PHYS141 OUTLINE QUESTIONS SOLUTIONS

BY AHMAD HAMDAN

BZU-HUB.COM

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 1 | Chapter 5, Page 100

Answered 2 years ago

Step 1 1 of 2

In order to solve this problem let's write the sum of forces in vector notation

$$\vec{F} = \vec{F}_1 + \vec{F}_2 = 9\text{N}\,\hat{i} + 7\text{N}\,\hat{j}$$

The acceleration is then found from

$$\vec{F} = m\vec{a}$$

$$\vec{a} = \frac{\vec{F}}{m} = \frac{9\hat{i} + 7\hat{j}}{6}$$

$$\vec{a} = 1.5\text{m/s}^2\hat{i} + 1.17\text{m/s}^2\hat{j}$$

a) We find the magnitude of the acceleration by using the well known relation

$$|\vec{a}| = \sqrt{1.5^2 + 1.17^2}$$

$$|\vec{a}| = 1.9\text{m/s}^2$$

b) The direction is found by employing the following relation

$$\tan\theta = \frac{a_y}{a_x} = \frac{1.17}{1.5}$$

Which gives us the angle as

$$\theta = 38^\circ$$

Result 2 of 2

a) $|\vec{a}| = 1.9\text{m/s}^2$

b) $\theta = 38^\circ$

Rate this solution

‹ Exercise 82 Exercise 2 ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 7a | Chapter 5, Page 101

Answered 1 year ago

Step 1

1 of 7

Givens:

- $m = 2 \ \text{Kg}$
- $a = 12 \ \text{m/s}^2$
- $\theta = 30^\circ$ to the y-axis
- $F_1 = 20 \ \text{N}$

Assuming that the gravitational force is not affecting the box.

Step 2

2 of 7

To solve this equation, we will divide Newton's second law into two sides, $L.H.S.$ and $R.H.S.$

$$\vec{F} = m\vec{a} = \vec{F}_1 + \vec{F}_2$$

Where $L.H.S. = m\vec{a}$, and

$R.H.S. = \vec{F}_1 + \vec{F}_2$

Starting with the following:

$$L.H.S. = m\vec{a}$$

We need to calculate the x-component and y-component of the acceleration vector.

Step 3

3 of 7

First, we have the acceleration in the third quarter, where x and y are negative, then:

$$\begin{aligned} a_x &= -a \sin\theta \\ &= -(12)\sin 30^\circ \\ &= -6 \ \ \text{m/s}^2 \end{aligned}$$

$$\begin{aligned} a_y &= -a \cos\theta \\ &= -(12)\cos 30^\circ \\ &= -10.39 \ \ \text{m/s}^2 \end{aligned}$$

$$\Rightarrow \vec{a} = -6\,\hat{i} - 10.39\,\hat{j} \ \ \text{m/s}^2$$

Now, we can calculate the total force, by multiplying the mass by the calculated acceleration:

$$\begin{aligned} \vec{F} &= m\vec{a} \\ &= (2)(-6\,\hat{i} - 10.39\,\hat{j}) \\ &= -12\,\hat{i} - 20.78\,\hat{j} \ \ \text{N} \end{aligned}$$

Step 4

4 of 7

Taking the $R.H.S.$:

$$\begin{aligned} \vec{F} &= \vec{F}_1 + \vec{F}_2 \\ &= 20\hat{i} + (\vec{F}_{2x} + \vec{F}_{2y}) \end{aligned}$$

Step 5

5 of 7

Now, we will equate both of the $L.H.S.$ and $R.H.S$:

$$\begin{aligned} m\vec{a} &= \vec{F}_1 + \vec{F}_2 \\ -12\hat{i} - 20.78\hat{j} \ \ \text{N} &= 20\hat{i} + (\vec{F}_{2x} + \vec{F}_{2y}) \ \ \text{N} \\ 20\hat{i} + (\vec{F}_{2x} + \vec{F}_{2y}) + 12\hat{i} + 20.78\hat{j} &= 0 \end{aligned}$$

Separating the x-components and y-components, we get:

$$(20 + \vec{F}_{2x} + 12)\hat{i} + (\vec{F}_{2y} + 20.78)\hat{j} = 0$$

Step 6

6 of 7

That means the sum of forces in the x direction and the Sum of forces in the y direction is zero. Thus, we can write:

$$\begin{aligned} \because \ (20 + \vec{F}_{2x} + 12)\hat{i} &= 0 \\ \Rightarrow F_{2x} i = -20 - 12 &= -32i \ \ \text{N} \\ \because \ (\vec{F}_{2y} + 20.78)\hat{j} &= 0 \\ \Rightarrow \vec{F}_{2y}\hat{j} &= -20.78\hat{j} \ \ \text{N} \end{aligned}$$

$$\begin{aligned} \vec{F}_2 &= \vec{F}_{2x}\hat{i} + \vec{F}_{2y}\hat{j} \\ &= -32\hat{i} + -20.78\hat{j} \ \ \text{N} \end{aligned}$$

Result

7 of 7

$$\vec{F}_2 = -32\hat{i} + -20.78\hat{j} \ \ \text{N}$$

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 7b | Chapter 5, Page 101

Answered 1 year ago

Step 1 1 of 2

The magnitude of the force is calculated as below:

$$F = \sqrt{(\vec{F}_{2x})^2 + (\vec{F}_{2y})^2}$$

$$= \sqrt{(-32\hat{i})^2 + (-20.78\hat{j})^2}$$

$$= 38.16 \text{ N}$$

Result 2 of 2

$$F = 38.16 \text{ N}$$

Exercise 7a

Rate this solution

Exercise 7c

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 7c | Chapter 5, Page 101

Answered 1 year ago

Step 1 1 of 2

The angle can be calculated as below:

$$\theta_2 = \tan^{-1}\frac{F_{2y}}{F_{2x}}$$

$$= \tan^{-1}\frac{-20.78}{-32}$$

$$= 33^\circ \text{ from -ve x-axis}$$

To get the angle with respect to the +ve x-axis, we sum up 180 to the calculated angle:

$$\Rightarrow \theta_2 = 180 + 33$$
$$= 213^\circ$$

Result 2 of 2

$$\theta_2 = 213^\circ$$

Exercise 7b

Rate this solution

Exercise 8

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 10 | Chapter 5, Page 101

Answered 2 years ago

Step 1 1 of 2

In order to solve this problem we will find the velocity and the acceleration of the particle and then we are going the calculate the force at a given moment. Since the motion is one dimensional, we will omit vector symbols. The position of the particle is given as

$$x = -13 + 2t + 4t^2 - 3t^3$$

Now, the velocity is given as

$$v = \frac{dx}{dt} = 2 + 8t - 9t^2$$

And the acceleration becomes

$$a = 8 - 18t$$

At the moment $t = 2.6\text{s}$ the acceleration has a value

$$a = 8 - 18 \times 2.6 = -38.8\text{m/s}^2$$

Now, by definition, the force acting on the particle is

$$F = ma = 0.15 \times (-38.8)$$

$$F = -5.82\text{N}$$

Result 2 of 2

$$F = -5.82\text{N}$$

‹ Exercise 9

Rate this solution

Exercise 11 ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 14 | Chapter 5, Page 101

Answered 2 years ago

Step 1 1 of 2

In order to determine the force with which object acts on the table, we will have to take the sum of all the forces acting on the object and find the force with which table acts on the object. Then, from Newton's third law the force by which the object acts on the table has the same magnitude but the opposite direction.

$$0 = F_N + F_K - F_G$$

$$F_N = F_G - F_K = 4 - 1 = 3\text{N}$$

Then the force acting on the table by the object is

$$F = -F_N = -3\text{N}$$

Result 2 of 2

$$F = -3\text{N}$$

Exercise 13

Rate this solution

Exercise 15a

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 15a | Chapter 5, Page 101

Answered 1 year ago

Step 1 1 of 3

Givens:

- Three figures demonstrating three ways of measuring the weight of a salami.

Step 2 2 of 3

In this formation, the spring reading equals the weight of the salami, therefore we can write:

$$\begin{aligned} W &= m \cdot g \\ &= 11.0 \times 9.81 \\ &= \boxed{108\ \text{N}} \end{aligned}$$

Result 3 of 3

$$108\ \text{N}$$

Exercise 14

Rate this solution

Exercise 15b

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 15b | Chapter 5, Page 101

Answered 1 year ago

Step 1 1 of 2

In this formation, the scale reading equals the tension in the rope, and because the salami is stationary, the tension in the rope is equal to the weight, therefore:

$$\begin{aligned} T &= W \\ &= m \cdot g \\ &= 11.0 \times 9.81 \\ &= \boxed{108\ \text{N}} \end{aligned}$$

Result 2 of 2

$$T = 108\ \text{N}$$

‹ Exercise 15a

Rate this solution ☆ ☆ ☆ ☆ ☆

Exercise 15c ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 15c | Chapter 5, Page 101

Answered 1 year ago

Step 1 1 of 2

In this formation, the scale is under equilibrium due to equal tension in opposite directions, therefore the scale reading is equal to the salami weight:

$$\begin{aligned} W &= m \cdot g \\ &= 11.0 \times 9.81 \\ &= \boxed{108\ \text{N}} \end{aligned}$$

Result 2 of 2

$$W = 108\ \text{N}$$

Exercise 15b

Rate this solution

Exercise 16a

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 34 | Chapter 5, Page 103

Answered 2 years ago

Step 1 1 of 2

a) In order to solve this problem, we will have to decompose forces into two coordinates, we will use the surface of the ramp as the first axis and the normal on it as the second. Since the block is moving at a constant speed, i.e. $a = 0$, along the ramp we have that $F\cos\theta - mg\sin\theta = 0$

$$F = mg\tan\theta = 115 \times 9.81 \times \tan 30^\circ$$

Which finally gives that

$$F = 651\text{N}$$

b) The projections on acting forces on the axis perpendicular to the ramp's surface gives that

$$F_n - F\sin\theta - mg\cos\theta = 0$$

since the body is not moving along this coordinate.

$$F_n = F\sin\theta + mg\cos\theta = 651 \times \sin 30^\circ + 115 \times 9.81 \times \cos 30^\circ$$

Finally, the force by which the ramp acts on the object is

$$F_n = 1.3 \times 10^3\text{N}$$

Result 2 of 2

$$F_n = 1.3 \times 10^3\text{N}$$

‹ Exercise 33

Rate this solution

Exercise 35 ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 35 | Chapter 5, Page 103

Answered 2 years ago

Step 1 1 of 2

In order to solve this problem, we will have to find the first the moment of time in which the magnitude of the force has the given value. To do this we will have to know the force time dependence, i.e. the acceleration. The latter is to be found as

$$\vec{a} = \frac{d\vec{v}}{dt} = 7\hat{i} + 4t\hat{j}$$

Now, the force is equal to

$$\vec{F} = m\vec{a} = m(7\hat{i} + 4t\hat{j})$$

And the square of the magnitude is

$$F^2 = m^2(7^2 + 4^2t^2)$$

If we solve this for t we obtain

$$t^2 = \frac{F^2 - 49m^2}{16m^2} = \frac{35^2 - 49 \times 2.5^2}{16 \times 2.5^2}$$

$$t = 3.03\text{s}$$

a) At the given moment we have that the direction of the force is found from

$$\tan\theta_F = \frac{F_y}{F_x} = \frac{4 \times 3.03}{7}$$

Which gives us that

$$\theta_F = \arctan 2.6 = 60^\circ$$

b) At the same moment the direction of the motion is found in the same way, but using the velocity vector instead

$$\tan\theta_v = \frac{v_y}{v_x} = \frac{2 \times 3.03^2}{7 \times 3.03}$$

Which gives us that

$$\theta_v = \arctan 0.86 = 41^\circ$$

Result 2 of 2

a) $\theta_F = 60^\circ$

b) $\theta_v = 41^\circ$

‹ Exercise 34

Rate this solution

Exercise 36 ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 43a | Chapter 5, Page 103

Answered 1 year ago

Step 1 1 of 4

Givens:

Five links each link has 0.1 kg are lifted with a constant acceleration $a = 2.5\ \mathrm{m/s^2}$

Step 2 2 of 4

The force acts on these links is upward and there are another force acts on them which are the gravitational force.

These five links connect to each other and arranged from bottom to top, so each link acts on the following link, 2 on 1, 3 on 2, 4 on 3, 5 on 4 and vice-versa according to Newton's third law.

The forces acts on each link are the gravitational force F_g and that exerted from the directly above link

Step 3 3 of 4

Part a:

The force applied by link 2 on link 1 is F_{21}, so

$$F_{21} - m_1 g = m_1 a$$

Then

$$\begin{aligned} F_{21} &= m_1(a+g) \\ &= 0.1 \times (2.5 + 9.8) \\ &= 1.23\ \mathrm{N} \end{aligned}$$

$$\boxed{F_{21} = 1.23\ \mathrm{N}}$$

Result 4 of 4

(a) $F_{21} = 1.23\ \mathrm{N}$

Exercise 42

Rate this solution

Exercise 43b

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 43b | Chapter 5, Page 103

Answered 1 year ago

Step 1 1 of 2

Part b:

The force applied by link 3 on link 2 is F_{32}, but the force of link 2 on link 1 acts on link 2 (downward), so it is opposite in direction with F_{32},in addition to the gravitational one which is in the same direction of F_{21} and opposite with F_{32}. so,

$$F_{32} - F_{21} - m_2 g = m_2 a$$

Then

$$\begin{aligned} F_{32} &= m_2(a+g) + F_{21} \\ &= 0.1 \times (2.5 + 9.8) + 1.23 \\ &= 2.46 \text{ N} \end{aligned}$$

$$\boxed{F_{32} = 2.46 \text{ N}}$$

Result 2 of 2

(b) $F_{32} = 2.46 \text{ N}$

‹ Exercise 43a

Rate this solution ☆ ☆ ☆ ☆ ☆

Exercise 43c ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 43c | Chapter 5, Page 103

Answered 1 year ago

Step 1 1 of 2

Part c:

The force applied by link 4 on link 3 is F_{43}, but the force of link 3 on link 2 acts on link 3 (downward), so it is opposite in direction with F_{43},in addition to the gravitational one which is in the same direction of F_{32} and opposite with F_{43}. so,

$$F_{43} - F_{32} - m_3 g = m_3 a$$

Then

$$F_{43} = m_2(a+g) + F_{32} = 0.1 \times (2.5 + 9.8) + 2.46 = 3.69 \text{ N}$$

$$\boxed{F_{43} = 3.69 \text{ N}}$$

Result 2 of 2

(c) $F_{43} = 3.69 \text{ N}$

‹ Exercise 43b

Rate this solution

Exercise 43d ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 43d | Chapter 5, Page 103

Answered 1 year ago

Step 1 1 of 2

Part d:

The force applied by link 5 on link 4 is F_{54}, but the force of link 4 on link 3 acts on link 4 (downward), so it is opposite in direction with F_{54},in addition to the gravitational one which is in the same direction of F_{43} and opposite with F_{54}. so,

$$F_{54} - F_{43} - m_4 g = m_4 a$$

Then

$$F_{54} = m_4(a+g) + F_{43} = 0.1 \times (2.5 + 9.8) + 3.69 = 4.92 \text{ N}$$

$$\boxed{F_{43} = 4.92 \text{ N}}$$

Result 2 of 2

(d) $F_{43} = 4.92 \text{ N}$

‹ Exercise 43c

Rate this solution

Exercise 43e ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 43e | Chapter 5, Page 103

Answered 1 year ago

Step 1 1 of 2

Part e:

The force applied on link 5 is F, but the force of link 5 on link 4 acts on link 5 (downward), so it is opposite in direction to F,in addition to the gravitational one which is in the same direction of F_{54} and opposite with F. so,

$$F - F_{54} - m_5 g = m_5 a$$

Then

$$F = m_5(a+g) + F_{54} = 0.1 \times (2.5 + 9.8) + 4.92 = 6.15\ \text{N}$$

$$\boxed{F_{43} = 6.15\ \text{N}}$$

If we notice here the force acts on each link from the previous one are equal, but here it exists because the masses of all links are the same and the same acceleration.

Result 2 of 2

(e)$F_{43} = 6.15\ \text{N}$

‹ Exercise 43d

Rate this solution

Exercise 43f ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 43f | Chapter 5, Page 103

Answered 1 year ago

Step 1 1 of 2

Part f:

because the masses are the same $m_1 = m_2 = m_3 = m_4 = m_5 = m$ and the same acceleration so the net force acts on each link is:

$$F = ma = 0.1 \times 2.5 = 0.25 \text{ N}$$

$$\boxed{F = 0.25 \text{ N}}$$

Result 2 of 2

(f) $F = 0.25 \text{ N}$

Exercise 43e

Rate this solution

Exercise 44

Expert-written solutions

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 45a | Chapter 5, Page 103

Solution A Solution B

Answered 3 months ago

Step 1 1 of 4

Data known from the problem:

$$W = 27.8 \text{ kN} = 27.8 \times 10^3 \text{ N}$$
$$a_1 = 1.22 \frac{\text{m}}{\text{s}^2}$$
$$a_2 = -1.22 \frac{\text{m}}{\text{s}^2}$$

Step 2 2 of 4

We know that the elevator weight and mass connect with the following formula:

$$W = mg$$

There are two forces acting in this case. The first force is gravity force and the second one is tension. As we know gravity force always acts downwards. And tension is acting on the cable that holds the elevator, so this force is acting upwards. Now we can find the mass of the elevator:

$$m = \frac{W}{g}$$
$$m = 2.84 \times 10^3 \text{ kg}$$

Now, from Newton's second low we can say that:

$$ma = T - mg$$

Step 3 3 of 4

Case a:

Now, we need to find tension in the cable if the cab's speed is increasing. Now, from Newton's second low we can say that:

$$ma_1 = T - mg$$
$$T = ma_1 + mg$$
$$T = 31.29 \times 10^3 \text{ N}$$

Result 4 of 4

$$T = 31.29 \times 10^3 \text{ N}$$

Exercise 44 Rate this solution Exercise 45b

Expert-written solutions

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 45b | Chapter 5, Page 103

Solution A Solution B

Answered 3 months ago

Step 1 1 of 4

Data known from the problem:

$$W = 27.8 \text{ kN} = 27.8 \times 10^3 \text{ N}$$
$$a_1 = 1.22 \frac{\text{m}}{\text{s}^2}$$
$$a_2 = -1.22 \frac{\text{m}}{\text{s}^2}$$

Step 2 2 of 4

We know that the elevator weight and mass connect with the following formula:

$$W = mg$$

There are two forces acting in this case. The first force is gravity force and the second one is tension. As we know gravity force always acts downwards. And tension is acting on the cable that holds the elevator, so this force is acting upwards. Now we can find the mass of the elevator:

$$m = \frac{W}{g}$$
$$m = 2.84 \times 10^3 \text{ kg}$$

Now, from Newton's second low we can say that:

$$ma = T - mg$$

Step 3 3 of 4

Case b:

We need to find tension in the cable if the cab's speed is decreasing: Newton's second's low:

$$ma_2 = T - mg$$
$$T = ma_2 + mg$$
$$T = 24.37 \times 10^3 \text{ N}$$

Result 4 of 4

$$T = 24.37 \times 10^3 \text{ N}$$

‹ Exercise 45a

Rate this solution

Exercise 46 ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 51a | Chapter 5, Page 104

Answered 1 year ago

Step 1

1 of 6

Information

This very interesting example, after we figure out the concept behind it, will be of great use to us when dealing with similar but more complex examples.

But before we continue, let's note the given values.

Known values:

- first block's mass: $m_1 = 1.3\ \text{kg}$
- second block's mass: $m_2 = 2.8\ \text{kg}$

Our goal is to find the acceleration of this system of two blocks and the magnitude of the tension in the rope.

Step 2

2 of 6

Strategy

Newton's second law states that a body (or system of bodies) will accelerate as a result of some net force $\vec{F}_{\text{net}}$ being applied to it

$$\vec{F}_{\text{net}} = m \cdot \vec{a} \tag{1}$$

where m denotes the mass of the body (or system of bodies) and $\vec{a}$ is the acceleration of the body (or system of bodies).

In our example, the motion is happening only along the vertical, so we will not use any additional notation.

Note that we took the **upward** direction for the first block and the **downward** direction for the second block as **positive** ones, as seen in the picture $1)$ on the next pages.

For the first block (the green one), the equation of motion, using the formula (1) and paying **attention** to all present forces and their directions, can be written as

$$F_{\text{net}} = T - W_1 = T - m_1 \cdot g = m_1 \cdot a \tag{2}$$

where T is the tension in the rope, W_1 is the weight and the m_1 the mass of the first block, g is the acceleration due to gravity.

Step 3

3 of 6

For the second block (the red one), the equation of motion, using the formula (1) and again paying **attention** to all present forces and their directions, can be written as

$$F_{\text{net}} = W_2 - T = m_2 \cdot g - T = m_2 \cdot a \tag{3}$$

where W_2 is the weight and the m_2 is the mass of the second block.

If we add the equations (2) and (3), we can easily obtain the expression for the acceleration of these two blocks as

$$a = \frac{m_2 - m_1}{m_2 + m_1} \cdot g \tag{4}$$

After we find the acceleration, we can use any of the two formulas (2) or (3) to find the magnitude of the tension in the rope, so picking the formula (2) we get it to be

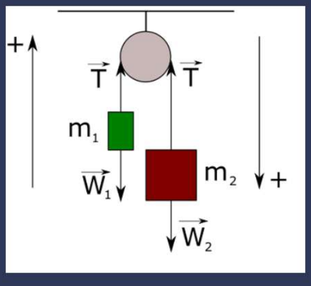
$$T = m_1 \cdot (a + g) \tag{5}$$

The picture that shows us this situation can be seen on the next page, so check it out.

Step 4

4 of 6

Here we assumed that the first (green) block moves up and the second (red) block moves down.



Picture $1)$

So let's find these two values together, in the next segment.

Step 5

5 of 6

Solution

The value for the acceleration due to gravity is

$$g = 9.8\ \text{m/s}^2$$

a) The magnitude of the acceleration of this system of two blocks, according to the formula (4) and known data, is equal to

$$\begin{aligned} a &= \frac{m_2 - m_1}{m_2 + m_1} \cdot g \\ &= \left(\frac{2.8\ \text{kg} - 1.3\ \text{kg}}{2.8\ \text{kg} + 1.3\ \text{kg}}\right) \cdot (9.8\ \text{m/s}^2) \\ &= \boxed{3.6\ \text{m/s}^2} \end{aligned}$$

Here the positive value means that our assumption was indeed correct. This system will move as we noted in the picture $1)$.

Result

6 of 6

a)

$$a = 3.6\ \text{m/s}^2$$

Exercise 50b

Rate this solution ☆ ☆ ☆ ☆ ☆

Exercise 51b

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 51b | Chapter 5, Page 104

Answered 1 year ago

Step 1 1 of 2

b) The magnitude of the tension in the rope in this situation, according to the formula (5) and known data, is equal to

$$\begin{aligned} T &= m_1 \cdot (a+g) \\ &= (1.3\ \text{kg}) \cdot (3.6\ \text{m/s}^2 + 9.8\ \text{m/s}^2) \\ &= \boxed{17.4\ \text{N}} \end{aligned}$$

Result 2 of 2

b)

$$T = 17.4\ \text{N}$$

‹ Exercise 51a

Rate this solution

Exercise 52 ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 58 | Chapter 5, Page 104

Answered 2 years ago

Step 1 1 of 3

This is one of the fundamental problems in physics and allows us to fully demonstrate our understanding of forces acting on a system. In the case when the man is pulling himself, the system is isolated so the total force acting on the ceiling is $mg + ma = T_1$ and on the pulley, the net force is $T_2 + T_3 = T_1$ but we see that $T_2 = T_3$ so we can write that

$$T_1 = 2T_2$$

But we know that on the massless rope we have that

$$F - T_2 = 0$$

$F = T_2 = \frac{1}{2}T_1 = \frac{1}{2}m(g + a)$ a) In the case when $a = 0$

$$F = \frac{1}{2}mg = 0.5 \times 9.81 \times 103$$

$$F = 505\text{N}$$

b) In the case when $a = 1.3\text{m/s}^2$ we write

$$F = \frac{1}{2}m(g + a) = 0.5 \times (9.81 + 1.3) \times 103$$

$F = 572\text{N}$ In the case when another person is pulling us down, will not start from the ceiling but from the chair. Now the equation of the chair is given as

$$mg - T_2 = -ma$$

$$T_2 = m(g + a)$$

But we know again that $T_2 = F$ so we can write

$$F = m(g + a)$$

c) In the case when $a = 0$ we have that

$$F = mg = 103 \times 9.81$$

$$F = 1010\text{N}$$

d) When $a = 1.3$ we obtain the following

$$F = m(g + a) = 103 \times (9.81 + 1.3)$$

$$F = 1144\text{N}$$

Step 2 2 of 3

The magnitude of the force on the ceiling, as we introduce it in very beginning T_1 is always going to be $T_1 = 2T_2 = 2F$. So we can write that

$$\text{e) } T_1 = 2F_a = 2 \times 505 = 1010\text{N}$$

$$\text{f) } T_1 = 2F_b = 2 \times 572 = 1144\text{N}$$

$$\text{g) } T_1 = 2F_c = 2 \times 1010 = 2020\text{N}$$

$$\text{g) } T_1 = 2F_d = 2 \times 1144 = 2288\text{N}$$

Result 3 of 3

a) $F = 505\text{N}$

b) $F = 572\text{N}$

c) $F = 1010\text{N}$

d) $F = 1144\text{N}$

e) $T_1 = 1010\text{N}$

f) $T_1 = 1144\text{N}$

g) $T_1 = 2020\text{N}$

g) $T_1 = 2288\text{N}$

Exercise 57 Rate this solution Exercise 59a

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 59a | Chapter 5, Page 105

Answered 1 year ago

Step 1 1 of 3

Givens:

The mass of the monkey is: m = 10 kg.

The mass of the package is: M = 15 kg.

Step 2 2 of 3

Part a:

The direction of the motion is the y-axis, we use the application of the net force to find the magnitude of the least acceleration, so:

$$T - mg = ma_m \ (1)$$

The up tension of the monkey is in the opposite direction of the monkey's weight.

Now, for the package, the net force acts on it can be determined as:

$$T + F_N + Mg = Ma$$

Where, F_N is the normal force exerted by the ground.

Now, for the minimum force used to lift the package

$$a = 0, \text{ and } F_N = 0$$
$$\Rightarrow T = Mg$$

By substituting into (1)

$$T - mg = ma_m$$
$$\Rightarrow Mg - mg = ma_m$$
$$\Rightarrow \frac{(M-m)g}{m} = a_m$$

$$a_m = \frac{(15\text{ kg} - 10\text{ kg})(9.8\text{ m/s}^2)}{10\text{ kg}}$$

Then, the least acceleration is:

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

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

Result 3 of 3

(a) a_m = 4.9 ^{2}

‹ Exercise 58

Rate this solution

Exercise 59b ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 59b | Chapter 5, Page 105

Answered 1 year ago

Step 1 1 of 2

Part b:

To determine the acceleration, first, we need to determine the direction of motion.

-The direction of the package is downward.
-The direction of the monkey is upward.

$$T = M(g + a)$$
$$T = m(g + a_m)$$

Now, by using the acceleration direction,

$$\Rightarrow T = M(g + a) = m(g + a_m)$$
$$\Rightarrow ma_m = M(g + a) - mg$$

where, $a_m = -a$

Then,

$$ma_m + Ma_m = (M - m)g$$

$$a_m = \frac{(M - m)g}{m + M}$$
$$= \frac{(15\ \text{kg} - 10\ \text{kg})(9.8\ \text{m/s}^2)}{10\ \text{kg} + 15\ \text{kg}}$$
$$= 1.96\ \text{m/s}^2.$$

$$\boxed{a_m = 1.96\ \ \text{m/s}^2}$$

Result 2 of 2

(b) $a_m = 1.96^{\ 2}$

Rate this solution

‹ Exercise 59a Exercise 59c ›

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 59c | Chapter 5, Page 105

Answered 1 year ago

Part c:

Where the monkey's acceleration is +ve, then the direction of the acceleration is upward.

$$\boxed{\text{Upward}}$$

Exercise 59b

Rate this solution

Exercise 59d

Expert-written solution

Principles of Physics, International Edition
ISBN: 9781118230749

Table of contents

Exercise 59d | Chapter 5, Page 105

Answered 1 year ago

Step 1 1 of 2

Part d:

We can calculate, the tension of the rope from

$$\begin{aligned} T &= m(g + a_m) \\ &= 10\ \text{kg}\ (9.8\ \text{m/s}^2 + 1.96\ \text{m/s}^2) \\ &= 117.6\ \text{N}. \end{aligned}$$

$$\boxed{T = 117.6\ \text{N}}$$

Result 2 of 2

(d) T = 117.6 N

Exercise 59c

Rate this solution ☆ ☆ ☆ ☆ ☆

Exercise 60a