

RECOMMENDED PROBLEMS

CHAPTER 5



@GENERALPHYSICSA

Physics A - Serway

إعداد

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معيدي قسم الفيزياء في الجامعة الإسلامية

15. Two forces, $\vec{F}_1 = (-6.00\hat{i} - 4.00\hat{j}) \text{ N}$ and $\vec{F}_2 = (-3.00\hat{i} + 7.00\hat{j}) \text{ N}$, act on a particle of mass 2.00 kg that is initially at rest at coordinates $(-2.00 \text{ m}, +4.00 \text{ m})$. (a) What are the components of the particle's velocity at $t = 10.0 \text{ s}$? (b) In what direction is the particle moving at $t = 10.0 \text{ s}$? (c) What displacement does the particle undergo during the first 10.0 s? (d) What are the coordinates of the particle at $t = 10.0 \text{ s}$?

21. A 15.0-lb block rests on the floor. (a) What force does the floor exert on the block? (b) A rope is tied to the block and is run vertically over a pulley. The other end is attached to a free-hanging 10.0-lb object. What now is the force exerted by the floor on the 15.0-lb block? (c) If the 10.0-lb object in part (b) is replaced with a 20.0-lb object, what is the force exerted by the floor on the 15.0-lb block?

- 23.** A 1 000-kg car is pulling a 300-kg trailer. Together, the car and trailer move forward with an acceleration of 2.15 m/s^2 . Ignore any force of air drag on the car and all friction forces on the trailer. Determine (a) the net force on the car, (b) the net force on the trailer, (c) the force exerted by the trailer on the car, and (d) the resultant force exerted by the car on the road.

28. The systems shown in Figure P5.28 are in equilibrium.

W If the spring scales are calibrated in newtons, what do they read? Ignore the masses of the pulleys and strings and assume the pulleys and the incline in Figure P5.28d are frictionless.

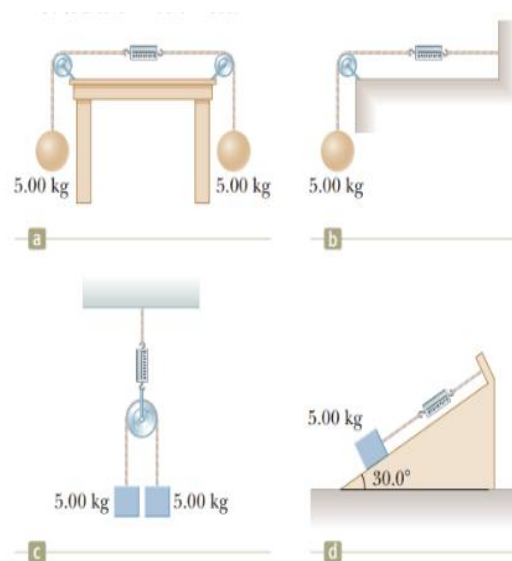


Figure P5.28

- 29.** Assume the three blocks portrayed in Figure P5.29 move on a frictionless surface and a 42-N force acts as shown on the 3.0-kg block. Determine (a) the acceleration given this system, (b) the tension in the cord connecting the 3.0-kg and the 1.0-kg blocks, and (c) the force exerted by the 1.0-kg block on the 2.0-kg block.



Figure P5.29

- 31.** The distance between two telephone poles is 50.0 m. When a 1.00-kg bird lands on the telephone wire midway between the poles, the wire sags 0.200 m. (a) Draw a free-body diagram of the bird. (b) How much tension does the bird produce in the wire? Ignore the weight of the wire.

- 33.** A bag of cement weighing 325 N hangs in equilibrium from three wires as suggested in Figure P5.33. Two of the wires make angles $\theta_1 = 60.0^\circ$ and $\theta_2 = 40.0^\circ$ with the horizontal. Assuming the system is in equilibrium, find the tensions T_1 , T_2 , and T_3 in the wires.

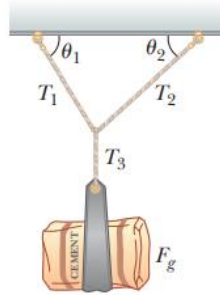


Figure P5.33
Problems 33 and 34.

- 40.** An object of mass $m_1 = 5.00$ 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 $m_2 = 9.00$ kg as shown in Figure P5.40. (a) Draw free-body diagrams of both objects. Find (b) the magnitude of the acceleration of the objects and (c) the tension in the string.

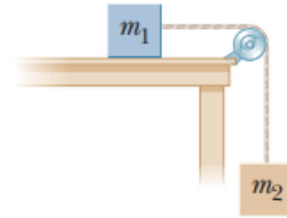


Figure P5.40
Problems 40, 63,
and 87.

42. Two objects are connected by a light string that passes over a frictionless pulley as shown in Figure P5.42. Assume the incline is frictionless and take $m_1 = 2.00 \text{ kg}$, $m_2 = 6.00 \text{ kg}$, and $\theta = 55.0^\circ$. (a) Draw free-body diagrams of both objects. Find (b) the magnitude of the acceleration of the objects, (c) the tension in the string, and (d) the speed of each object 2.00 s after it is released from rest.

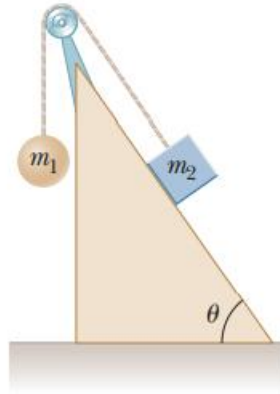


Figure P5.42

43. Two blocks, each of mass $m = 3.50 \text{ kg}$, are hung from the ceiling of an elevator as in Figure P5.43. (a) If the elevator moves with an upward acceleration $\vec{a}$ of magnitude 1.60 m/s^2 , find the tensions T_1 and T_2 in the upper and lower strings. (b) If the strings can withstand a maximum tension of 85.0 N , what maximum acceleration can the elevator have before a string breaks?

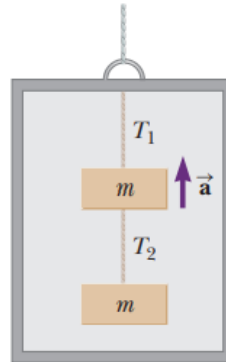


Figure P5.43
Problems 43 and 44.

44. Two blocks, each of mass m , are hung from the ceiling of an elevator as in Figure P5.43. The elevator has an upward acceleration a . The strings have negligible mass. (a) Find the tensions T_1 and T_2 in the upper and lower strings in terms of m , a , and g . (b) Compare the two tensions and determine which string would break first if a is made sufficiently large. (c) What are the tensions if the cable supporting the elevator breaks?

Figure P5.43
Problems 43 and 44.

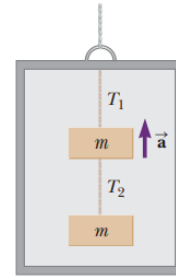


Figure P5.43
Problems 43 and 44.

- 45.** In the system shown in Figure P5.45, a horizontal force $\vec{F}_x$ acts on an object of mass $m_2 = 8.00$ kg. The horizontal surface is frictionless. Consider the acceleration of the sliding object as a function of F_x . (a) For what values of F_x does the object of mass $m_1 = 2.00$ kg accelerate upward? (b) For what values of F_x is the tension in the cord zero? (c) Plot the acceleration of the m_2 object versus F_x . Include values of F_x from -100 N to $+100$ N.

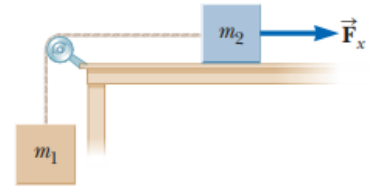


Figure P5.45

- 46.** An object of mass m_1 hangs from a string that passes over a very light fixed pulley P_1 as shown in Figure P5.46. The string connects to a second very light pulley P_2 . A second string passes around this pulley with one end attached to a wall and the other to an object of mass m_2 on a frictionless, horizontal table. (a) If a_1 and a_2 are the accelerations of m_1 and m_2 , respectively, what is the relation between these accelerations? Find expressions for (b) the tensions in the strings and (c) the accelerations a_1 and a_2 in terms of the masses m_1 and m_2 , and g .

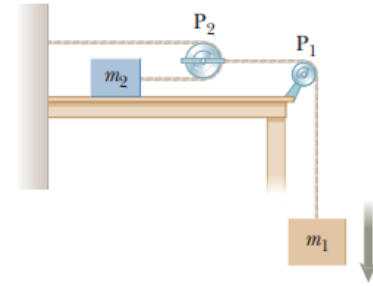


Figure P5.46

47. A block is given an initial velocity of 5.00 m/s up a frictionless incline of angle $\theta = 20.0^\circ$ (Fig. P5.47). How far up the incline does the block slide before coming to rest?

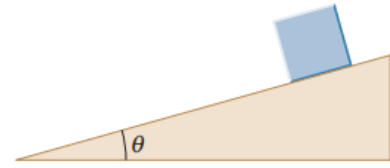


Figure P5.47

49. Two blocks of mass 3.50 kg and 8.00 kg are connected by a massless string that passes over a frictionless pulley (Fig. P5.49). The inclines are frictionless. Find (a) the magnitude of the acceleration of each block and (b) the tension in the string.

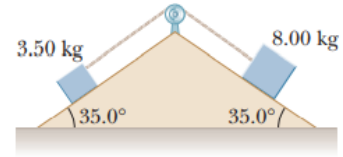


Figure P5.49 Problems 49 and 71.

55. A 25.0-kg block is initially at rest on a horizontal surface. A horizontal force of 75.0 N is required to set the block in motion, after which a horizontal force of 60.0 N is required to keep the block moving with constant speed. Find (a) the coefficient of static friction and (b) the coefficient of kinetic friction between the block and the surface.

- 60.** A woman at an airport is towing her 20.0-kg suitcase at constant speed by pulling on a strap at an angle θ above the horizontal (Fig. P5.60). She pulls on the strap with a 35.0-N force, and the friction force on the suitcase is 20.0 N. (a) Draw a free-body diagram of the suitcase. (b) What angle does the strap make with the horizontal? (c)



Figure P5.60

What is the magnitude of the normal force that the ground exerts on the suitcase?

- 63.** A 9.00-kg hanging object is connected by a light, inextensible cord over a light, frictionless pulley to a 5.00-kg block that is sliding on a flat table (Fig. P5.40). Taking the coefficient of kinetic friction as 0.200, find the tension in the string.

64. Three objects are connected on a table as shown in Figure P5.64. The coefficient of kinetic friction between the block of mass m_2 and the table is 0.350. The objects have masses of $m_1 = 4.00$ kg, $m_2 = 1.00$ kg, and $m_3 = 2.00$ kg, and the pulleys are frictionless. (a) Draw a free-body diagram of each object. (b) Determine the acceleration of each object, including its direction. (c) Determine the tensions in the two cords. **What If?** (d) If the tabletop were smooth, would the tensions increase, decrease, or remain the same? Explain.

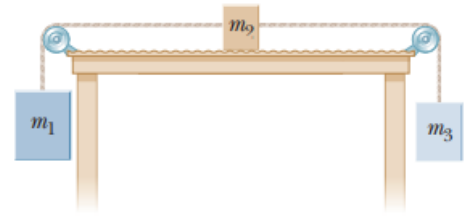


Figure P5.64

65.

AMT

M

Two blocks connected by a rope of negligible mass are being dragged by a horizontal force (Fig. P5.65).

Suppose $F = 68.0 \text{ N}$, $m_1 = 12.0 \text{ kg}$, $m_2 = 18.0 \text{ kg}$,

and the coefficient of kinetic friction between each block and the surface is 0.100. (a) Draw a free-body diagram for each block. Determine (b) the acceleration of the system and (c) the tension T in the rope.

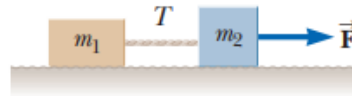


Figure P5.65

66. A block of mass 3.00 kg is pushed up against a wall by a force $\vec{P}$ that makes an angle of $\theta = 50.0^\circ$ with the horizontal as shown in Figure P5.66. The coefficient of static friction between the block and the wall is 0.250. (a) Determine the possible values for the magnitude of $\vec{P}$ that allow the block to remain stationary. (b) Describe what happens if $|\vec{P}|$ has a larger value and what happens if it is smaller. (c) Repeat parts (a) and (b), assuming the force makes an angle of $\theta = 13.0^\circ$ with the horizontal.

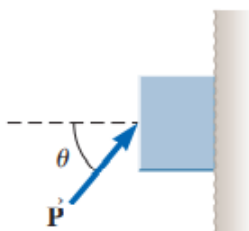


Figure P5.66

70. A 5.00-kg block is placed on top of a 10.0-kg block (Fig. P5.70). A horizontal force of 45.0 N is applied to the 10-kg block, and the 5.00-kg block is tied to the wall. The coefficient of kinetic friction between all moving surfaces is 0.200. (a) Draw a free-body diagram for each block and identify the action–reaction forces between the blocks. (b) Determine the tension in the string and the magnitude of the acceleration of the 10.0-kg block.

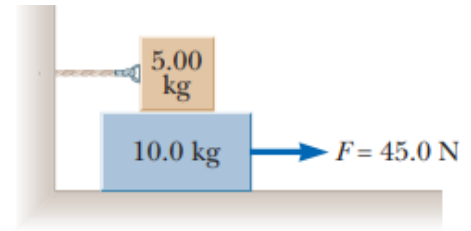


Figure P5.70

- 83.** In Example 5.7, we pushed on two blocks on a table. Suppose three blocks are in contact with one another on a frictionless, horizontal surface as shown in Figure P5.83. A horizontal force $\vec{F}$ is applied to m_1 . Take $m_1 = 2.00 \text{ kg}$, $m_2 = 3.00 \text{ kg}$, $m_3 = 4.00 \text{ kg}$, and $F = 18.0 \text{ N}$. (a) Draw a separate free-body diagram for each block. (b) Determine the acceleration of the blocks. (c) Find the *resultant* force on each block. (d) Find the magnitudes of the contact forces between the blocks. (e) You are working on a construction project. A coworker is nailing up plasterboard on one side of a light partition, and you are on the opposite side, providing “backing” by leaning against the wall with your back pushing on it. Every hammer blow makes your back sting. The supervisor helps you put a heavy block of wood between the wall and your back. Using the situation analyzed in parts (a) through (d) as a model, explain how this change works to make your job more comfortable.

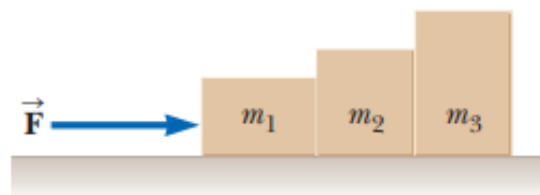


Figure P5.83

- 85.** An object of mass M is held in place by an applied force $\vec{F}$ and a pulley system as shown in Figure P5.85. The pulleys are massless and frictionless. (a) Draw diagrams showing the forces on each pulley. Find (b) the tension in each section of rope, T_1 , T_2 , T_3 , T_4 , and T_5 and (c) the magnitude of $\vec{F}$.

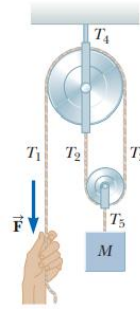


Figure P5.85

88. Consider the three connected objects shown in Figure P5.88. Assume first that the inclined plane is frictionless and that the system is in equilibrium. In terms of m , g , and θ , find (a) the mass M and (b) the tensions T_1 and T_2 . Now assume that the value of M is double the value found in part (a). Find (c) the acceleration of each object and (d) the tensions T_1 and T_2 . Next, assume that the coefficient of static friction between m and $2m$ and the inclined plane is μ_s and that the system is in equilibrium. Find (e) the maximum value of M and (f) the minimum value of M . (g) Compare the values of T_2 when M has its minimum and maximum values.

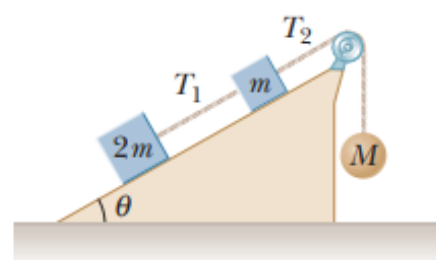


Figure P5.88

89. A crate of weight F_g is pushed by a force $\vec{P}$ on a horizontal floor as shown in Figure P5.89. The coefficient of static friction is μ_s , and $\vec{P}$ is directed at angle θ below the horizontal. (a) Show that the minimum value of P that will move the crate is given by

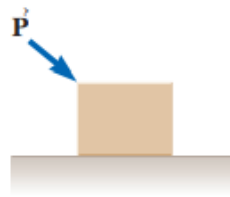


Figure P5.89

$$P = \frac{\mu_s F_g \sec \theta}{1 - \mu_s \tan \theta}$$

- 93.** What horizontal force must be applied to a large block of mass M shown in Figure P5.93 so that the tan blocks remain stationary relative to M ? Assume all surfaces and the pulley are frictionless. Notice that the force exerted by the string accelerates m_2 .

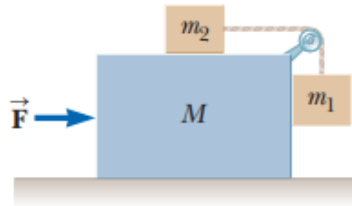


Figure P5.93
Problems 93 and 98.

- 101. Review.** A block of mass $m = 2.00$ kg is released from rest at $h = 0.500$ m above the surface of a table, at the top of a $\theta = 30.0^\circ$ incline as shown in Figure P5.101. The frictionless incline is fixed on a table of height $H = 2.00$ m. (a) Determine the acceleration of the block as it slides down the incline. (b) What is the velocity of the block as it leaves the incline? (c) How far from the table will the block hit the floor? (d) What time interval elapses between when the block is released and when it hits the floor? (e) Does the mass of the block affect any of the above calculations?

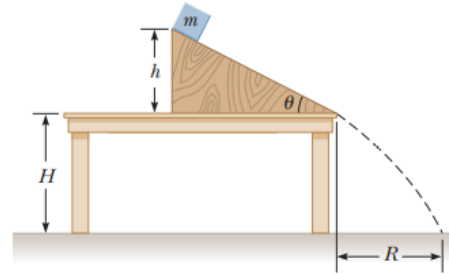


Figure P5.101 Problems 101 and 102.

- 103.** A block of mass $m = 2.00$ kg rests on the left edge of a block of mass $M = 8.00$ kg. The coefficient of kinetic friction between the two blocks is 0.300, and the surface on which the 8.00-kg block rests is frictionless. A constant horizontal force of magnitude $F = 10.0$ N is applied to the 2.00-kg block, setting it in motion as shown in Figure P5.103a. If the distance L that the leading edge of the smaller block travels on the larger block is 3.00 m, (a) in what time interval will the smaller block make it to the right side of the 8.00-kg block as shown in Figure P5.103b? (*Note:* Both blocks are set into motion when $\vec{F}$ is applied.) (b) How far does the 8.00-kg block move in the process?

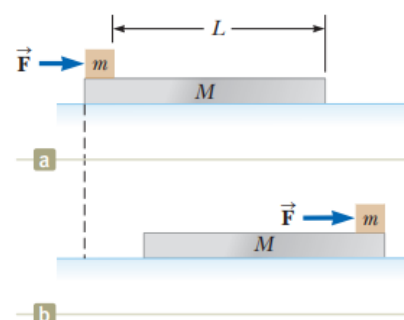


Figure P5.103

ch-51

أشرف فضل الثاني
إسحاق علي محمد داية

5.15

$$F_1 = (-6\hat{i} - 4\hat{j}) \text{ N}$$

$$F_2 = (-3\hat{i} + 7\hat{j}) \text{ N}$$

$$m = 2 \text{ kg} \quad V_i = 0 \quad r = (-2\hat{i} + 4\hat{j})$$

a) V at $t = 10 \text{ s}$.

$$V_f = V_i + at$$

$$\boxed{\text{at } t = 10 \text{ s}} \quad \Sigma F = F_1 + F_2$$

$$= (-9\hat{i} + 3\hat{j}) \text{ N}$$

$$\Sigma F = ma$$

$$(-9\hat{i} + 3\hat{j}) = 2a \Rightarrow a = (-4.5\hat{i} + 1.5\hat{j}) \text{ m/s}^2$$

$$\text{So, } V_f = 0 + (-4.5\hat{i} + 1.5\hat{j}) \times 10$$

$$\boxed{V_f = (-45\hat{i} + 15\hat{j}) \text{ m/s}}$$

b) the direction of moving?

$$\tan \theta = \frac{V_y}{V_x}$$

$$\theta = \tan^{-1} \left(\frac{15}{45} \right) = 18.43^\circ$$

$$\theta = 180 - 18.43$$

$$\boxed{= 161.56^\circ}$$

زاوية θ مع x
في الربع الثاني



15

c) the displacement at $t = 10$ s

$$\Delta \mathbf{r}|_{10s}$$

$$\Delta x = v_{ix}t + \frac{1}{2}a_x t^2$$

$$x_f - (-2) = 0 + \frac{1}{2} \times (-4.5) \times 10^2$$

$$x_f + 2 = -225 \Rightarrow \boxed{x_f = -227m}$$

$$\Delta y = v_{iy}t + \frac{1}{2}a_y t^2$$

$$y_f - 4 = 0 + \frac{1}{2} \times (1.5) \times 10^2$$

$$y_f - 4 = 75 \Rightarrow \boxed{y_f = 79m}$$

$$\Delta \mathbf{r} = (-225\hat{i} + 75\hat{j})m$$

d) $\mathbf{r}|_{10s}$

$$\mathbf{r}_f = x_f \hat{i} + y_f \hat{j}$$

$$\boxed{\mathbf{r}_f = -227\hat{i} + 75\hat{j}}$$

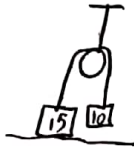
5.21)

a) $h = 2.7$

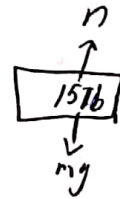
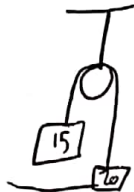
$$1N = 2.2lb$$

$$n = 15lb$$

b) $15 - 10 = \boxed{5lb}$



c) $n = 0$

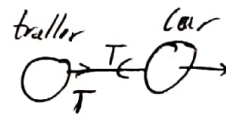


5.23)

$$m_{\text{car}} = 1000 \text{ kg}$$

$$m_{\text{trailer}} = 300 \text{ kg}$$

$$a = 2.15 \text{ m/s}^2$$



a) F_{net} on the car

$$\Sigma F = ma$$

$$= 1000 \times 2.15$$

$$= \boxed{2150 \text{ N}} \text{ forward}$$

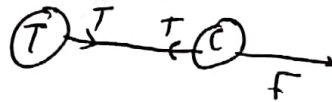
b) F_{net} on the trailer

$$\Sigma F = ma$$

$$= 300 \times 2.15$$

$$= \boxed{645 \text{ N}} \text{ forward}$$

c) The force exerted by the trailer on the car.



T is the only force

$$\boxed{T = 645 \text{ N}} \text{ backward.}$$

d) the resultant force from the car on the road.

the force from the road equal $R = \sqrt{n_{\text{car}}^2 + F^2}$

$$\Sigma F = ma$$

$$F - T = ma$$

$$\Rightarrow F = T + 2150$$

$$= \boxed{2795 \text{ N}}$$

$$n_c = mg$$

$$= 9800 \text{ N}$$

$$R = \sqrt{2795^2 + (9800)^2}$$

$$= \boxed{10.2 \times 10^3 \text{ N}}$$

$$\theta = \tan^{-1}\left(\frac{n_{\text{car}}}{F}\right) \Rightarrow \theta = 74^\circ$$

So, $F_{\text{cr}} = 10.2 \times 10^3 \text{ N}$ at 74° under the (x) and backward. ③

5.28)

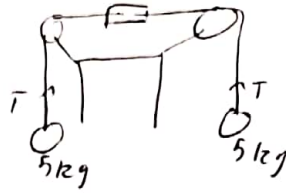
Find the read of the spring scales.

a)

$$\sum F_y = 0$$

$$T - mg = 0$$

$$T = 5 \times 9.8 = \underline{49 \text{ N}}$$



b) $\sum F_y = 0$

$$T - mg = 0 \Rightarrow \underline{T = 49 \text{ N}}$$

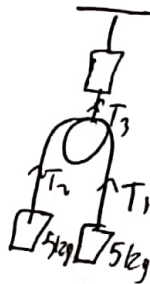
c)

$$T_3 = T_1 + T_2$$

$$T_1 = 49 \text{ N}$$

$$T_2 = 49 \text{ N}$$

$$\text{So, } \underline{T_3 = 98 \text{ N}}$$



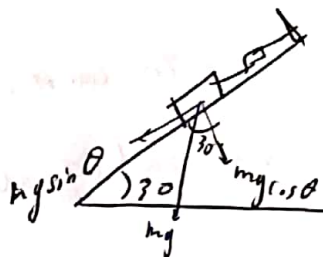
d)

$$\sum F_y = 0$$

$$T - mg \sin \theta = 0$$

$$T = mg \sin \theta$$

$$= 5 \times 9.8 \times \sin(30) = \underline{24.5 \text{ N}}$$

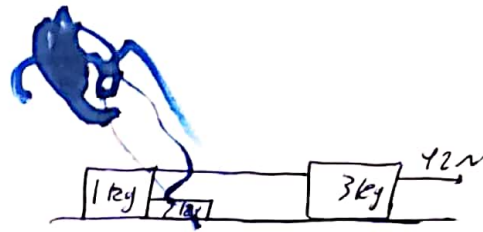


5.29)

a) $a = ?$

$$\Sigma F = ma$$

$$42 = 6a \Rightarrow a = 7 \text{ m/s}^2 \text{ to the right}$$



b) $T = ?$

$$\Sigma F = ma$$

$$42 - T = 3a$$

$$T = 42 - (3 \times 7) = \boxed{21 \text{ N}}$$

c) F from 1 kg on 2 kg

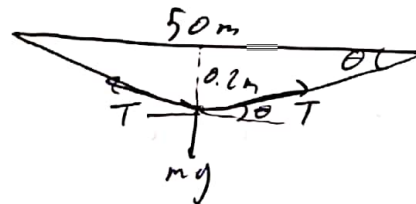
$$F = ma = 2 \times 7 = 14 \text{ N to the right}$$

5.31 $m = 11 \text{ kg}$

a) free body diagram

b) $T = ?$

$$\theta = \tan^{-1} \left(\frac{12}{25} \right) = \boxed{26.1^\circ}$$



$$\Sigma F_y = T \sin \theta + T \sin \theta - mg = 0$$

$$\Rightarrow 2T \sin(45^\circ) = mg$$

$$T = \frac{1 \times 9.8}{2 \sin(45^\circ)} = \boxed{6.93 \text{ N}}$$

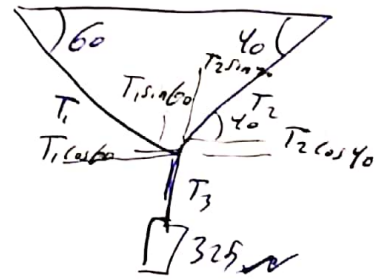
5.33

Find T_1 , T_2 , T_3 .

$$\sum F_y = 0$$

$$T_3 - F_g = 0$$

$$T_3 = F_g = \boxed{325 \text{ N}}$$



$$\sum F_y = 0$$

$$T_1 \sin 60 + T_2 \sin 40 - T_3 = 0$$

$$\boxed{T_1 \sin 60 + T_2 \sin 40 = 325 \text{ N}} \quad \text{--- (1)}$$

$$\sum F_x = 0$$

$$T_2 \cos 40 - T_1 \cos 60 = 0$$

$$T_2 \cos 40 = T_1 \cos 60 \Rightarrow \boxed{T_1 = 1.53 T_2} \text{ into (1)}$$

$$1.53 T_2 \times (\sin 60) + T_2 \times \sin 40 = 325$$

$$1.32 T_2 + 0.64 T_2 = 325$$

$$1.96 T_2 = 325 \Rightarrow \boxed{T_2 = 165}$$

$$\boxed{T_1 = 253.45 \text{ N}}$$

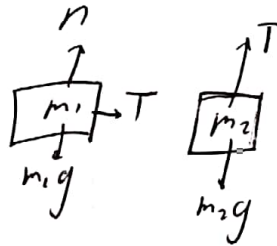
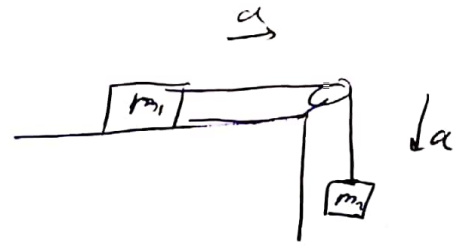
⑥

5.40)

$$m_1 = 5 \text{ kg}$$

$$m_2 = 9 \text{ kg}$$

a) free body diagram :-



b) $a = ?$

for m_1

$$\sum F_x = m_1 a$$

$$T = 5a \quad \text{--- (1)}$$

for m_2

$$\sum F_y = m_2 a$$

$$m_2 g - T = m_2 a$$

$$9 \times 9.8 - (5a) = 9a$$

$$88.2 = 14a \Rightarrow a = 6.3 \text{ m/s}^2$$

and $T = 5a$ from (1)

c) $T = ?$

from (1)

$$T = 5a$$

$$T = 5 \times 6.3$$

$$= \underline{31.5 \text{ N}}$$

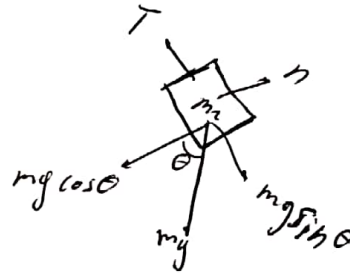
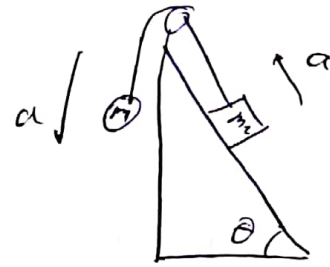
5.42)

$$m_1 = 2 \text{ kg}$$

$$m_2 = 6 \text{ kg}$$

$$\theta = 55^\circ$$

a) free body diagram



b) $a = ?$

for m_1

$$\sum F_y = m_1 a$$

$$m_1 g - T = m_1 a$$

$$2 \times 9.8 - T = 2a \quad (1)$$

for m_2

$$\sum F_x = m_2 a$$

$$T - m_2 g \sin \theta = m_2 a$$

$$T - 6 \times 9.8 \times \sin 55 = 6a$$

$$T - 48.16 = 6a \quad (2)$$

$$(1) + (2)$$

$$\frac{-28.56}{8} = \frac{8a}{8}$$

$$a = -3.57$$

النتيجة سالبة
المفترض

c) $T = ?$

from (1)

$$19.6 - T = 2 \times (-3.57)$$

$$\Rightarrow T = 26.74 \text{ N}$$

d) The speed of each object after 2s:

$$v_f = v_i + at$$

$$= 0 + (3.57) \times 2$$

$$= 7.14 \text{ m/s}$$

5.43) $m = 3.5 \text{ kg}$

find T_1/T_2

a) If the elevator move up with $a = 1.6 \text{ m/s}^2$

$$\Sigma F_y = ma$$

$$T_2 - mg = ma \Rightarrow T_2 = m(g+a)$$

$$= 3.5(9.8 + 1.6) = \boxed{39.9 \text{ N}} = T_2$$

$$\Sigma F_y = ma$$

$$T_1 - mg - T_2 = ma$$

$$\begin{aligned} T_1 &= ma + T_2 + mg \\ &= m(g+a) + T_2 \Rightarrow T_1 = 39.9 + 39.9 \\ &= \boxed{79.8 \text{ N}} \text{ or } \boxed{T_2 = 2m(g+a)} \end{aligned}$$

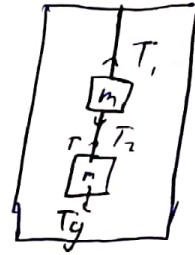
b) If $T_2 = 85 \text{ N}$ find a_{max} .

$$T = 2m(g+a)$$

$$85 = 2 \times 3.5 (9.8 + a)$$

$$85 = (7 \times 9.8) + (7a)$$

$$16.4 = 7a \Rightarrow \boxed{a = 2.34 \text{ m/s}^2 \text{ upward}}$$



5.44)

a) Find T in terms of m , a and g

$$T_1 = ??$$

$$\sum F_y = ma$$

$$T_2 - mg = ma \Rightarrow T_2 = mg + ma$$

$$\boxed{T_2 = m(g+a)}$$

$$T_2 =$$

$$\sum F_y = ma$$

$$T_1 - mg - T_2 = ma \Rightarrow T_1 = ma + T_2 + mg$$

$$= ma + mg + ma + mg$$

$$\boxed{T_1 = 2m(g+a)}$$

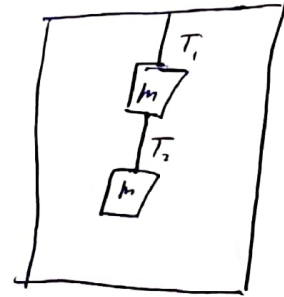
b) $T_1 = 2T_2$

T_1 will break first.

c) There will be free falling $\boxed{a = -g}$

$$T_2 = m(g + (-g)) \boxed{= 0}$$

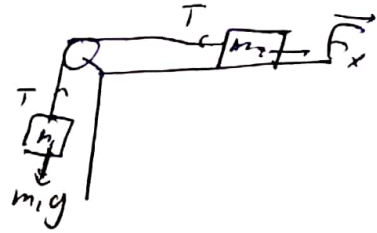
$$T_1 = 2m(g + (-g)) \boxed{= 0}$$



5.45)

$$m_1 = 8 \text{ kg}$$

a) $F_x = ?$ if $m_1 = 2 \text{ kg}$ accelerate up.



for m_1

$$\Sigma F_y = m_1 a$$

$$T - m_1 g = 0$$

$$\boxed{T = m_1 g} \sim \textcircled{1}$$

for m_2

$$\Sigma F_x = m_2 a$$

$$F_x - T = 0$$

$$\boxed{T = F_x} \sim \textcircled{2}$$

into $\textcircled{1}$

$$F_x = m_1 g$$

$$= 2 \times 9.8$$

$$= \boxed{19.6 \text{ N}}$$

So, $F_x > 19.6 \text{ N}$

b) $F_x = ?$

$$\boxed{T = 0}$$

move downward

$$\Sigma F_y = m_1 a$$

$$m_1 g - T = m_1 a$$

$$\boxed{m_1 g - T = 2a} \sim \textcircled{1}$$

$$\Sigma F_x = m_2 a$$

$$\boxed{T - F_x = 8a} \sim \textcircled{2}$$

$$\textcircled{2} - \textcircled{1}$$

$$(T - F_x = 8a) - (4m_1 g - 4T = 8a)$$

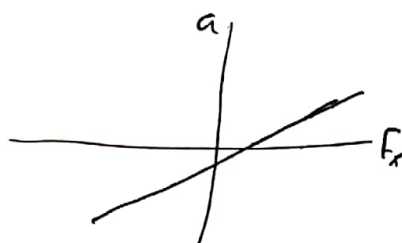
$$5T - F_x - 4m_1 g = 0$$

$$5T - F_x = 4m_1 g$$

$$\Rightarrow F_x = 5T - 4m_1 g$$

$$\boxed{F_x = -78.4 \text{ N}}$$

c)



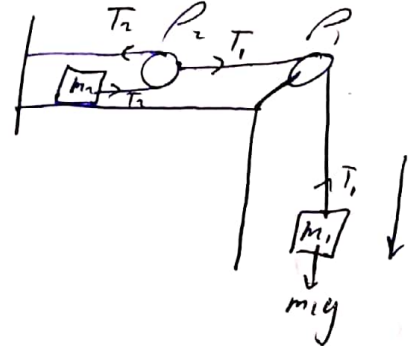
$$\boxed{F_x = m_1 g - 10a}$$

11

Ex. 46)

a) Since m_2 moves twice the distance P_2 in the same time

$$a_2 = 2a_1$$



b) $\Sigma F = ma$

$$m_1 g - T_1 = m_1 a \quad \text{--- (1)}$$

$$T_2 = m_2 a_2 = 2m_2 a_1 \quad \text{--- (2)}$$

$$T_1 = 2T_2 \quad \text{--- (3)}$$

$$m_1 g - 2T_2 = m_1 a_1$$

$$T_2 = \frac{m_1 m_2}{2m_2 + \frac{1}{2}m_1} g \quad \text{and} \quad T_2 = \frac{m_1 m_2}{m_2 + \frac{1}{4}m_1} g$$

$$c) \quad a_2 = \frac{T_2}{m_2} = \frac{m_1 g}{2m_2 + \frac{1}{2}m_1}$$

$$a_1 = \frac{1}{2} a_2 = \frac{m_1 g}{4m_2 + m_1}$$

$$v_i = 5 \text{ m/s}$$

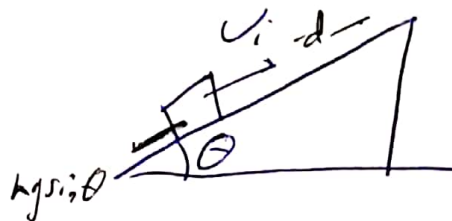
$$\sum F_x = ma$$

$$mg \sin 20 = ma$$

$$a = g \sin 20$$

$$= 3.35 \text{ m/s}^2$$

~~$$d = \frac{v_f^2 - v_i^2}{2a}$$~~



$$v_f^2 = v_i^2 + 2ad$$

$$0 = 5^2 - 2 \times (3.35) d$$

$$d = 3.73 \text{ m}$$

5.49)

$$a) \text{ and } d = ?$$

$$\text{For } m = 3.5 \text{ kg}$$

$$\sum F_x = ma$$

$$T - mg \sin \theta = ma$$

$$T - 3.5 \times 9.8 \times \sin 35 = 3.5a$$

$$T - 19.67 = 3.5a \quad \text{--- (1)}$$

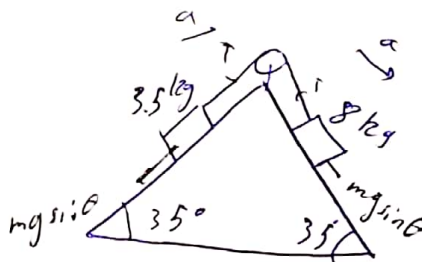
$$\text{For } m = 8 \text{ kg}$$

$$\sum F_x = ma$$

$$mg \sin \theta - T = ma$$

$$8 \times 9.8 \times \sin 35 - T = 8a$$

$$44.96 - T = 8a \quad \text{--- (2)}$$



$$\text{①} + \text{②}$$

$$25.29 = 11.5a$$

$$a = 2.19 \text{ m/s}^2$$

$$b) T = ??$$

$$T - 19.67 = 3.5 \times (2.19)$$

$$T = 27.36 \text{ N}$$

5.55)

$$F_s = 75 \text{ N} \quad m = 25 \text{ kg}$$

$$F_k = 60 \text{ N}$$

$$a) \mu_s = 2.2$$

$$F_s = \mu_s n$$

$$75 = \mu_s (25 \times 9.8)$$

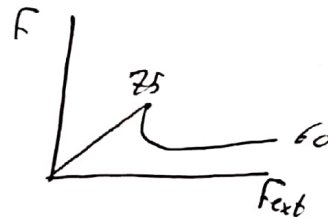
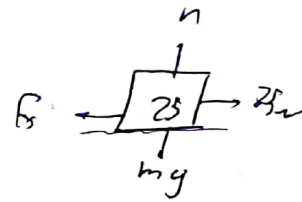
$$\mu_s = 0.3$$

$$b) \mu_k = 2.2$$

$$F_k = \mu_k n$$

$$60 = \mu_k (25 \times 9.8)$$

$$\mu_k = 0.24$$



5.60)

$$F_k = 20 \text{ N}$$

constant speed $\Rightarrow a = 0$

a) free body diagram

$$b) \theta = 2.2$$

$$\sum F_x = 0$$

$$F \cos \theta - F_k = 0$$

$$35 \cos \theta = 20 \Rightarrow \theta = \cos^{-1}\left(\frac{20}{35}\right) = 55.15^\circ$$

$$c) n = 2.2$$

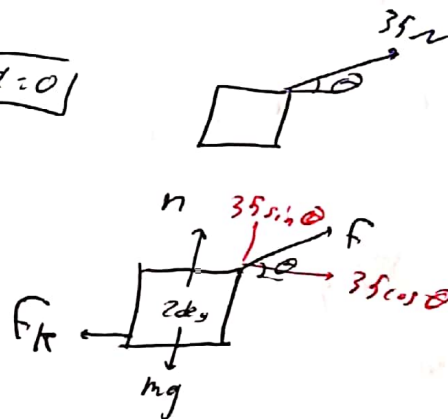
$$\sum F_y = 0$$

$$n + 35 \sin \theta - mg = 0$$

$$n = mg - 35 \sin \theta$$

$$= 20 \times 9.8 - 35 \sin (55.15)$$

$$\Rightarrow n = 167.7 \text{ N}$$



(14)

5.63)

$$\mu_k = 0.2$$

$$T = 2.2$$

For $m = 9 \text{ kg}$

$$\sum F_y = ma$$

$$mg - T = ma$$

$$9 \times 9.8 - T = 9a$$

$$88.2 - T = 9a \quad \text{--- (1)}$$

For $m = 5 \text{ kg}$

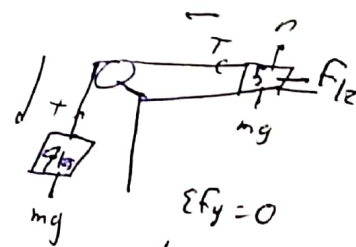
$$\sum F_x = ma$$

$$T - F_k = ma$$

$$T - (\mu_k n) = 5a$$

$$T - (0.2 \times 49) = 5a$$

$$T - 9.8 = 5a \quad \text{--- (2)}$$



$$\sum F_y = 0$$

$$n - mg = 0$$

$$n = mg = 49$$

$$\textcircled{1} + \textcircled{2}$$

$$78.4 = 14a$$

$$a = 5.6 \text{ m/s}^2$$

$$T - 9.8 = 5 \times (5.6)$$

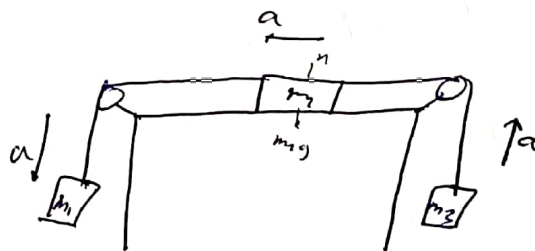
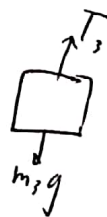
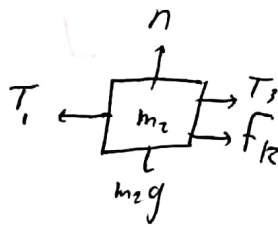
$$T = 32.8 \text{ N}$$

5.64)

$$\mu_k = 0.35$$

$$m_1 = 4 \text{ kg} \quad m_2 = 1 \text{ kg} \quad m_3 = 2 \text{ kg}$$

a) free body diagram



b) a = 2.2

For $m_1 = 4 \text{ kg}$

$$\sum F_y = ma$$

$$m_1g - T_1 = m_1a$$

$$39.2 - T_1 = 4a \quad \text{--- (1)}$$

For $m_2 = 1 \text{ kg}$

$$\sum F_x = ma$$

$$T_1 - T_3 - F_k = m_2a$$

$$T_1 - T_3 - (\mu_k n) = a$$

$$T_1 - T_3 - (0.35 \times 9.8) = a \quad \text{--- (2)}$$

For $m_3 = 2 \text{ kg}$

$$\sum F_y = ma$$

$$T_3 - m_3g = ma$$

$$T_3 - 19.6 = 2a \quad \text{--- (3)}$$

① + ② + ③

$$39.2 - 3.43 - 19.6 = 7a$$

$$16.17 = 7a \Rightarrow \boxed{a = 2.31 \text{ m/s}^2}$$

c) T_1 / T_3

from ①

$$39.2 - T_1 = 4a \Rightarrow T_1 = 39.2 - (4 \times 2.31) = \boxed{29.96 \text{ N}}$$

from ③

$$T_3 - 19.6 = 2a$$

$$T_3 = (19.6 + 2 \times (2.31)) = \boxed{24.22 \text{ N}}$$

5.65)

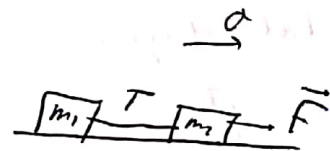
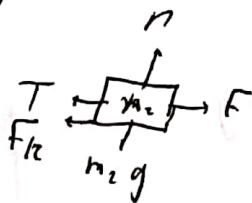
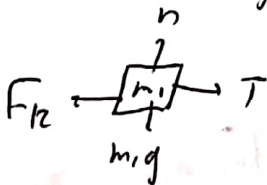
$$F = 68 \text{ N}$$

$$m_1 = 12 \text{ kg}$$

$$m_2 = 18 \text{ kg}$$

$$\mu_k = 0.1$$

a) free body diagram



b) $a = 2.2$

For $m_1 = 12 \text{ kg}$

$$\sum F_y = 0$$

$$n - m_1 g = 0$$

$$n = m_1 g = \boxed{117.6 \text{ N}}$$

$$\sum F_x = m_1 a$$

$$T - F_k = m_1 a$$

$$T - (\mu_k n) = 12a$$

$$\boxed{T - 11.76 = 12a} \quad \text{--- (1)}$$

(1) + (2)

$$38.6 = 30a \Rightarrow \boxed{a = 1.28 \text{ m/s}^2}$$

c) $T = ?$

from (1)

$$T - 11.76 = 12a$$

$$T = 12 \times (1.28) + 11.76$$

$$\boxed{T = 27.2 \text{ N}}$$

For $m_2 = 18 \text{ kg}$

$$\sum F_y = 0$$

$$n - m_2 g = 0$$

$$n = m_2 g = \boxed{176.4 \text{ N}}$$

$$\sum F_x = m_2 a$$

$$F - T - F_k = m_2 a$$

$$68 - T - (\mu_k n) = 18a$$

$$\boxed{68 - T - 17.64 = 18a} \quad \text{--- (2)}$$

5.66)

$$m = 3 \text{ kg}$$

$$\theta = 50^\circ$$

$$\mu_s = 0.25$$

$$P = 2.7$$

max

$$\sum F_y = 0 \quad P \cos \theta - n = 0$$

$$(n = P \cos \theta)$$

$$\sum F_x = 0$$

$$P \sin \theta - mg - f_s = 0$$

$$P \sin \theta - (3 \times 9.8) - \mu_s \times P \cos \theta = 0$$

$$P \sin 50 - 29.4 - 0.16P = 0$$

$$P = \frac{29.4}{0.60} = 48.51 \text{ N}$$

المساحة ضوئياً
still

$$P_{min} = 2.7$$

$$\sum F_x = 0$$

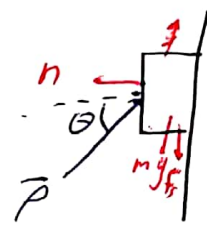
$$P \sin \theta + f_s - mg = 0$$

$$P \sin 50 + 0.16P - 29.4 = 0$$

$$\Rightarrow P = 31.74 \text{ N}$$

If $P > 48.51 \text{ N} \rightarrow \text{move up}$

If $P < 31.74 \text{ N} \rightarrow \text{move down}$



b) what happens if $|P|$ has larger and smaller values?

$$\text{If } P > P_{\max}$$

$$P > 48.51$$

the object will move up.

and If $P < P_{\min}$

$$P < 31.74 \text{ N}$$

the object will move down

c) Repeat Part (a) and (b) but $\theta = 13^\circ$.

$$P_{\max} = 2.?$$

$$\sum F_y = 0 \quad P \cos \theta - n = 0$$

$$n = P \cos \theta$$

$$\sum F_y = 0 \quad n = P \cos 13$$

$$P \sin \theta - mg - F_s = 0$$

$$P \sin 13 - (3 \times 9.8) - 0.24P = 0$$

$$P_{\max} = -1543.4 \text{ N}$$

$$P_{\min} = 2.?$$

$$\sum F_y = 0$$

$$P \sin \theta - mg + F_s = 0$$

$$P \sin(13) - 3 \times 9.8 + 0.24P = 0$$

$$P_{\min} = 62.7 \text{ N}$$

so

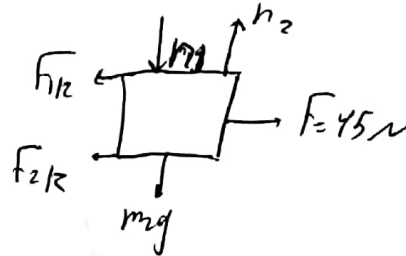
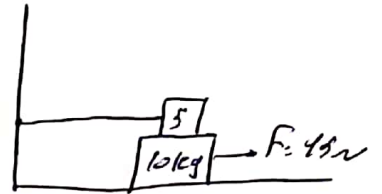
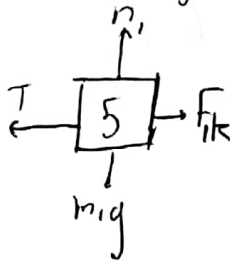
$P > 62.7 \text{ N}$ the object can't move up.

$P < 62.7 \text{ N}$ the object moves down

5.701

$$\mu_k = 0.2$$

a) free body diagram.



b) $T = 2.2$ $a = 2.2$ of the 10 kg

For $m = 5 \text{ kg}$

$$\sum F_y = 0$$

$$n - m_1g = 0$$

$$n = m_1g$$

$$= 5 \times 9.8 = \boxed{49 \text{ N}}$$

$$\sum F_x = 0$$

$$F_{1k} - T = 0$$

$$T = F_{1k}$$

$$= \mu_k n_1$$

$$= 0.2 \times 49$$

$$= \boxed{9.8 \text{ N}}$$

For $m = 10 \text{ kg}$

$$\sum F_y = 0$$

$$n_2 - n_1 - m_2g = 0$$

$$n_2 = n_1 + m_2g$$

$$= 49 + (10 \times 9.8) = \boxed{147 \text{ N}}$$

$$\sum F_x = ma$$

$$F - F_{1k} - F_{2k} = ma$$

$$45 - 9.8 - (0.2 \times 147) = 10a$$

$$5.8 = 10a$$

$$\boxed{a = 0.58 \text{ m/s}^2}$$

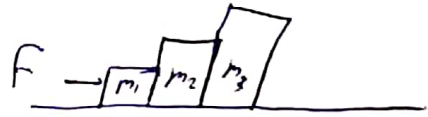
5.83)

$$m_1 = 2 \text{ kg}$$

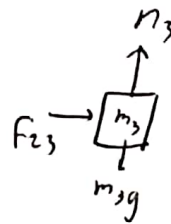
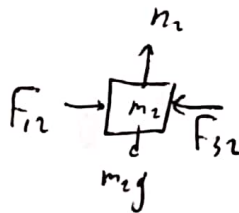
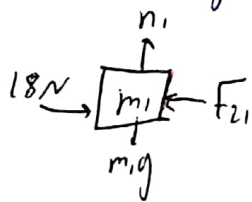
$$m_2 = 3 \text{ kg}$$

$$m_3 = 4 \text{ kg}$$

$$F = 18 \text{ N}$$



a) free body diagram



b) the acceleration

$$\Sigma F = ma$$

$$18 = (2+3+4)a \Rightarrow a = 18/9 = \boxed{2 \text{ m/s}^2}$$

c) Find the force on each block

on m_1

$$\Sigma F_x = ma$$

$$18 - F_{21} = 2a$$

$$18 - F_{21} = 2 \times 2 \Rightarrow \boxed{F_{21} = 14 \text{ N}}$$

$$F_{12} = m_1 a = 2 \times 2 = \boxed{4 \text{ N}}$$

$$F_{23} = m_2 a = 3 \times 2 = \boxed{6 \text{ N}}$$

$$F_{32} = m_3 a = 4 \times 2 = \boxed{8 \text{ N}}$$

d) the contact force: قوة التماس

on m_1

$$\Sigma F_x = ma$$

$$18 - F_{21} = 2a$$

$$18 - F_{21} = 2 \times 2 \Rightarrow \boxed{F_{21} = 14 \text{ N}}$$

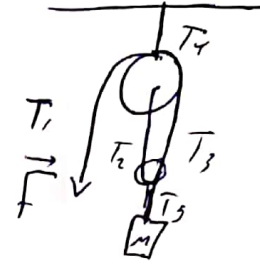
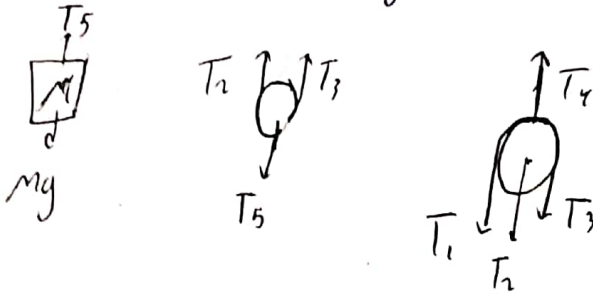
on m_3

$$\Sigma F = 8 \text{ N}$$

$$\boxed{F_{23} = 8 \text{ N}}$$

5.85)

a) draw free body diagram.



b) Find T_1 / T_2 / T_3 / T_4 and T_5

Since all pulleys are frictionless so,

$$T_1 = T_3 = T_2$$

and for M $\sum F_y = 0 \leftarrow T_2 = T_3$ no acceleration
 $T_5 - Mg = 0 \Rightarrow \boxed{T_5 = Mg}$

$$\sum F_y = 0$$

$$T_2 + T_3 - T_5 = 0$$

$$2T = T_5 \Rightarrow T_1 = T_2 = T_3 = \frac{Mg}{2}$$

$$T_4 = T_1 + T_2 + T_3$$

$$= \boxed{\sqrt{\frac{3Mg}{2}}}$$

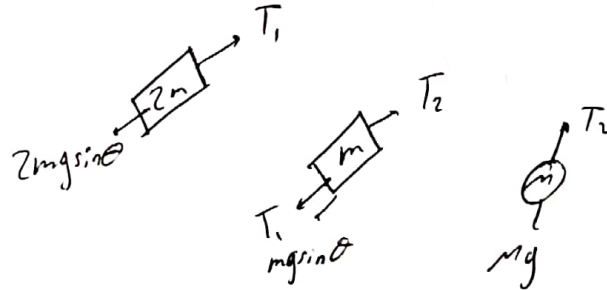
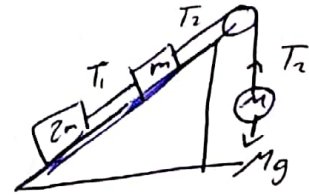
$$F = T_1 \Rightarrow \boxed{F = \frac{Mg}{2}}$$

5.88)

the system is in equilibrium.

in terms of m, g , and θ

a) Find the mass M



$$\sum F_y = 0$$

$$T_2 - Mg = 0 \Rightarrow T_2 = Mg$$

$$M = \frac{T_2}{g}$$

$$M = \frac{3mg \sin \theta}{g}$$

$$\boxed{M = 3m \sin \theta}$$

$$\sum F_x = 0$$

$$T_2 = T_1 + mg \sin \theta$$

$$= 2mg \sin \theta + mg \sin \theta$$

$$= \boxed{3mg \sin \theta}$$

b) T_1, T_2

$$T_1 = 2mg \sin \theta$$

$$T_2 = 3mg \sin \theta$$

c) IF M is doubled $\Rightarrow \boxed{M \Rightarrow 2M}$ so, $\boxed{M = 6m \sin \theta}$

Find a ?

for $2M$:-

$$\sum F_y = ma$$

$$2Mg - T_2 = 2Ma \quad \text{--- (1)}$$

for m :-

$$\sum F_x = ma$$

$$T_2 - T_1 - mg \sin \theta = ma \quad \text{--- (2)}$$

for $2m$:-

$$\sum F_x = 2ma$$

$$\cancel{T_2 = 2ma}$$

$$T_1 - 2mg \sin \theta = 2ma$$

$$T_1 = 2m(g \sin \theta + a) \quad \text{--- (3)}$$

$$T_1 = 2m(g \sin \theta + a) \quad \text{into } \textcircled{1}$$

$$T_2 = T_1 + mg \sin \theta + ma$$

$$= 2m(g \sin \theta + a) + m(g \sin \theta + a)$$

$$T_2 = 3m(g \sin \theta + a) \quad \text{into } \textcircled{1}$$

$$2Mg - T_1 = 2Ma$$

$$T_2 = 2M(g + a)$$

$$3m(g \sin \theta + a) = 6m \sin \theta (g + a)$$

$$3mg \sin \theta + 3ma = 6mg \sin \theta + 6ma \sin \theta$$

$$+ 3mg \sin \theta = 3ma + 6ma \sin \theta$$

$$= a(3m + 6m \sin \theta)$$

$$a = \frac{3mg \sin \theta}{3m + 6m \sin \theta}$$

$$a = \frac{g \sin \theta}{1 + 2 \sin \theta}$$

d) Find T_1 / T_2

$$T_1 = 2m(g \sin \theta + a)$$

$$= 2m\left(g \sin \theta + \frac{g \sin \theta}{1 + 2 \sin \theta}\right)$$

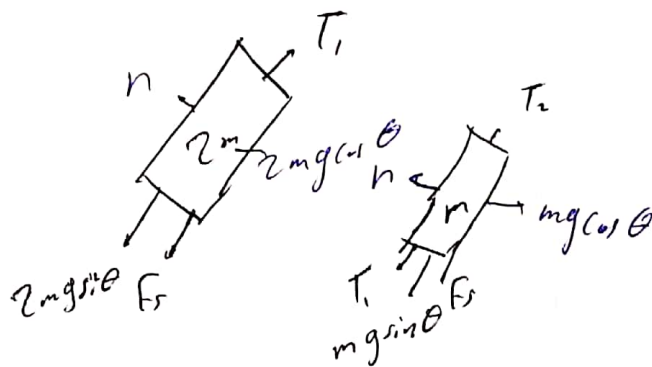
$$T_2 = 3m(g \sin \theta + a)$$

$$= 3m\left(g \sin \theta + \frac{g \sin \theta}{1 + 2 \sin \theta}\right)$$

(24)

e) If μ_s and equilibrium $(a=0)$

Find the maximum value of M .



مكتوب اننا
لا نعلم الارتفاع
فكنا نستخدم



For $2m$:-

$$\sum F_x = 0$$

$$T_1 - 2mg \sin \theta - \mu_s (2mg \cos \theta) = 0$$

$$T_1 = 2mg (\sin \theta + \mu_s \cos \theta)$$

For m :-

$$\sum F_x = 0$$

$$T_2 - T_1 - mg \sin \theta - F_f = 0$$

$$T_2 = 2mg (\sin \theta + \mu_s \cos \theta) + \underbrace{mg \sin \theta + \mu_s (mg \cos \theta)}_{mg (\sin \theta + \mu_s \cos \theta)}$$

$$= 3mg (\sin \theta + \mu_s \cos \theta)$$

for M :-

$$\sum F_y = 0$$

$$-T_2 + Mg = 0$$

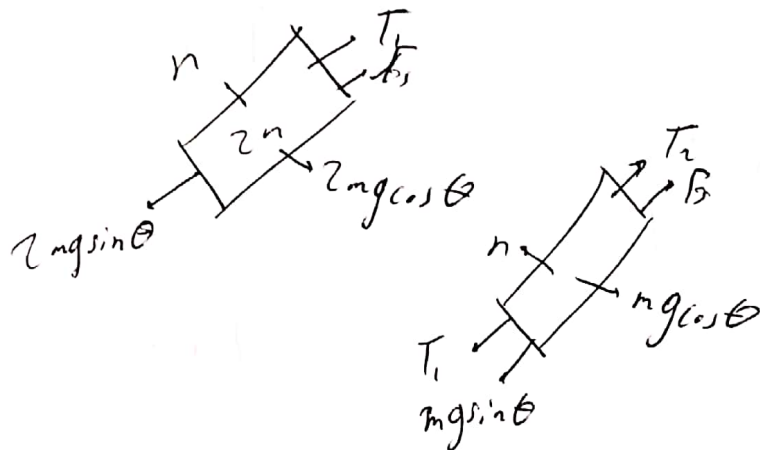
$$M = \frac{T_2}{g}$$

$$= 3m (\sin \theta + \mu_s \cos \theta)$$

(25)

f) The minimum value of M .

M ستبقى الا - نقايه M عاكس الحركة



For $2m$:-

$$\sum F_x = 0$$

$$T_1 + F_1 - 2mg \sin \theta = 0$$

$$\begin{aligned} T_1 &= 2mg \sin \theta - (M \times 2mg \cos \theta) \\ &= 2mg(\sin \theta - M \cos \theta) \end{aligned}$$

For m :-

$$\sum F_x = 0$$

$$T_2 + F_2 - T_1 - mg \sin \theta = 0$$

$$\begin{aligned} T_2 &= T_1 + mg \sin \theta - M \times m \\ &= 2mg(\sin \theta - M \cos \theta) + mg \sin \theta - (M \times mg \cos \theta) \\ &= 3mg(\sin \theta - M \cos \theta) \end{aligned}$$

For M :-

$$T_2 - Mg = 0$$

$$M = \frac{T_2}{g} = 3m(\sin \theta - M \cos \theta)$$

g) T_2 بين T_{min} / T_{max}

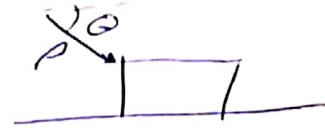
$$T_{2max} = 3mg(\sin \theta + M \cos \theta)$$

$$T_{2min} = 3mg(\sin \theta - M \cos \theta)$$

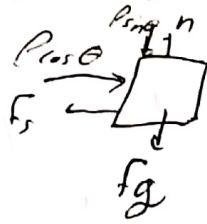
$$T_{2max} - T_{2min} = 6mg M \cos \theta$$

5-89)

a) Find P_{min} that will move the crate:



المسألة هي أن نجد القوة التي ستحرك الصندوق



$$P = \frac{\mu_s fg \sec \theta}{1 - \mu_s \tan \theta}$$

$$\sum F_y = 0$$

$$n - P \sin \theta - fg = 0$$

$$n = P \sin \theta + fg$$

$$\sum F_x = 0$$

$$P \cos \theta - f_s = 0$$

$$P \cos \theta = f_s$$

$$P \cos \theta \leq \mu_s n$$

$$P \cos \theta \leq \mu_s (P \sin \theta + fg)$$

$$P \cos \theta \leq \mu_s P \sin \theta + \mu_s fg$$

$$P (\cos \theta - \mu_s \sin \theta) \leq \mu_s fg \div (\cos \theta)$$

$$P (1 - \mu_s \tan \theta) \leq \mu_s fg \sec \theta$$

$$\frac{1}{\cos \theta} = \sec \theta$$

$$P_{min} = \frac{\mu_s fg \sec \theta}{1 - \mu_s \tan \theta} \quad \text{--- (1)}$$

b)

ما لا يتحرك الجسم

$$f_s > P \cos \theta$$

$$\mu_s n > P \cos \theta$$

$$\mu_s (P \sin \theta + fg) > P \cos \theta$$

$$\mu_s P \sin \theta + \mu_s fg > P \cos \theta$$

$$\mu_s fg > P (\cos \theta - \mu_s \sin \theta)$$

$$\text{but } P = \frac{\mu_s fg \sec \theta}{1 - \mu_s \tan \theta}$$

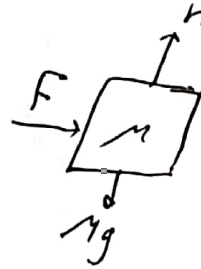
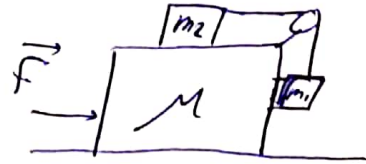
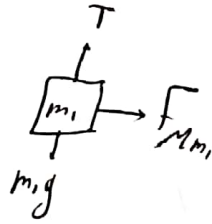
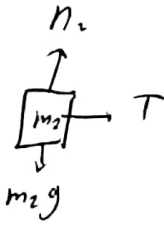
that will give.

$$\mu_s \tan \theta > 1$$

$$\tan \theta > \frac{1}{\mu_s}$$

in this condition the object can't move.

5.73)



for m_1 :

$$\sum F_y = 0$$

$$T - m_1 g = 0 \Rightarrow \boxed{T = m_1 g}$$

for m_2

$$\sum F_x = m_2 a$$

$$\boxed{T = m_2 a}$$

$$\sum F = ma$$

$$F = (M + m_1 + m_2) a \quad \text{--- (1)} \quad \boxed{a = ??}$$

$$\text{So, } m_1 g = m_2 a$$

$$\boxed{a = \frac{m_1}{m_2} g} \quad \text{into (1)}$$

$$\boxed{F = (M + m_1 + m_2) \frac{m_1}{m_2} g}$$

5.101) $m = 2 \text{ kg}$

$h = 0.5 \text{ m}$. $\theta = 30^\circ$

$H = 2 \text{ m}$

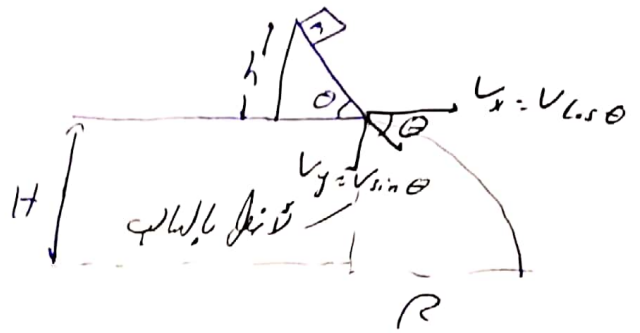
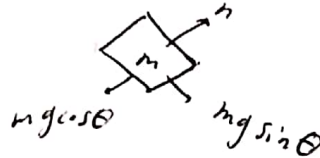
a) Find a on the incline.

$\Sigma F = ma$

$mg \sin \theta = ma$

$a = 9.8 \times \sin 30$

$a = 4.9 \text{ m/s}^2$



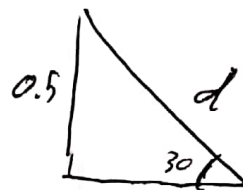
b) V at the end of the incline.

$V_i = 0$ (from rest).

$V_f^2 = V_i^2 + 2ad$

$= 0 + 2 \times 4.9 \times 1$

$V_f^2 = 9.8 \Rightarrow V_f = 3.13 \text{ m/s}$



$\sin \theta = \frac{0.5}{d}$

$\frac{1}{2} = \frac{0.5}{d}$

$d = 1 \text{ m}$

c) $R = ?$

$x = V_{ix}t + \frac{1}{2}at^2$

$R = 3.13 \cos 30^\circ \quad t = 2.2$

$R = 3.13 \times (\cos 30^\circ) \times 0.499$
 $= 1.35 \text{ m}$

but $H = 2 \text{ m}$

$y = V_{iy}t - \frac{1}{2}gt^2$

$2 = -3.13 \sin(30^\circ)t - \frac{1}{2} \times 9.8 t^2$

$-4.9t^2 + 1.565t - 2 = 0$

$t = \frac{-0.81}{\times} \quad 0.499$ into ①

d) the total time

$T = t_{\text{incline}} + t_{\text{projectile}}$

$= \frac{3.13}{4.9} + 0.499$

$= 1.13 \text{ s}$

$V_f = V_{\text{stab}} \rightarrow 3.13 = 0.49t$

$3.13 = 0.49t$

c) the mass makes no difference because the acceleration is independent on mass.

5.103)

$$m = 2 \text{ kg}$$

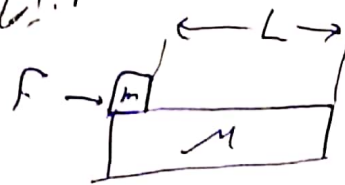
$$M = 8 \text{ kg}$$

$$\mu_k = 0.3$$

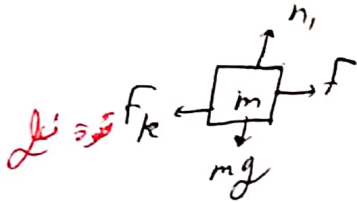
$$F = 10 \text{ N}$$

$$L = 3 \text{ m}$$

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أ. أ. ش. نقل الشاقي



a) the time interval for m to reach the right edge.



for $m = 2 \text{ kg}$

$$\sum F_y = 0$$

$$n_1 - mg = 0$$

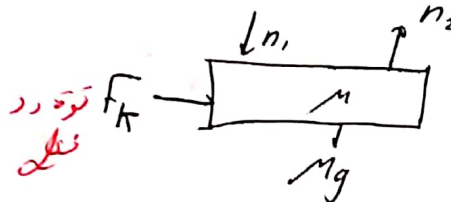
$$n_1 - 2g = 0 \Rightarrow n_1 = 19.6 \text{ N}$$

$$\sum F_x = ma$$

$$F - F_k = ma$$

$$10 - (0.3 \times 19.6) = 2a$$

$$a = 2.06 \text{ m/s}^2$$



for $M = 8 \text{ kg}$

$$\sum F_x = Ma$$

$$F_k = 8a$$

$$(0.3 \times 19.6) = 8a$$

$$a = 0.735 \text{ m/s}^2$$

لا بد ان الكتلة M تتحرك مع m حتى لا يتركها من تحتها

$$a_{ME} = 2.06 \quad / \quad a_{ME} = 0.735 \quad / \quad a_{mM} = 2.06 - 0.735 = 1.325 \text{ m/s}^2$$

$$L = v_{ix}t + \frac{1}{2}at^2$$

$$3 = \frac{1}{2} \times 1.325 \times t^2 \Rightarrow t = 2.1275$$

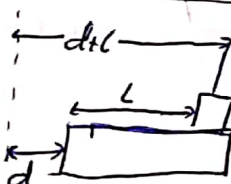
b) المسافة التي يقطعها الكتلة M

$$d = \frac{1}{2}at^2$$

$$= \frac{1}{2} \times 0.735 \times (2.1275)^2$$

$$= 1.66 \text{ m}$$

يوجد طريق آخر للحل راجع
حل المسألة



$$\left(\frac{1}{2} \times 2.06 \times t^2 \right) - \left(\frac{1}{2} \times 0.735 \times t^2 + 3 \right) = L$$

$$t = 2.1275 \text{ s}$$

(30)