What are the components of your name Key

AP Physics C: Unit FRQs

FRQ Horizontal Motion

1. A person tossed a box horizontally off a cliff, with a velocity of 4V, that has a height 2H. if we ignore air resistance, *(write all answers in terms of V, H, g and any other terms needed)*
   a. How much time will it take to strike the floor?

$X = X_0 + V_0 t + \frac{1}{2} a t^2$

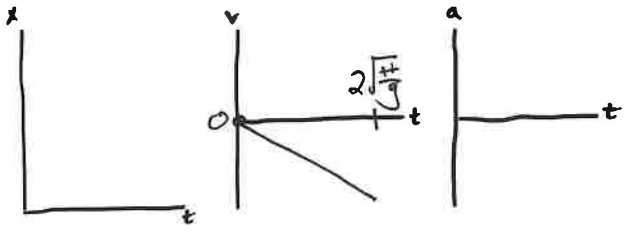
$t = 2\sqrt{\frac{H}{g}}$

   b. How far horizontally does the box travel before it hits the ground?

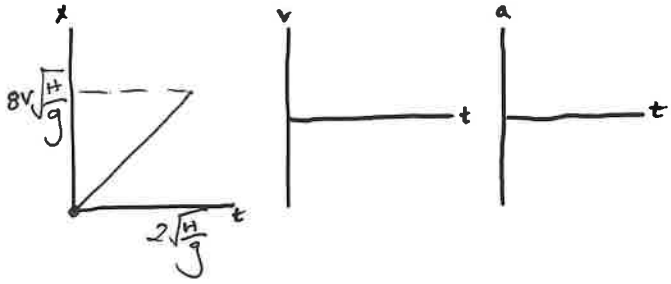
$d = 8V\sqrt{\frac{H}{g}}$

   c. Sketch the graphs for the vertical and horizontal components of the object being thrown. (label the x and y axis with any values you might know)

Vertical



Horizontal



   d. Another box was thrown horizontally off the same cliff that landed a distance of $6\sqrt{\frac{H}{g}}$ meters from the base of the cliff. Calculate the velocity this box was tossed.

$V = 3\ m/s$

   a. If there was a strong wind in the same direction of the box's horizontal velocity, what would that do to the horizontal distance the box travels?

_____ the box would fly a shorter distance _____ the box would fly a farther distance

_____ the box would fly the same distance

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FRQ Projectile Motion

A marble launcher is being used to test results from calculated results done in class. Below a student launched a marble at an angle θ with some initial velocity, the marble went a distance R horizontally. The maximum height the ball reached was Y. *(write all answers in terms of θ, g, Y, R and any other terms needed)*

a. Calculate the initial velocity of the marble with the given terms.

$$V_0 = \frac{\sqrt{2gY}}{\sin(\theta)}$$

b. The students then launched at a 30-degree angle and put a meter stick behind the launch to see how high the marble went. To the right are the recorded results.

Using their average height, calculate the initial velocity the marble was launched.

Trial	Height
1	0.70 meters
2	0.83 meters
3	0.65 meters

avg = .727m

ans: 7.55 m/s

c. Using this information, calculate the average time the marble was in the air.

$x = x_0 + V_0 t + \frac{1}{2} a t^2$

t = .77sec

d. The students also put a meter stick along the floor to measure the range of the marble. To the right are their results. Does this information correlate with the average range they can calculate?

Trial	Range
1	2.44 meters
2	3.22 meters
3	2.71 meters

avg = 2.79m

Calculated Range = 5.03m

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PVA FRQ

$a_A = 2t - 5$ $a_B = 2t + 3$

Spacecrafts A and B are flying parallel to each other through space and are next to each other at time $t = 0$. For the interval $0 < t < 6$ s, spacecraft A's velocity v_A and spacecraft B's velocity v_B as functions of t are given by the equations $v_A(t) = t^2 - 5t + 20$ and $v_B(t) = t^2 + 3t + 10$, respectively, where both velocities are in units of meters per second. At $t = 6$ s, the spacecrafts both turn off their engines and travel at a constant speed.

(a) At $t = 0$, is the speed of spacecraft A greater than, less than, or equal to the speed of spacecraft B?

_____ Greater than _____ Less than _____ Equal to

Justify your answer.

$v_A(0) = 20$

$v_B(0) = 10$

(b) Each spacecraft has thrusters for speeding up and reverse thrusters for slowing down. At $t = 0$, one of the spacecrafts is slowing down and one is speeding up.

i. Which spacecraft is slowing down?

_____ Spacecraft A _____ Spacecraft B _____ Both spacecrafts _____ Neither spacecraft

Justify your answer.

$v_A(0) = 20$ $a_A(0) = -5$

$v_B(0) = 10$ $a_B(0) = 3$

ii. Calculate the time interval during which the spacecraft selected in part (b) (i) is slowing down.

When does acceleration begin to be positive? Graph $v_A(t)$ and $a_A(t)$ and see when they're the same sign.

(c) Calculate the value of t at which the two spacecrafts are traveling at the same speed.

$v_A(t) = v_B(t)$

(d) Is the acceleration of spacecraft A increasing, decreasing, or constant?

_____ Increasing _____ Decreasing _____ Constant

Justify your answer.

It's asking if acceleration is inc. so think about the function $a_A(t) = 2t - 5$

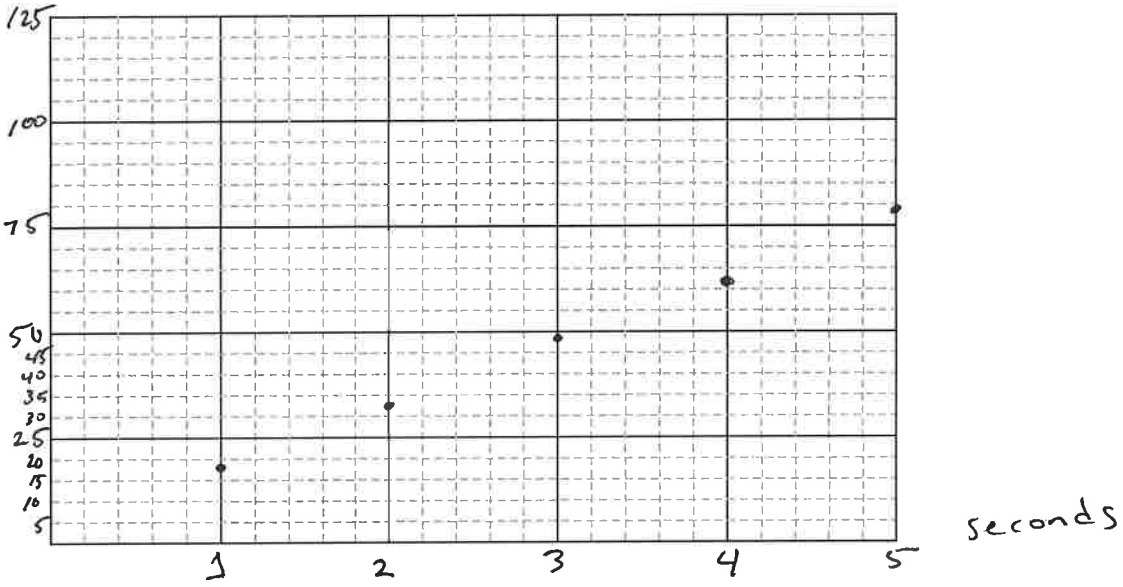
Continue on back

What are the components of your name_____

(e) The following data are collected on the position of spacecraft A and spacecraft B. Both spacecrafts are at position $x = 0$ at $t = 0$.

t (s)	Position x_A (m) of Spacecraft A	Position x_B (m) of Spacecraft B
1	18	12
2	33	29
3	47	53
4	61	85
5	79	129

i. Plot the data points for the positions of the two spacecrafts on the graph below. Clearly scale and label all axes including units, if appropriate. Draw a solid line that best represents the trend for the data of spacecraft A and a dashed line that best represents the trend for the data of spacecraft B.



ii. At the point where the two graphs cross, is the speed of spacecraft A greater than, less than, or equal to the speed of spacecraft B?

_____ Greater than _____ Less than _____ Equal to

Justify your answer.

Think about the slopes of the lines at the time it crosses.