

Instructions: You have a total of 50 minutes to complete this test.

Answer each question completely showing complete details.

For complete credit you must include correct SI units with numerical answers.

Time Start _____ Time finish _____ pledged _____

Constants: $g = 9.8 \frac{\text{m}}{\text{s}^2}$

(1) A particle is observed to move with a constant acceleration given by:

$$\vec{a} = 0\hat{x} - ct^2\hat{y}$$

where the constant c has SI units of $[c] = \left[\frac{\text{m}}{\text{s}^4} \right]$.

(a) Find the velocity **vector** at a later time assuming that at $t=0$ the initial velocity vector is zero.

(b) Find the position **vector** at a later time assuming that at $t=0$, the velocity and position vectors are both zero.

Suppose another particle is seen to have a position vector given by:

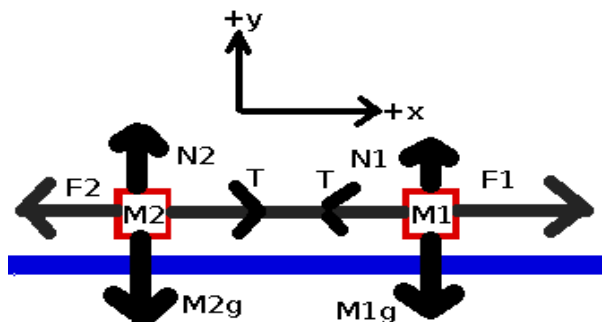
$$\vec{R}(t) = (v_{0,x}t)\hat{x} + (v_{0,y}t - kt^3)\hat{y}$$

The constant k has SI units of $[k] = \left[\frac{\text{m}}{\text{s}^3} \right]$.

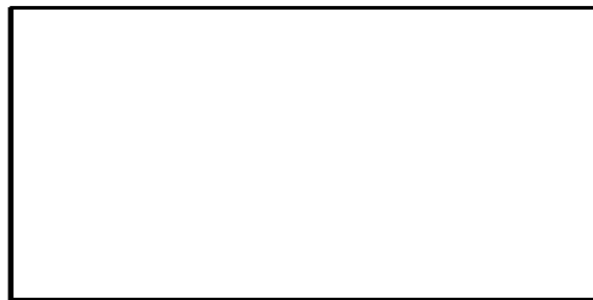
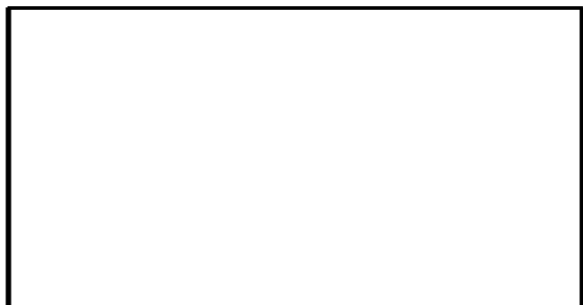
(c) Find the velocity **vector** at a later time.

(d) Find the acceleration **vector** at some later time.

(2) Two masses resting on a frictionless table are connected by a string and forces are applied as shown. You may assume $F_1 > F_2$ here.



(a) In the boxes below, draw complete and correct free body diagrams for this system.



(b) Provide the 4 equations that come from Newton's Laws for this system.

(c) Find the acceleration of the system in terms of M_1 , M_2 , F_1 and F_2 .

(d) Find the tension in the string in terms of M_1 , M_2 , F_1 and F_2 .

(e) If $M_1=1\text{kg}$, $M_2=2\text{kg}$, $F_1=5\text{N}$, $F_2=3\text{N}$, then provide numerical answers for a and T together with correct SI units.

$a =$ _____

$T =$ _____

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(3) A ball is thrown upward at an angle of 70° with respect to the horizontal direction with an initial velocity of 20 m/s. Answer the following questions, **providing correct SI units**.

- (a)** How long is the ball in the air?
- (b)** What is the maximum height to which the ball rises?
- (c)** What is the impact velocity **vector** of the ball?
- (d)** What is the range of the ball?

(4) Consider the following vectors:

$$\vec{A} = 3\hat{x} - 1\hat{y} : \vec{B} = -3\hat{x} + 4\hat{y} : \vec{C} = 5\hat{x} - 6\hat{y}$$

(a) $\vec{A} + \vec{B} + \vec{C} =$ _____

(b) $\vec{A} \cdot \vec{B} =$ _____

(c) $|\vec{A} + \vec{B}| =$ _____

(d) $(\vec{A} + \vec{B}) \cdot \hat{x} =$ _____