Chapter 2 Review

Understanding Concepts

1. Describe briefly the four fundamental forces that can account for all known forces.
2. Name the type(s) of force responsible for each of the following:
   (a) A nickel is attracted to a special steel bar.
   (b) A coasting cyclist gradually comes to a stop.
   (c) An electron in a hydrogen atom travels in an orbit around a proton.
   (d) A meteor accelerates toward Earth.
   (e) The meteor in (d) begins to burn and give off light.
3. An airplane is travelling with constant speed, heading east at a certain altitude. What forces are acting on the airplane? What is the net force on the airplane?
4. The scale used to draw the forces in Figure 1 is 1.0 cm = 2.0 N.
   (a) Find the net force acting on the cart.
   (b) If the cart's mass is 1.2 kg, what is its acceleration?

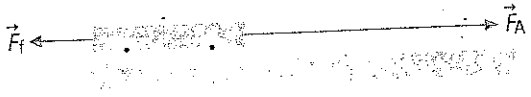

Figure 1

5. Apply Newton's first law of motion to explain the danger in travelling too quickly on a curve of an icy highway.
6. A tractor pulls forward on a moving plow with a force of 2.5×10^4 N, which is just large enough to overcome friction.
   (a) What are the action and reaction forces between the tractor and the plow?
   (b) Are these action and reaction forces equal in magnitude but opposite in direction? Can there be any acceleration? Explain.
7. A football player kicks a 410-g football, giving it an acceleration of magnitude $|25\vec{g}|$ for 0.10 s.
   (a) What net force is imparted to the ball?
   (b) Name and state the magnitude of the reaction force.
8. One of the world's greatest jumpers is the flea. For a brief instant a flea is estimated to accelerate with a magnitude of 1.0×10^3 m/s^2. What is the magnitude of the net force a 6.0×10^{-7}-kg flea would need to produce this acceleration?
9. A net force of magnitude 36 N gives a mass m_1 an acceleration of magnitude 4.0 m/s^2. The same net force gives another mass m_2 an acceleration of magnitude 12 m/s^2. What magnitude of acceleration will this net force give to the entire mass if m_1 and m_2 are fastened together?
10. In an electronic tube, an electron of mass 9.1×10^{-31} kg experiences a net force of magnitude 8.0×10^{-15} N over a distance of 2.0 cm.
    (a) Calculate the magnitude of the electron's acceleration.
    (b) Assuming it started from rest, how fast would the electron be travelling at the end of the 2.0-cm motion?
11. A 1.2×10^4-kg truck is travelling south at 22 m/s.
    (a) What net force is required to bring the truck to a stop in 330 m?
    (b) What is the cause of this net force?
12. Calculate the acceleration of the cart shown in Figure 2, given the following assumptions:
    (a) No friction is acting on the cart.
    (b) A frictional resistance of magnitude 2.0 N is acting on the cart.

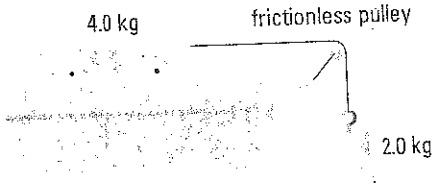

Figure 2

13. You are standing on the edge of a frozen pond where friction is negligible. In the centre of the ice is a red circle 1.0 m in diameter. A prize of a megadollar will be offered if you can apply all three of Newton's laws of motion to get to the red circle and stop there. Describe what you would do to win the prize.
14. A shuffleboard disk of mass 0.50 kg accelerates under an applied force of 12.0 N [forward].
    (a) If the magnitude of the frictional resistance is 8.0 N, find the magnitude of the disk's acceleration.
    (b) If the disk moves from rest for 0.20 s, how far does it travel while accelerating?
15. Each of the four wheels of a car pushes on the road with a force of 4.0×10^3 N [down]. The driving force on the car is 8.0×10^3 N [W]. The frictional resistance on the car is 6.0×10^3 N [E]. Calculate the following:
    (a) the mass of the car
    (b) the net force on the car
    (c) the car's acceleration

16. Draw a free-body diagram to determine the net force acting on the object in *italics* in each of the following situations:
    (a) Two teenagers are pushing a *dirt bike* through a freshly plowed field. One exerts a force of 390 N [W] on the bike while the other exerts a force of 430 N [W]. Frictional resistance amounts to 810 N.
    (b) A *water-skier* is being pulled directly behind a motorboat at a constant speed of 20.0 m/s. The tension in the horizontal rope is 520 N.
    (c) An *elevator*, including passengers, has a mass of 1.0×10^3 kg. The cable attached to the elevator exerts an upward force of 1.2×10^4 N. Friction opposing the motion of the elevator is 1.5×10^3 N.
17. Use unit analysis to check the validity of this equation:

$$\vec{F}_{net} = \frac{m(\vec{v}_f - \vec{v}_i)}{\Delta t}$$

Applying Inquiry Skills

18. A group performing an investigation uses a 100.0-g mass to cause the acceleration of a cart. They record the force of gravity on the mass as 1.0 N. Assuming the true value of the force is 0.98 N, what is the percentage error of their value?
19. (a) State at least one possible source of error when using a spring scale to determine the force needed to support an object.
    (b) What would you do to account for that source of error in an experiment?
20. Design a virtual experiment in which you test the advantages of wearing a safety helmet while mountain biking.
21. A student performs an experiment to study the relationship between applied force and acceleration on a dynamics cart. After applying five different forces and determining the resulting acceleration, the student plots a graph of acceleration versus applied force and obtains the result shown in **Figure 3**.
    (a) Explain why the graph does not pass through the origin.
    (b) How would the graph change if the experiment were repeated using a surface where friction between the cart and the surface was greater?
    (c) What was the value of the frictional force (assumed constant) that acted upon the cart when the student carried out the experiment?

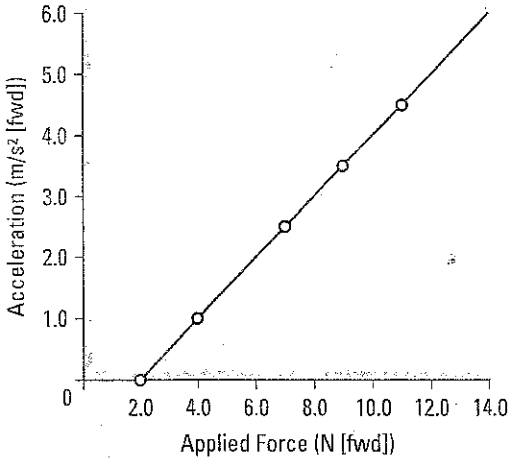

Figure 3

Making Connections

22. A car has a fuel consumption of 7.2 L/100.0 km on an expressway and 9.5 L/100.0 km on city roads. Explain why there is a difference.
23. List possible careers that apply the principles presented in this chapter.
24. Explain these warnings found on the visor of a new automobile:

    "Children 12 and under should be seated in the rear seat."

    "Never seat a rearward-facing child in the front."

Exploring

25. Research the current progress toward a "unified field theory" of forces. Follow the links for Nelson Physics 11, Chapter 2 Review. Use a concept map to summarize your findings about the electroweak force, the Grand Unified Theory (GUT), and the Theory of Everything (TOE).

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26. Many resources are available that depict the life and contributions of Galileo and Newton, the two scientists whose work has been featured frequently in this chapter. Research some interesting aspects of either of these scientists. Write a summary of what you discover.