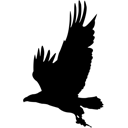
# ECE 105 Quiz 2

## Thursday Tutorial



Vm

250m



40o

Vi=7.5m/s

20o

**Individual (10 marks):** A mouse is walking down a plane, inclined at 20 degrees, with constant speed vm. An eagle is flying overhead at constant velocity vi=7.5 m/s at an angle θ=40 degrees below the horizontal. When the eagle is located 250m from the mouse in a direction perpendicular to the plane, it begins a constant acceleration. The eagle pounces exactly on top of the mouse, 12s later. Assuming the mouse does not change its speed, find the component of the eagle’s final velocity that is directed perpendicular to the plane.

**Thursday Group work:**

1. What is the acceleration of the eagle?
   1. The acceleration is not necessarily equal to g, is not zero, and has a component that is perpendicular to the plane
   2. Gravity is the only force, so it must be g, downward
   3. Gravity is the only force, but the plane is inclined so the acceleration is g in a direction perpendicular to the plane
   4. The eagle is diving at constant velocity so a=0
2. Between the time when the eagle begins its dive, to the instant it reaches the mouse, what is the magnitude (in m) of the component of its displacement in the direction *perpendicular* to the plane?
   1. It depends on the speed of the mouse, vm
   2. 250 sin 20
   3. 250
   4. 250 sin 40
3. Between the time the eagle begins its dive, to the instant it reaches the mouse, what is the magnitude (in m) of the component of its displacement in the direction *parallel* to the plane?
   1. 250 cos 20
   2. 250 cos 40
   3. It depends on the speed of the mouse, vm
   4. 250
4. In what direction is the eagle’s final velocity (at the instant it pounces on the mouse)?
   1. Down and to the left
   2. Straight down
   3. Along the plane
   4. Perpendicular to the plane
5. If we choose a coordinate system oriented perpendicular to (y) and parallel to (x) the plane, which of the following equations is correct? vi and vf represent the initial and final velocity of the eagle, respectively.
   1. 250cos20=tvi,y+1/2ayt2
   2. 250 = tvi,y+1/2ayt2
   3. vf,y2=vi,y2+2(250)ay
   4. b and c are correct.

## Friday Morning Tutorial (8:30)

**Individual (10 marks):** An object moves clockwise in a vertical circle with a radius of 6.00 m. At t=0 the object is at  (vertical, above the centre) with a speed *v*. The speed of the object is 20.0 m/s when the object is 30° along the circle, and 1.00 m/s when the object is opposite its position at t=0. The tangential acceleration is uniform. What is the radial acceleration, and the magnitude of the total acceleration, of the object at t=0?

**Friday Morning Group work:**

1. The total acceleration vector at t=0
   1. Points straight down
   2. Points to the right and down
   3. Points to the left
   4. Points to the left and down
2. The average tangential acceleration between θ=0 and θ=180°
   1. Points to the right
   2. Points down and to the right
   3. Points to the left
   4. Points up and to the right
3. The average total acceleration between θ=0 and θ=180°
   1. Points down and to the right
   2. Points up and to the right
   3. Points to the right
   4. Points to the left
4. The average velocity between θ =0 and θ=180°
   1. Points up
   2. Points to the right
   3. Points to left
   4. Points down
5. The distance covered by the object is
   1. Always less than the magnitude of the displacement
   2. Always larger than the magnitude of the displacement
   3. Equal to the magnitude of the displacement
   4. Not enough info to tell.

## Friday Afternoon Tutorial (1:30)

**Individual (10 marks):** A balloonist throws a ball to another nearby balloonist who is 3m east and 12m below her at the instant she throws the ball. She, the thrower, is moving downward at constant v = -15j m/min while the ‘catcher’ is moving at constant v = 15j m/min. If she throws the ball horizontally, at what speed does the ball need to be thrown to be caught?

**Friday Afternoon Group work:**

1. The acceleration vector of the lower balloon
   1. Points straight down
   2. Points straight up
   3. Points up and to the left due to wind
   4. Is zero
2. Neglecting air resistance, the acceleration of the ball when thrown
   1. Is zero
   2. Points down and to the right
   3. Points straight down
   4. Points up and to the right
3. The speed of the ball while in motion from one balloon to the other
   1. Decreases with increasing time
   2. Remains constant
   3. The answer depends on when the ball is caught
   4. Increases with increasing time
4. The vertical distance through which the ball travels after it leaves the first balloon
   1. Decreases linearly with time
   2. Decreases quadratically with time
   3. Increases linearly with time
   4. Increases quadratically with time
5. The horizontal distance covered by the ball after it leaves the first balloon
   1. Increases quadratically with time
   2. Increases linearly with time
   3. Decreases linearly with time
   4. Decreases quadratically with time

# Solutions to individual parts

## Thursday Quiz 2

x

y

200

Choose a coordinate system oriented parallel to and perpendicular to the inclined plane:

This is convenient because the answer we want is the final y-component of the velocity, and we know Δsy=250m and t=12s, if we choose the initial time to be when the Eagle starts its dive and the final time to be when it hits the mouse.

Then we just need to find the initial y-component of the velocity, which is vi,y=7.5cos(300). Using our kinematic equations:

so ay=2/122[250-6.5(12)]=2.39 m/s2. Then using

gives **vf,y=35.2m/s**

## Friday Morning Quiz 2

Then the velocity at t=0 is

The radial acceleration is

The total acceleration is

## Friday Afternoon Quiz 2

Relative to the catcher’s balloon yt = 12 -15t/60 ; ybot = 12 - 15t/60 – 4.9t2 ; yc = 15t/60 to catch ball ybot = yc so that 12 – 15t/60 – 4.9t2 = 15t/60 or 4.9t2 + 30t/60 – 12 = 0 ⇒ t =( -0.5+/- root[(0.52+4(12x4.9)])/9.8 = 2.757 s or t = 1.51 s so that vx = 3/1.51 = 1.98 m/s or equivalently 118.8 m/min