = \boxed{-4\,\frac{m}{s^2}}$

c)

$x_c = x_{oc} + \left(\frac{v_{oc} + v_c}{2}\right)t = 20 + \left(\frac{-15+0}{2}\right)(3.5) = \boxed{-6.25\,m}$

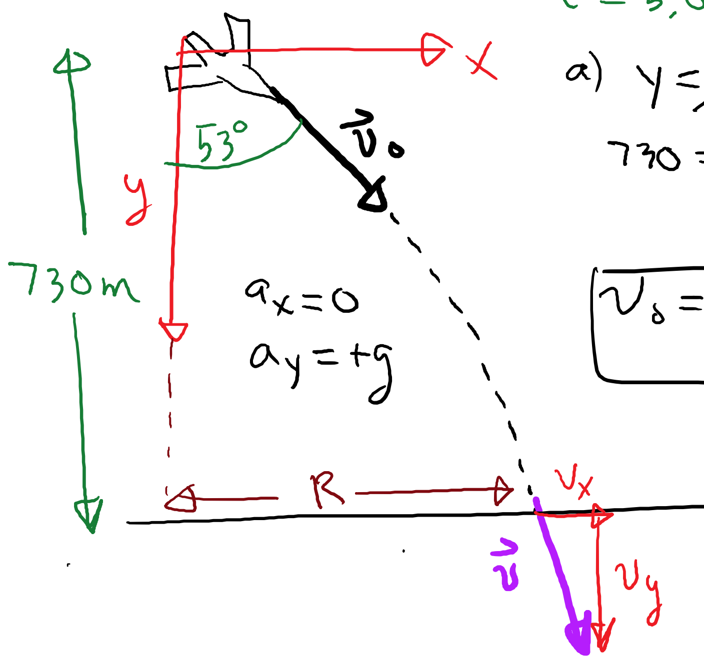
$x_t = -40 + \left(\frac{10+0}{2}\right)2.5 = \boxed{-27.5\,m}$

$\boxed{\Delta x = 21.25\,m}$

3. A plane, diving with constant speed at an angle of 53° with the *__vertical__*, releases a package at an altitude of 730 m. The package strikes the ground 5.0 s after released. (10 pts)

a) Calculate the speed of the plane.
b) Calculate the horizontal distance traveled by the projectile.
c) Calculate the speed of the projectile when it strikes the ground.

$t = 5.0\,s$



a) $y = \cancel{y_0}^{\,0} + v_{0y}t + \frac{1}{2}a_y t^2$

$730 = (v_0 \cos 53)5 + \frac{1}{2}(9.8)(5)^2$

$$\boxed{v_0 = 202\,\frac{m}{s}}$$

b) $x = \cancel{x_0}^{\,0} + v_{0x}t + \cancel{\frac{1}{2}a_x t^2}^{\,0}$

$R = (202 \sin 53)(5)$

$$\boxed{R = 807\,m}$$

c) $v = \sqrt{v_x^2 + v_y^2}$

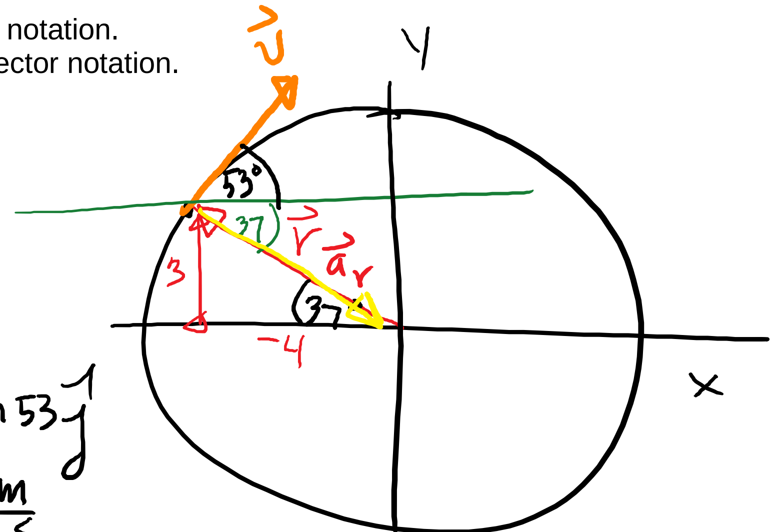
$v_x = v_0 \sin 53 = \boxed{161.3\,\frac{m}{s}}$

$v_y = v_{0y} + a_y t$

$= v_0 \cos 53 + (9.8)(5) = \boxed{171\,\frac{m}{s}}$

$$\boxed{v = 235\,\frac{m}{s}}$$

4. A particle is in uniform circular motion about the origin of an xy coordinate system, moving clockwise with a period of 10.0 s. At one instant, its position vector (measured from the origin) is $\vec{r} = -(4.00m)\hat{\imath} + (3.00m)\hat{\jmath}$. At that instant calculate: (10 pts)
   a) The speed of the particle.
   b) The velocity vector in unit-vector notation.
   c) The acceleration vector in unit-vector notation.



a)

$$v = \frac{2\pi r}{T} = \frac{2\pi(5m)}{(10s)} = \boxed{3.14 \frac{m}{s}}$$

$$r = \sqrt{(-4)^2 + (3)^2} = 5m$$

$$T = 10s$$

b) $\vec{v} = v\cos 53\hat{\imath} + v\sin 53\hat{\jmath}$

$$\boxed{\vec{v} = 1.9\hat{\imath} + 2.5\hat{\jmath}} \frac{m}{s}$$

c) $$a_r = \frac{v^2}{r} = \frac{(3.14)^2}{5} = \boxed{1.97 \frac{m}{s^2}}$$

$$a_r = a_r\cos 37\hat{\imath} - a_r\sin 37\hat{\jmath}$$

$$\boxed{a_r = 1.57\hat{\imath} - 1.19\hat{\jmath}} \frac{m}{s^2}$$