

**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 \_\_\_\_\_

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

**[1]** A particle is observed to move with an acceleration given by:

$$\vec{a} = b\hat{x} + 0\hat{y}$$

where the constant  $b$  has SI units of  $[b] = \left[\frac{\text{m}}{\text{s}^2}\right]$ .

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

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

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

$$\vec{R}(t) = (-bt)\hat{x} + (ft^2)\hat{y},$$

Where the constants  $c, e, f,$  and  $h$  have SI units of  $[b] = \left[\frac{\text{m}}{\text{s}}\right], [f] = \left[\frac{\text{m}}{\text{s}^2}\right]$ .

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

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

**[2]** A ball is thrown upward at an angle of  $55^\circ$  with respect to the horizontal direction with an initial velocity of 5 m/s. Answer the following questions, **providing correct SI units**.

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

**[3]** Consider the following vectors:

$$\vec{A}=9\hat{x}+2\hat{y}; \vec{B}=-5\hat{x}+3\hat{y}; \vec{C}=5\hat{x}-3\hat{y}$$

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

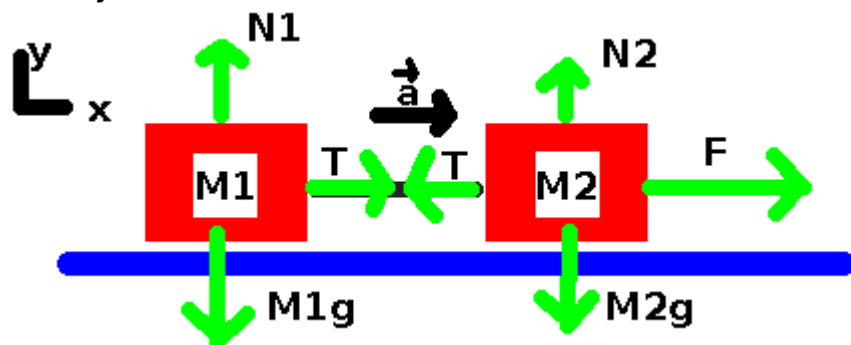
(b)  $\vec{A} \cdot \vec{B} =$  \_\_\_\_\_

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

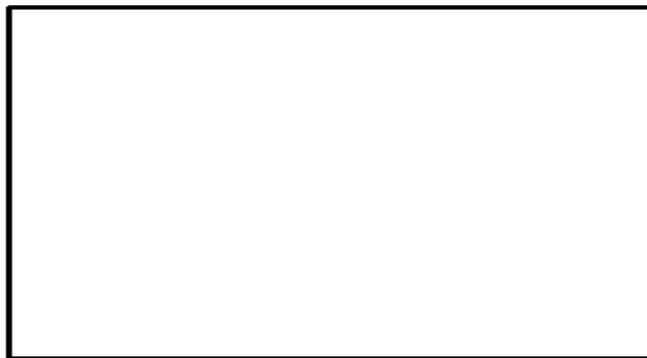
(d)  $(\vec{A} + \vec{C}) \cdot \hat{y} =$  \_\_\_\_\_

(e) The angle that vector A makes with respect to the positive x-axis.  $\theta =$  \_\_\_\_\_

**[4]** 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  $M_1$ ,  $M_2$ , and  $F$ .

**(d)** Find the tension in the string in terms of  $M_1$ ,  $M_2$ , and  $F$ .

**(e)** If  $M_1=2\text{kg}$ ,  $M_2=10\text{kg}$ ,  $F=15\text{N}$ , then provide numerical answers for  $a$  and  $T$  together with correct SI units.

$a =$  \_\_\_\_\_

$T =$  \_\_\_\_\_