

Solutions to Period 5 Exercises

E.1 Which of the following is TRUE?

- a) The strong force is not a fundamental force.
- b) The electromagnetic force is not a fundamental force.
- c) The weak force is not a fundamental force.
- d) The frictional force is not a fundamental force.
- e) All of the above are not fundamental forces.

E.1 = d The frictional force is not a fundamental force.

E.2 A bicycle and its rider have a combined mass of 80 kg. What horizontal force is necessary for the bike and rider to achieve an acceleration of 3 m/s^2 ? (Neglect the force of friction.)

- a) 240 newtons
- b) 77 newtons
- c) 27 newtons
- d) 3 newtons
- e) 0 newtons

$$F = M a = 80 \text{ kg} \times 3 \text{ m/s}^2 = 240 \text{ kg m/s}^2 \\ = 240 \text{ N}$$

E.2 = a

E.3 When you slow down your car by applying the brakes, what happens to the mechanical energy of motion of your car?

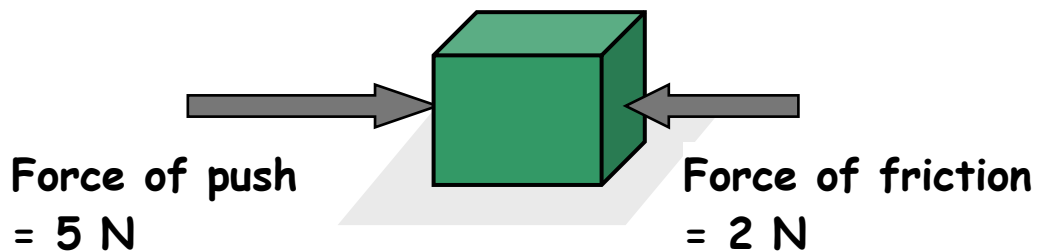
- a) It is stored as chemical energy in the car's battery.
- b) It is converted into thermal energy through friction.
- c) It is converted into chemical energy in the form of gasoline.
- d) It is stored as gravitational potential energy.
- e) Choice b) is true for all vehicles and choice a) is also true for hybrid vehicles.

E.3 = e The mechanical energy of motion of a vehicle is converted into thermal energy through friction when you apply the brakes.

In hybrid vehicles, some of the mechanical energy of the wheels is used to generate electricity, some of which is stored in the vehicle's battery.

E.4 A 0.5 kg block is pushed along a level floor with a force of 5 newtons. What is the acceleration of the block if the motion is opposed by a constant frictional force of 2 newtons?

- a) 0.8 m/s^2
- b) 1.5 m/s^2
- c) 2 m/s^2
- d) 4 m/s^2
- e) 6 m/s^2



Because the forces act in opposite directions, the **net force** on the box = force of the push – the force of friction

$$\begin{aligned}\text{Net force} &= \text{Force}_{\text{push}} - \text{Force}_{\text{friction}} \\ &= 5 \text{ N} - 2 \text{ N} = 3 \text{ N}\end{aligned}$$

$$a = \frac{F}{M} = = \frac{3 \text{ kg m/s}^2}{0.5 \text{ kg}} = 6 \text{ m/s}^2$$

E.4 = e

E.5 According to Newton's third law, the force of the sun on the moon is

- a) 100 times the force of the moon on the sun.
- b) 10 times the force of the moon on the sun
- c) equal to the force of the moon on the sun.
- d) equal to the ratio of the mass of the sun to the mass of the moon.
- e) equal to the ratio of the mass of the moon to the mass of the sun.

According to Newton's third law, the force of the sun on the moon **is equal to** the force of the moon on the sun.

E.5 = c

E.6 A box with a mass of 3 kg is at rest on a rough surface. You push the box with a constant force of 8 newtons, and the velocity of the box increases by 2 m/sec each second. What is the frictional force between the box and the rough surface?

- a) 1 newton
- b) 2 newtons
- c) 6 newtons
- d) 8 newtons
- e) Since you can move the box, there must be no frictional force between the box and the rough surface.

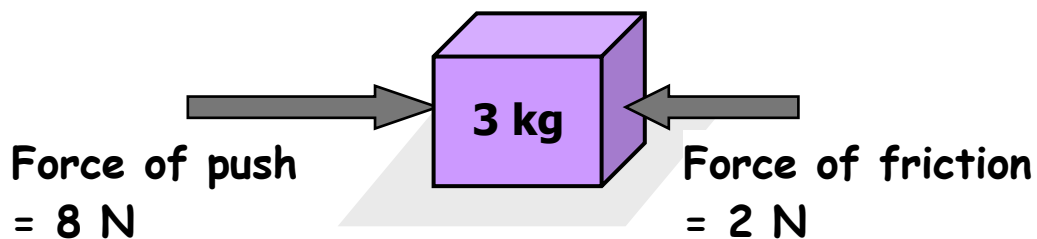
Since the box accelerates at 2 m/s^2 , the force accelerating it must be

$$F = M a = 3 \text{ kg} \times 2 \text{ m/s}^2 = 6 \text{ N}$$

$$6 \text{ N} = \text{Net force} = \text{Force}_{\text{push}} - \text{Force}_{\text{friction}}$$

$$\text{Force}_{\text{friction}} = \text{Force}_{\text{push}} - \text{Net force}$$

$$\text{Force}_{\text{friction}} = 8 \text{ N} - 6 \text{ N} = 2 \text{ N}$$



E.6 = b

Solutions to Period 5 Exercises

E.1 = d

E.2 = a

E.3 = e

E.4 = e

E.5 = c

E.6 = b