Name: ______________________________ DISC: ____________ Score: _____ / 20

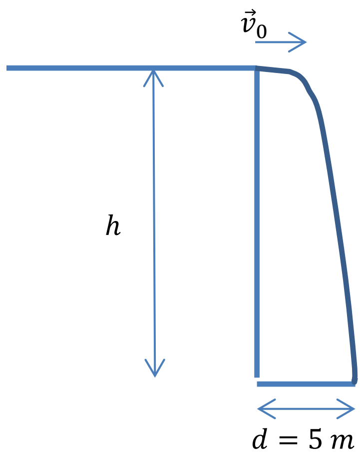
Instructions:
- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers

Q1	Q2	Q3	Q4
10	10	5	5

1. You throw a ball horizontally from off of a cliff. The ball has an initial velocity of 2 m/s and travels $d = 5\ m$. Let the x-direction be horizontal and the y-direction be vertical.

   a. Draw a picture of the path you expect the ball to take to the ground. *Include the coordinate system*.

Picture:



(Lecture 6, pp. 15-16)

   b. Now let's work on the motion of the ball.

Acceleration:
Direction:
v_x
v_y:

   i. What is the acceleration of the ball? $g = 9.81\ m/s^2$
   ii. What is the direction of the acceleration? Downward
   iii. What is the x-component of the ball's initial velocity (v_{0x})? $2\ m/s$
   iv. What is the y-component of the ball's initial velocity (v_{0y})? $0\ m/s$

   c. Now we want to find the distance h. Select the equations you could use to calculate h (select all correct equations).

Choice (2 pts):

   i. $x(t) = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$
   ii. $y(t) = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$
   iii. $v_x^2 = v_{0x}^2 + 2\,a_x\,\Delta x$
   iv. $v_y^2 = v_{0y}^2 + 2\,a_y \Delta y$

   d. Use your chosen equations to solve for h (the height of the cliff).

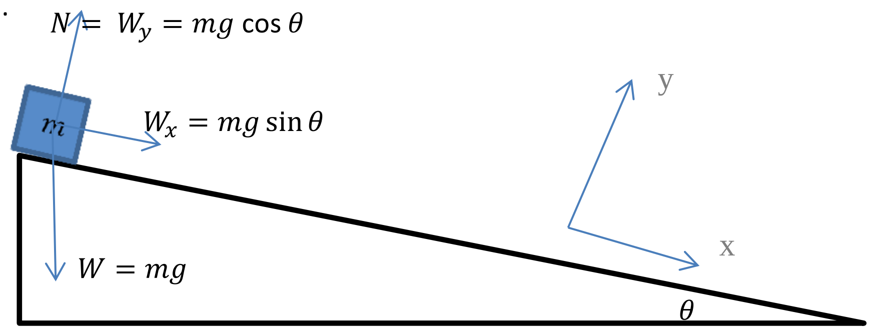
Solution (3 pts):

We know that $x_0 = 0, x(t) = d = 5\ m$, $v_{0x} = v_0 = 2\ m/s$, and $a_x = 0\ m/s^2$. Substituting: $5\ m = 2\frac{m}{s}t$, so $t = \frac{5}{2}s = 2.5\ s$. Now we can use this time to find h using the second chosen equation: $0 - h = -\frac{1}{2}\left(9.81\frac{m}{s^2}\right)(2.5\ s)^2 = 30.7\ m$

2. A block of mass m slides down a *frictionless* plane $5\ m$ long. The angle between the ramp and the floor is $\theta = 15^o$. **(Week 4 Discussion 4-4;)**

   a. Select a coordinate system and complete the free-body diagram. *Include your coordinate system on the diagram.*

Diagram (2pts):



   b. Let's consider the acceleration of the block:

Mass Dependence:
a_x:
a_y:

      i. Does the acceleration depend on the mass, m? No, the plank is frictionless, so there is no opposing frictional force (proportional to the normal force)

      ii. What is the x-component of the block's acceleration, a_x? Note: accept the properly "non-rotated" coordinate system answer as well:

$$\boxed{a_x = g\sin\theta}$$

$$a_x = (g\sin\theta)\cos(\theta) = 2\,g\sin(2\theta)$$

      iii. What is the y-component of the block's acceleration, a_y?

$$\boxed{a_y = 0}$$

$$a_y = -(g\sin\theta)\sin(\theta) = \frac{g(\cos(2\theta) - 1)}{2}$$

   c. The block starts at rest at the top of the ramp ($\vec{v}_0 = 0\ m/s$):

Equation Selection (2 pts):

      i. Write down the equation you would use to find the speed at the bottom of the ramp:

$$v_x^2 = v_{0x}^2 + 2\,a_x\,\Delta x$$

Speed (3 pts):

      ii. Find the speed of the block at the bottom of the ramp.

We know that $v_{0x} = 0\frac{m}{s}$, and $a_x = g\sin\theta$ and $\Delta x = 5\ m$ so we can substitute: $v_x^2 = 2\left(9.81\frac{m}{s^2}\right)(\sin 15^{\circ})(5\ m) = 25.4\frac{m^2}{s^2}$. Taking the square root we get: $v_x = 5.04\frac{m}{s}$.