

Solution for Homework 2

Chapter 4:

Questions:

4.8 Tendency to keep going in a straight line. Namely, it is due to inertia.

4.12 For city driving, there are more accelerations than that for freeway driving. More accelerations mean more forces required, leading to more gasoline consumption. On free way, force is only required to overcome small friction force.

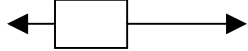
4.15 According to Newton's 3rd law, the force that cart pulls horse has the same magnitude as that the horse pulls the cart, and is 200N.

4.19 When you kick a rock, the rock kick you back simultaneously according to the Newton's third law. Namely, the rock exerts a force on your toe.

Chapter 5:

Exercises:

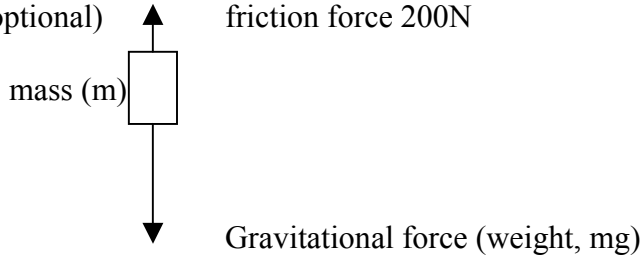
4.5 100N 200N



$$\text{net force} = 200\text{N} - 100\text{N} = 100\text{N}$$

$$\text{Acceleration} = \text{net force}/\text{mass} = 100\text{N}/40\text{kg} = 2.5 \text{ N/kg} = 2.5 \text{ m/s}^2$$

4.7(optional) friction force 200N

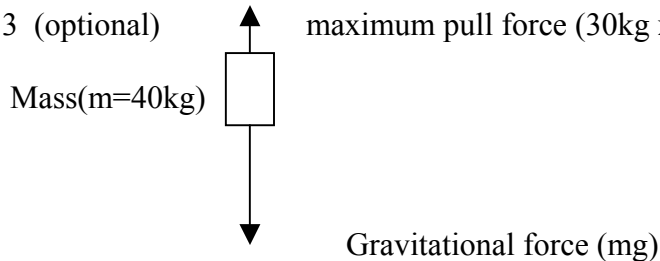


$$\begin{aligned} \text{Net force} &= \text{gravitational force} - \text{friction force} \\ &= \text{mass} \times g - 200\text{N} \\ &= 70\text{kg} \times 9.8\text{m/s}^2 - 200\text{N} \\ &= 686\text{kg m/s}^2 - 200\text{N} \\ &= 686\text{N} - 200\text{N} \\ &= 486\text{N} \end{aligned}$$

$$\begin{aligned} \text{acceleration} &= \text{net force}/\text{mass} \\ &= 486\text{N}/70\text{kg} \\ &= 6.9 \text{ N/kg} \\ &= 6.9 \text{ m/s}^2 \end{aligned}$$

$$\begin{aligned} 4.11 \quad \text{force} &= \text{mass} \times \text{acceleration} \\ &= 4.0\text{g} \times 10000\text{g} \\ &= 0.0040\text{kg} \times 10000 \times 9.8\text{m/s}^2 \\ &= 392\text{kg m/s}^2 \\ &= 392\text{N} \end{aligned}$$

4.13 (optional) maximum pull force ($30\text{kg} \times 9.8\text{m/s}^2$)



He has to escape with an acceleration downwards.

$$\begin{aligned} \text{Net force (downwards)} &= \text{gravitational force} - \text{pull force} \\ &= mg - \text{pull force} \\ &= 40\text{kg} \times 9.8\text{m/s}^2 - 30\text{kg} \times 9.8\text{m/s}^2 \end{aligned}$$

$$= 98 \text{ kg m/s}^2$$

acceleration (downwards) = net force / mass
 = $98 \text{ kg m/s}^2 / 40\text{kg}$
 = 2.5 m/s^2

Therefore, he has to slide down with a minimum acceleration of 2.5m/s^2 .

Questions:

5.4

1) According to Newton's 2nd law, net force = mass x acceleration.

Thus, the net force on the rock is zero because acceleration is zero.

2) After it is dropped, the force is the gravitational force, i.e., the weight, 50N.

3) Before it hits the floor, the force is the gravitational force, i.e., the weight, 50N.

Exercises:

5.1 On the earth, his weight will be: $mg=70\text{kg}\times 9.8\text{m/s}^2=686\text{kg m/s}^2=686\text{N}$

on the moon, his weight will be: $70\text{kg}\times 1.7\text{m/s}^2=119\text{kg m/s}^2= 119\text{N}$

on the Venus, his weight will be: $70\text{kg}\times 8.7\text{m/s}^2=609\text{kg m/s}^2= 609\text{N}$

5.9 height = $\frac{1}{2} \times \text{gravitational acceleration} \times \text{time}^2 = \frac{1}{2} \times 9.8\text{m/s}^2 \times (2.0\text{s})^2 = 19.6\text{m}$

horizontal distance = horizontal speed x time = $3.6\text{m/s} \times 2.0\text{s} = 7.2 \text{ m}$

Therefore, the cliff has a height of 19.6m, and the diver hit the water 7.2m away from its base.

Chapter 7:

questions:

7.1

The work depends on two factors: i) force, and ii) the distance through which the force acts.

7.16

She has potential energy. As she descends the hill, her kinetic energy increases while her potential energy decreases.

Exercises:

$$7.1 \text{ work} = \text{force} \times \text{distance} = 900\text{N} \times 2.5\text{km} = 900\text{N} \times 2500\text{m} = 2250000\text{Nm} = 2250000\text{J}$$

$$7.6 \text{ kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{velocity}^2 = \frac{1}{2} \times 55\text{kg} \times (9.0\text{m/s})^2 \\ = 2227.5\text{kg m/s}^2 = 2227.5\text{J}$$

$$7.13 \text{ change in potential is } mgh = 10\text{kg} \times 9.8\text{m/s}^2 \times 220\text{cm} = 10\text{ kg} \times 9.8\text{m/s}^2 \times 2.2\text{m} = 215.6\text{J}$$

$$7.21 \text{ Power} = \text{work}/\text{time} = (\text{force} \times \text{distance}) / \text{time}$$

$$= (mg \times \text{distance}) / \text{time} = (mg \times \text{height}) / \text{time}$$

$$= 65\text{kg} \times 9.8\text{m/s}^2 \times 3.5\text{m} / 5.0\text{s} = 445.9 \text{ kg m/s}^2 / \text{s} = 445.9 \text{ J/s}$$

$$= 445.9\text{watt} = 445.9 \text{ watt} \times (1\text{hp}/750\text{watt}) = 0.59\text{hp}$$