Spring-2018 Phys101
Assignment 3
Please check MateringPhysics for other problems
Due date: 28 Feb. 2018.

Discussion questions

1- A simple pendulum (a mass swinging at the end of a string) swings back and forth in a circular arc. What is the direction of the acceleration of the mass when it is at the ends of the swing? At the midpoint? In each case, explain how you obtain your answer.

2- A projectile is fired upward at an angle θ above the horizontal with an initial speed v_0. At its maximum height, what are its velocity vector, its speed, and its acceleration vector?

3- A stone is thrown into the air at an angle above the horizontal and feels negligible air resistance. Which graph in Fig. 1 best depicts the stone's *speed v* as a function of time *t* while it is in the air?

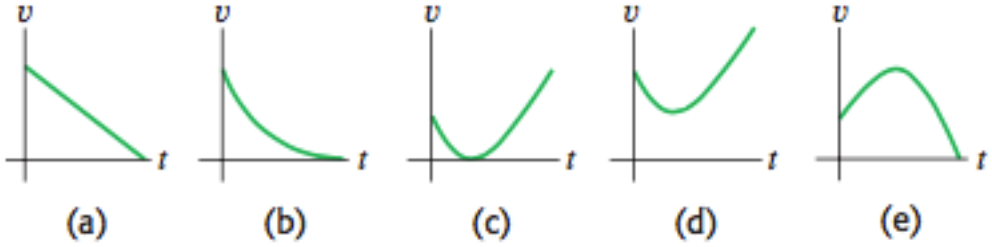

Fig. 1

4- Can an object accelerate if its speed is constant? Can an object accelerate if its velocity is constant?

5- A projectile is fired at an angle of 30° from the horizontal with some initial speed. Firing at what other projectile angle results in the same range if the initial speed is the same in both cases? Neglect air resistance

Problems

6- Ahmed in his car accelerates at the rate of(3.00**i** -2.00**j**) m/s^2, while Ali in his car accelerates at (1.00**i** + 3.00**j**) m/s^2. They both start from rest at the origin of an *xy* coordinate system. After 5.00 s, (a) what is Ahmed's speed with respect to Ali, (b) how far apart are they, and (c) what is Ahmed's acceleration relative to Ali?

7- Figure 2 shows the total acceleration and velocity of a particle moving clockwise in a circle of radius 2.50 m at a given instant of time. At this instant, find (a) the radial acceleration, (b) the speed of the particle, and(c) its tangential acceleration.

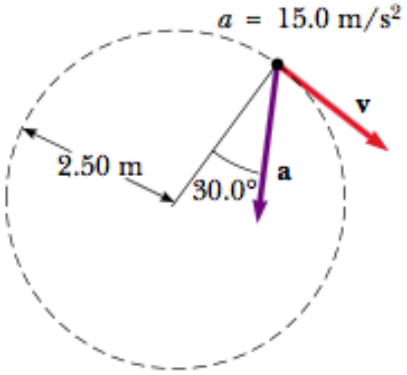

Fig. 2

8- A cannon with a muzzle speed of 1000 m/s is used to start an avalanche on a mountain slope. The target is 2000 m from the cannon horizontally and 800 m above the cannon. At what angle, above the horizontal, should the cannon be fired?

9- At its Ames Research Center, NASA uses its large "20-G" centrifuge to test the effects of very large accelerations ("hypergravity") on test pilots and astronauts. In this device, an arm 8.84 m long rotates about one end in a horizontal plane, and the astronaut is strapped in at the other end. Suppose that he is aligned along the arm with his head at the outermost end. The maximum sustained acceleration to which humans are subjected in this machine is typically 12.5*g*. (a) How fast must the astronaut's head be moving to experience this maximum acceleration? (b) What is the *difference* between the acceleration of his head and feet if the astronaut is 2.00 m tall? (c) How fast in rpm (rev/min) is the arm turning to produce the maximum sustained acceleration?

10- An athlete starts at point *A* and runs at a constantspeed of 6.0 m/s around a circular track 100 m in diameter, as shown in Fig. 3. Find the *x*-and *y*-components of this runner's average velocity and average acceleration between points(a) *A* and *B*, (b) *A* and *C*, (c) *C* and *D*, and (d) *A* and *A* (a full lap). (e) Calculate the magnitude of the runner's average speed between *A* and *B*. Is his average speed equal to the magnitude of his average velocity? Why?

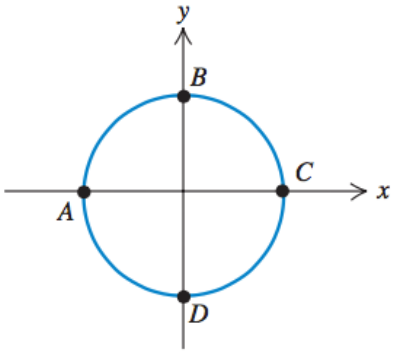

Fig. 3

11- Inside a starship at rest on the earth, a ball rolls off the top of a horizontal table and lands a distance *D* from the foot of the table. This starship now lands on the unexplored Planet X. The commander, Captain Curious, rolls the same ball off the same table with the same initial speed as on earth and finds that it lands a distance 2.76*D* from the foot of the table. What is the acceleration due to gravity on Planet X?