3.1 Types of Forces

Textbook pp. 114–122

Vocabulary

dynamics	free-body diagram (FBD)	normal force ($\vec{F}_N$)	net force ($\vec{F}_{net}$)
newton (N)	applied force ($\vec{F}_a$)	friction ($\vec{F}_f$)	
system diagram	tension ($\vec{F}_T$)	force of gravity ($\vec{F}_g$)	

MAIN IDEA: A force is a push or a pull. Force is a vector quantity, and the total force, or net force, acting on an object determines the effect of the forces on the object's motion. A free-body diagram is used to help determine the net force on an object.

1. How does kinematics differ from dynamics? K/U

Kinematics: Motion
Dynamics: Why the motion happens

2. The SI unit of force is the Newton. The symbol used for force is the N. K/U

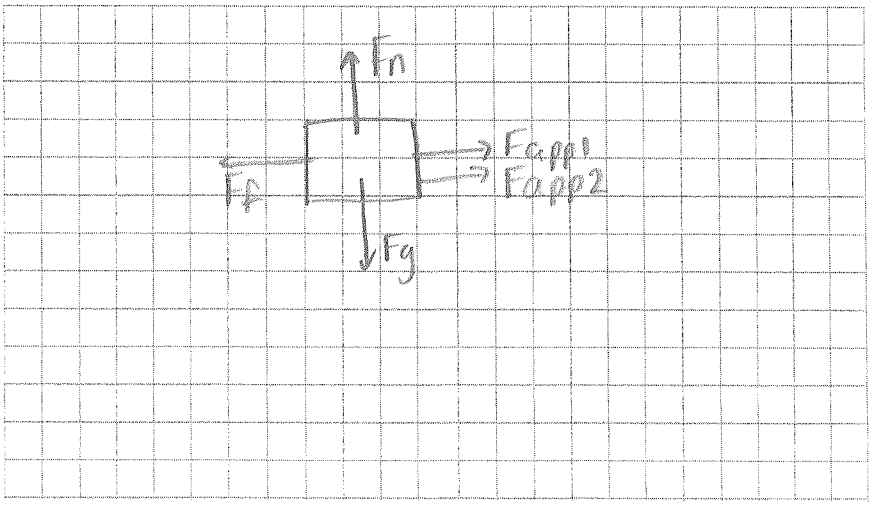
STUDY TIP

Free-Body Diagrams
Sketching a free-body diagram is a good way to visualize the forces acting on an object.

3. How does a system diagram differ from a free-body diagram? K/U

System → everything
FBD → only the object

4. Suppose two students are pushing a crate horizontally along the ground. Draw the free-body diagram for the crate, and label each force acting on it. C



5. Suppose several forces act on a single object. Define each of these terms in your own words: K/U

(a) applied force: The force you apply

(b) net force: All of the forces added up

6. Complete **Table 1** describing what characterizes each type of force. K/U

Table 1 Common Forces

	Force	Identifying feature	Direction
(a)	friction	opposes motion of one surface past another	opposite to motion
(b)	normal force	opposite to gravity holds you up	perpendicular to a surface
(c)	tension	pulling force exerted by a string, rope, or cable	along a string, rope, or cable
(d)	gravity	force of attraction to Earth, proportional to object's mass	to the Earth's centre

7. An object is in free fall when the only force acting on it is gravity. K/U

8. (a) What is a contact force?

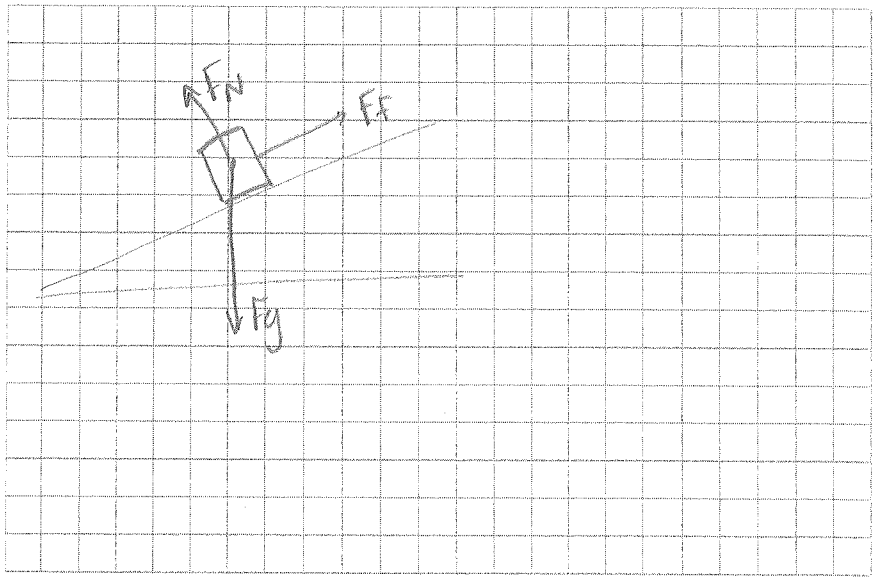
A force that is touching

(b) Give two examples of non-contact forces. K/U

gravity
magnetism

9. When an object with a mass of 0.50 kg hangs from a spring scale, the spring scale should indicate a force of 4.9 N. K/U $F_g = mg$

10. Draw the free-body diagram for a block of wood resting on a board that makes an angle of 30° with the horizontal direction. The force of friction, $\vec{F}_f$, keeps the block of wood from sliding. K/U A



STUDY TIP

When Many Forces Act

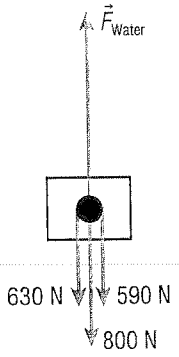
There may be many forces acting on one object. The vector sum of all the forces, which is the net force, is always what determines how the forces affect the motion of an object.

STUDY TIP

Calculating the Force of Gravity

To calculate the magnitude of the force of gravity on an object, use the equation $\vec{F}_g = m\vec{g}$ where $g = 9.8$ m/s^2 [down].

11. The following free-body diagram (**Figure 1**) illustrates the forces acting on a boat weighing 800 N as it floats in the water, with a 630 N passenger and a 590 N passenger. Determine the upward force $\vec{F}_{water}$ that the water exerts to support the boat so that the net force is zero.



$F_{NET} = F_{water} - F_1 - F_2 - F_3$

$F_{water} = F_1 + F_2 + F_3$

$= 630N + 800N + 590N$

$= 2020N$

Figure 1

MAIN IDEA: There are four categories of forces called the four fundamental forces: the gravitational force, the electromagnetic force, the strong nuclear force, and the weak nuclear force.

12. Complete **Table 2** with descriptions of the four fundamental forces.

Table 2 The Fundamental Forces

	Fundamental force	Description
(a)	gravitational	keeps planets in orbit and pulls objects toward Earth's centre
(b)	electromagnetic	
(c)	strong nuclear	
(d)	weak nuclear	