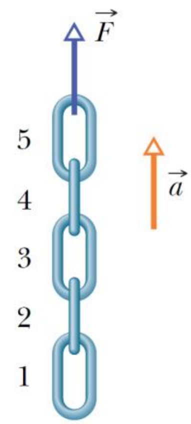
ENG1004 Engineering Physics

Dynamics additional questions

Question 1

A chain consisting of five links, each of mass 0.100 kg, is lifted vertically with constant acceleration of magnitude a = 2.50 m/s^2. Find the magnitudes of (a) the force on link 1 from link 2, (b) the force on link 2 from link 3, (c) the force on link 3 from link 4, and (d) the force on link 4 from link 5. Then find the magnitudes of (e) the force on the top link from the person lifting the chain and (f) the net force accelerating each link.



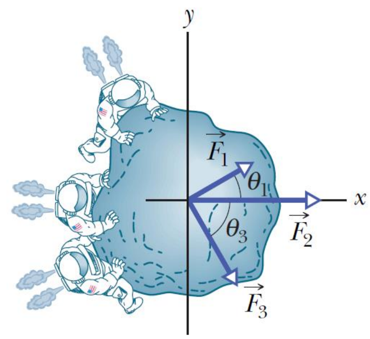
Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answers

(a) 1.23 N; (b) 2.46 N; (c) 3.69 N; (d) 4.92 N; (e) 6.15 N; (f) 0.250 N

Question 2

Three astronauts, propelled by jet backpacks, push and guide a 120 kg asteroid toward a processing dock, exerting the forces shown in the figure, with F_1 = 32 N, F_2 = 55 N, F_3 = 41 N, θ_1 = 30°, and θ_3 = 60°. What is the asteroid's acceleration (a) in unit-vector notation and as (b) a magnitude and (c) a direction relative to the positive direction of the x axis?



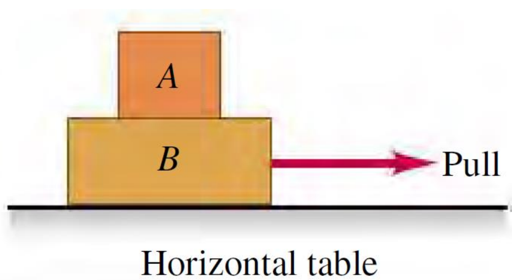
Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answers

(a) $(0.86\ m/s^2)\mathbf{i} - (0.16\ m/s^2)\mathbf{j}$;   (b) $0.88\ m/s^2$;   (c) -11º

Question 3

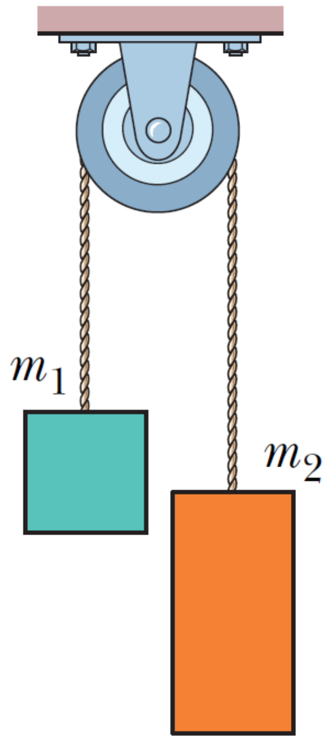
You pull horizontally on block B in the figure, causing both blocks to move together as a unit. For this moving system, make a carefully labeled free-body diagram of block A if (a) the table is frictionless and (b) there is friction between block B and the table and the pull is equal in magnitude to the friction force on block B due to the table.



Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Question 4

Two blocks connected by a cord (of negligible mass) that passes over a frictionless pulley (also of negligible mass). The arrangement is known as Atwood's machine. One block has mass m_1 = 1.30 kg; the other has mass m_2 = 2.80 kg. What are (a) the magnitude of the blocks' acceleration and (b) the tension in the cord?

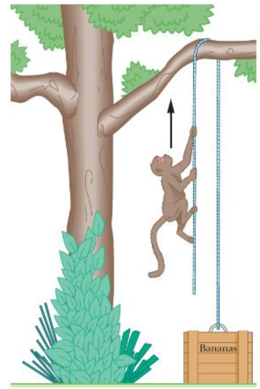


Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answer

(a) 3.6 m/s^2;   (b) 17 N

Question 5



A 10 kg monkey climbs up a massless rope that runs over a frictionless tree limb and back down to a 15 kg package on the ground. (a) What is the magnitude of the least acceleration the monkey must have if it is to lift the package off the ground? If, after the package has been lifted, the monkey stops its climb and holds onto the rope, what are the (b) magnitude and (c) direction of the monkey's acceleration and (d) the tension in the rope?

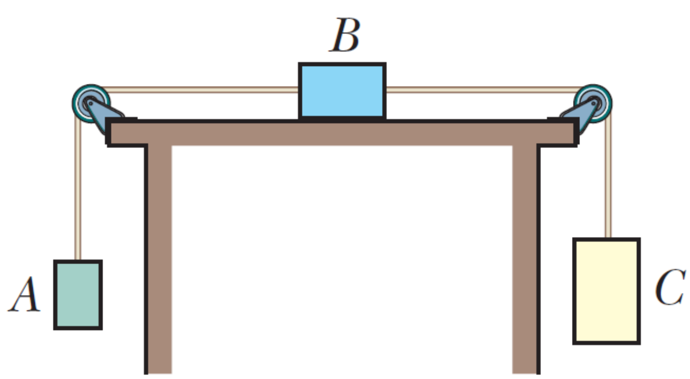
Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answer

(a) 4.9 m/s^2; (b) 2.0 m/s^2; (c) Upwards; (d) 120 N

Question 6

Three blocks are connected by cords that loop over frictionless pulleys. Block B lies on a frictionless table; the masses are m_A = 6.00 kg, m_B = 8.00 kg, and m_C = 10.0 kg. When the blocks are released, what is the tension in the cord at the right connecting B and C?



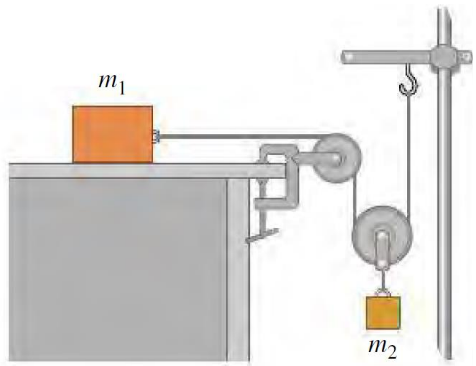
Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answer

82 N

Question 7 *

In terms of m_1, m_2, and g, find the acceleration of each block in the figure. There is no friction anywhere in the system.



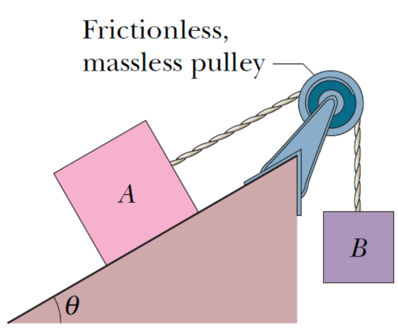
Adapted from Young and Freedman, "University Physics with Modern Physics", 14th Edition, Pearson, 2015.

Answer

$$a_1 = \frac{2m_2 g}{4m_1 + m_2};\ a_2 = \frac{m_2 g}{4m_1 + m_2}$$

Question 8

Body A weighs 102 N, and body B weighs 32 N. The coefficients of friction between A and the incline are $\mu_s = 0.56$ and $\mu_k = 0.25$. The angle θ is 40°. Let the positive direction of an x axis be up the incline. In unit-vector notation, what is the acceleration of A if A is initially (a) at rest, (b) moving up the incline, and (c) moving down the incline?



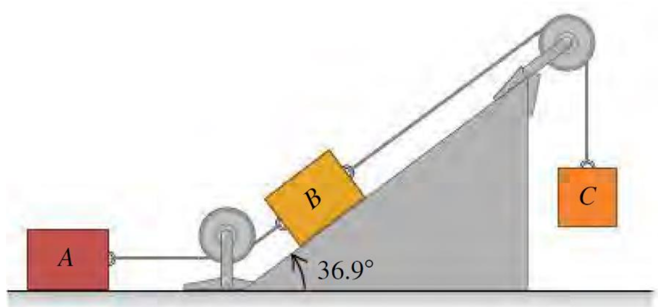
Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answers

(a) 0 m/s; (b) (-3.9 m/s^2) **i**; (c) (-1.0 m/s^2) **i**;

Question 9

Blocks A, B, and C are connected by ropes of negligible mass. Both A and B weigh 25.0 N each, and the coefficient of kinetic friction between each block and the surface is 0.35. Block C descends with constant velocity. (a) Draw separate free-body diagrams showing the forces acting on A and on B. (b) Find the tension in the rope connecting blocks A and B. (c) What is the weight of block C? (d) If the rope connecting A and B were cut, what would be the acceleration of C?



Adapted from Young and Freedman, "University Physics with Modern Physics", 14th Edition, Pearson, 2015.

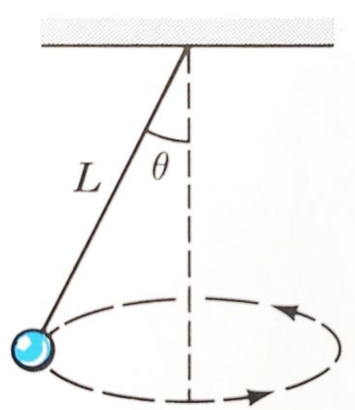
Answer

(b) 8.8 N; (c) 31.0N; (d) 1.54 m/s^2

Question 10 *

In a conical pendulum a bob moves in a horizontal circle. Show that the period is:

$$T = 2\pi\sqrt{\frac{L\cos\theta}{g}}$$



Adapted from Benson, "University Physics", Revised Edition, John Wiley & Sons, inc., 1996.