

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 ball is thrown upward at an angle of 40° with respect to the horizontal direction with an initial velocity of 15 m/s. Answer the following questions, **providing correct SI units**.

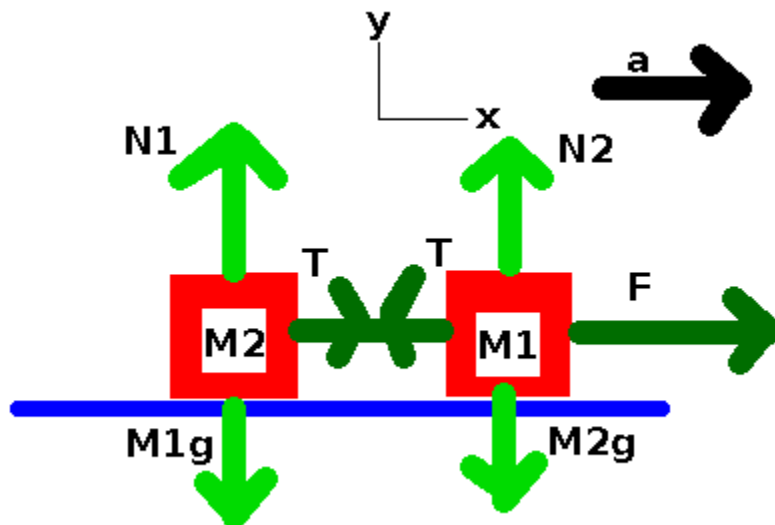
(a) How long is the ball in the air?

(b) What is the maximum height to which the ball rises?

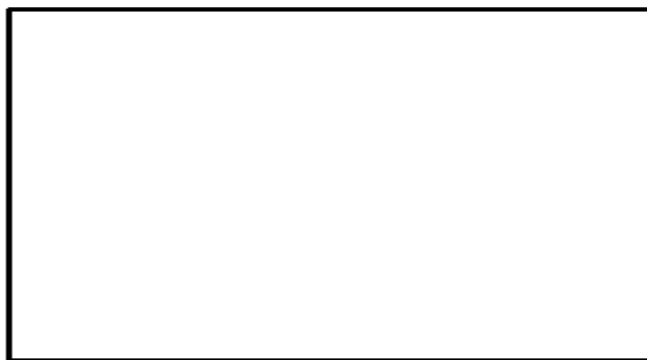
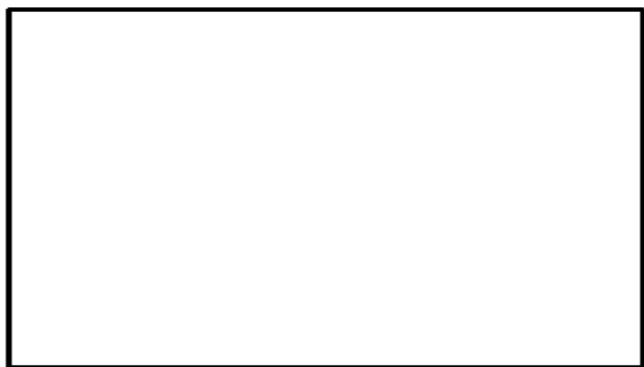
(c) What is the impact **velocity vector** of the ball?

(d) What is the range of the ball?

(2) Two masses resting on a frictionless table are connected by a string and forces are applied as shown.



(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 , F .

(e) If $M_1=1\text{kg}$, $M_2=2\text{kg}$, $F=12\text{N}$ then provide numerical answers for a and T together with correct SI units.

$a =$ _____

$T =$ _____

(3) Consider the following vectors:

$$\vec{A} = 1\hat{x} + 2\hat{y} : \vec{B} = -3\hat{x} + 4\hat{y} : \vec{C} = 5\hat{x} - 3\hat{y}$$

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

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

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

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

(4) A particle is observed to move with an acceleration given by:

$$\vec{a} = 0\hat{x} - \frac{1}{2}ht^2\hat{y}$$

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

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

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

Suppose another particle (named particle 2) has a position vector given by:
 $\vec{R} = \vec{R}_0 + (5t)\hat{x} - (20t^5)\hat{y}$, with the units of R being m .

(c) Find the **velocity vector** at some later time, t .

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