Newton's Laws of motion

Phys109

November 1, 2019

1. If a net horizontal force of 132 N is applied to a person with a mass of 60 kg who is resting on the edge of a swimming pool, what horizontal and vertical acceleration is produced? ($a_x = 2.2 m/s^2$, $a_y = 0$)

2. A box rests on a frozen pond, which serves as a frictionless horizontal surface. A fisherman applies a horizontal force with a magnitude of 48.0 N at an angle of 30° to the horizontal produces an acceleration of 3.00 $m/s2$, what is the mass of the box? (13.9 kg)

3. A particle with the mass 2kg gains an acceleration of $\vec{a} = (1.5\hat{i} + 2\hat{j})$ m/s^2 with the effect of the net force acting on it. What is the magnitude of the net force acting on the particle? (5 N)

4. An object of mass $m_1 = 55$ kg placed on a frictionless, horizontal table is connected to a string that passes over a pulley and then is fastened to a hanging object of mass $m_2 = 59$ kg as shown in Figure below.

   (a) Draw free-body diagrams of both objects.

   (b) Find the magnitude of the acceleration of the objects.(5.08 m/s^2)

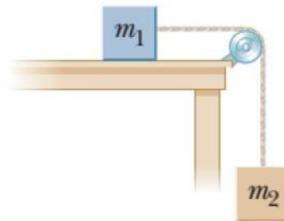   (c) Find the tension in the string.(279.4 N)

Figure 1: Problem no.4

5. A woman at an airport is pulling her 20kg suitcase at constant speed by pulling on a strap at an angle above the horizontal. She pulls on the strap with a 35N force, and the friction force on the suitcase is 20N.

(a) Draw a free body diagram of the suitcase.

(b) What angle does the strap make with the horizontal? $(55.15°)$

(c) What is the magnitude of the normal force that the ground exerts on the suitcase? (167.48 N)

Figure 2: Problem no.5

6. A certain orthodontist uses a wire brace to align a patient's crooked tooth. The tension in the wire is adjusted to have a magnitude of 18.0 N. Find the magnitude of the net force exerted by the wire on the crooked tooth. (8.7 N)
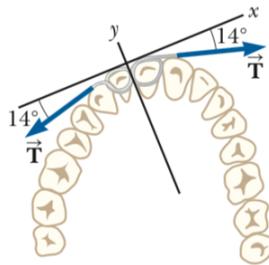

Figure 3: Problem no.6

7. A force $\overrightarrow{F}$ applied to an object of mass m_1 produces an acceleration of $3.00 \ m/s^2$. The same force applied to a second object of mass m_2 produces an acceleration of $1.00 \ m/s^2$. find its

(a) What is the value of the ratio m_1/m_2? (1/3)

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(b) If m_1 and m_2 are combined into one object, find its acceleration under the action of the force $\vec{F}$.
(0.75 m/s²)

8. Two blocks connected by a rope of negligible mass are being dragged by a horizontal force. Suppose $F = 68.0$N, $m_1 = 12$ kg, $m_2 = 18.0$ kg, and the friction force between block 1, and 2 and the surface is 11.8 N, 17.6 N respectively.

(a) Draw a free-body diagram for each block.

(b) Determine the acceleration of the system. (1.29 m/s²)

(c) Find the tension T in the rope.(27.08 N)
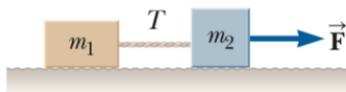

Figure 4: Problem no.8

9. Three forces, given by $\vec{F_1} = (-2\hat{i} + 2\hat{j})$N, $\vec{F_2} = 5\hat{i} - 3\hat{j}$N, and $\vec{F_3} = (-45\hat{i})$N act on an object to give it an acceleration of magnitude 3.75 m/s².

(a) Find the net force exerted on the object. ($\vec{F}_{net} = -42\hat{i} - \hat{j}$N)

(b) Determine the magnitude of the net force. (42.02N)

(c) Determine the mass of the object. (11.2 kg)

(d) Is the vector acceleration positive or negative? Why? (Negative, $\vec{F} < 0, m > 0$ so $\vec{a}$ has to be negative.)

(e) If the object is initially at rest, what is its speed after 10 s? (37.5 m/s)

10. A 3 kg is moving in a plane, with its X and Y coordinates given by $x(t) = 5t^2 - 1$ and $y(t) = 3t^3 + 2$, where x(t) and y(t) are in meters and t is in seconds. Find the magnitude of the net force acting on this object at $t = 2$s. ($F = 112$N)