Chapter 1

E-1

Yes, there is a geometric connection between the two ratios. As the sketch shows, they are approximately equal.

\[
\frac{\text{Pole shadow}}{\text{Pole height}} = \frac{\text{Alexandria - Syene distance}}{\text{Earth radius}}
\]

Chapter 2

E-6

Nothing keeps them moving. The forces due to other planets or stars deflect their paths but are not needed to keep them moving.

E-13

Your seat pushes your body forward. If there is no support at the back of your head, your head is not pushed forward with your body according to Newton’s first law, likely injuring your neck.

E-24

At the top of its path (and elsewhere) the force of gravity acts to change the ball’s motion. Even though it momentarily stops at the top, the net force on the ball is not zero and it therefore is not in equilibrium.

E-37

Yes, the floor pushes upward against your feet with a force equal to that of your weight when you stand on a floor. This upward force (called the normal force) and your weight act in opposite direction. They cancel each other to produce a zero net force on you. Hence, you are not accelerated or moving upward.

E-44

They must be equal and opposite so that the net force = 0. Then the parachutist is in dynamical (mechanical) equilibrium.

E-48

The coin is moving along with you when you toss it. While in the air it maintains this forward motion. So the coin lands in your hand. If the train slows while the coin is in the air, it will land in front of you. If the train makes a turn while the coin is in the air, it will land off to the side of you.
Chapter 3

E-4
The speeds of both are exactly the same, but the velocities are not. Velocity includes direction, and since the directions of the airplanes are opposite, their velocities are opposite.

E-10
a) Yes, because of the change of direction. (b) Yes, because of the velocity changes.

E-22
The greater change in speeds occurs for the slower object; the change in speed for the slower object (30 km/h – 25 km/h = 5 km/h) is greater than the change in speed for the faster one (100 km/h – 96 km/h = 4 km/h). So for the same time, the slower one has the greater acceleration.

E-28
In the absence of air resistance, the acceleration will be g no matter how the ball is released.

E-36
If it were not for the slowing effect of the air, raindrops would strike the ground with the speed of high-speed bullets!

E-44
On the Moon the acceleration due to gravity is considerably less, so jumping height and the hang time would be considerably greater (in fact, about six times greater!).

P-3
Since it starts going up at \( v_0 = 30 \text{ m/s} \) and slows down by \( g = 10 \text{ m/s}^2 \), its time going up is 3 sec. \( (v = v_0 - gt, v_0 = 30 \text{ m/s}, t = 30/g = 3 \text{ sec as } v=0 \text{ at the top.}) \) Its time returning is also 3 seconds, so it’s in the air for a total of 6 sec. Distance up is \( d = \frac{1}{2} gt^2 = 5 \times 3^2 = 45 \text{ m} \).

P-8
Assume the total distance traveled is \( d = 2x \). The time traveled one way is \( t_1 = x/(40 \text{ km/h}) \) and the other way is \( t_2 = x/(60 \text{ km/h}) \). The total travel time is \( t = t_1 + t_2 \) and \( v_{ave} \) is \( v_{ave} = d/t = 2x/( t_1 + t_2) = 240/5 = 48 \text{ km/h} \).

P-9
Drops would be in free fall and \( v = gt \). We should first find the time of the fall. From \( d = \frac{1}{2}gt^2 \), \( t = \sqrt{2d/g} = \sqrt{2000 \text{ m}/10 \text{ m/s}^2} = 14.1 \text{ s} \). So \( v = (10 \text{ m/s}^2)(14.1 \text{ s}) = 141 \text{ m/s} \) (more than 300 miles per hour)!
Chapter 4
E-3
No. An object can move in a curve only when a force acts. With no force, its path would be a straight line.
E-14
10 kg weighs about 100 N on the Earth (W = mg = 10 kg \times 10 \text{ m/s}^2 = 100 \text{ N}.)
On the Moon the weight would be \frac{1}{6} of 100 N = 16.7 N. The mass is 10 kg everywhere.