

***Conceptual Integrated Science, 2e* (Hewitt et al.)**

**Chapter 2 Describing Motion**

Multiple-Choice Questions

1) Whereas Aristotle relied on logic in explaining nature, Galileo relied on

- A) observation.
- B) patterns.
- C) experiment.
- D) mathematics.

Answer: C

Diff: 1

Objective: 2.1

2) The scientist to first introduce the concept of inertia was

- A) Aristotle.
- B) Galileo.
- C) Newton.
- D) Copernicus.

Answer: B

Diff: 1

Objective: 2.2

3) Galileo's interpretation of motion differed from Aristotle's in that Galileo emphasized

- A) the acceleration of free fall.
- B) time rates.
- C) the role of distance in describing motion.
- D) all of the above
- E) none of the above

Answer: B

Diff: 1

Objective: 2.2

4) Which has the greater mass?

- A) a king-size pillow
- B) an automobile battery
- C) both about the same

Answer: B

Diff: 1

Objective: 2.3

5) A kilogram is a measure of an object's

- A) weight.
- B) force.
- C) mass.
- D) gravity.
- E) center of mass.

Answer: C

Diff: 1

Objective: 2.3

6) Compared with a 1-kg block of solid iron, a 2-kg block of solid iron has twice as much

- A) inertia.
- B) mass.
- C) volume.
- D) all of the above
- E) none of the above

Answer: D

Diff: 1

Objective: 2.3

7) Compared with a 1-kg block of solid iron, a 2-kg block of solid iron has the same

- A) mass.
- B) volume.
- C) weight.
- D) all of the above
- E) none of the above

Answer: E

Diff: 1

Objective: 2.3

8) Your weight is

- A) actually your mass.
- B) the gravitational attraction between you and the Earth.
- C) a property of mechanical equilibrium.
- D) all of the above
- E) none of the above

Answer: B

Diff: 1

Objective: 2.4

9) One object has twice as much mass as another object, and also has twice as much

- A) inertia.
- B) velocity.
- C) gravitational acceleration.
- D) volume.
- E) all of the above

Answer: A

Diff: 1

Objective: 2.3

10) Compared with the mass of a certain object on Earth, the mass of the same object on the Moon is

- A) less.
- B) more.
- C) the same.

Answer: C

Diff: 1

Objective: 2.3

11) A 1-kg mass at Earth's surface weighs about

- A) 1 N.
- B) 5 N.
- C) 10 N.
- D) 12 N.
- E) none of the above

Answer: C

Diff: 2

Objective: 2.3

12) In which of the following locations would a chunk of gold weighing 1 N have the largest mass?

- A) the Moon
- B) Earth
- C) the planet Jupiter

Answer: A

Diff: 3

Objective: 2.3

13) An object weighs 30 N on Earth. A second object weighs 30 N on the Moon. Which has the greater mass?

- A) the one on Earth
- B) the one on the Moon
- C) They have the same mass.
- D) not enough information given

Answer: B

Diff: 3

Objective: 2.3

14) Density is the ratio of

- A) weight to volume.
- B) mass to volume.
- C) mass to weight.
- D) weight to mass.

Answer: B

Diff: 1

Objective: 2.3

15) When a loaf of bread rises, its density

- A) increases.
- B) decreases.
- C) stays the same.

Answer: B

Diff: 1

Objective: 2.3

16) Which has the greatest density?

- A) 1 kg of feathers
- B) 10 kg of feathers
- C) 1 kg of lead

Answer: C

Diff: 1

Objective: 2.3

17) An object is pulled northward with a force of 10 N and southward with a force of 15 N. The magnitude of the net force on the object is

- A) 0 N.
- B) 5 N.
- C) 10 N.
- D) 15 N.
- E) none of the above

Answer: B

Diff: 1

Objective: 2.4

18) Which has zero acceleration?

- A) an object at rest
- B) an object moving at constant velocity
- C) an object in mechanical equilibrium
- D) all of the above
- E) none of the above

Answer: D

Diff: 1

Objective: 2.4

19) Whenever the net force on an object is zero, its acceleration

A) may be zero.

B) is zero.

Answer: B

Diff: 1

Objective: 2.4

20) An object in mechanical equilibrium is an object

A) at rest.

B) moving with constant velocity.

C) having no acceleration.

D) all of the above

Answer: D

Diff: 1

Objective: 2.5

21) If a nonrotating object has no acceleration, then we can say for certain that it is

A) at rest.

B) moving at constant nonzero velocity.

C) in mechanical equilibrium.

D) all of the above

E) none of the above

Answer: C

Diff: 2

Objective: 2.5

22) When you stand at rest on a pair of bathroom scales, the readings on the scales will always

A) each be half your weight.

B) each equal your weight.

C) add to equal your weight.

Answer: C

Diff: 2

Objective: 2.5

23) Hang from a pair of gym rings and the upward support forces of the rings will always

A) each be half your weight.

B) each be equal to your weight.

C) add up to equal your weight.

Answer: C

Diff: 2

Objective: 2.5

24) A man weighing 800 N stands at rest on two bathroom scales so that his weight is distributed evenly over both scales. The reading on each scale is

- A) 200 N.
- B) 400 N.
- C) 800 N.
- D) 1600 N.
- E) none of the above

Answer: B

Diff: 2

Objective: 2.5

25) Which direction does a table push a book resting on it?

- A) up
- B) left
- C) right
- D) down

Answer: A

Diff: 1

Objective: 2.6

26) When can an object be in a state of equilibrium?

- A) when two or more forces are acting on it
- B) when it is at rest and no forces are acting on it
- C) only when one force is acting on the object
- D) when an object is not moving

Answer: A

Diff: 1

Objective: 2.7

27) The force of friction on a sliding object is 10 N. The applied force needed to maintain a constant velocity is

- A) more than 10 N.
- B) less than 10 N.
- C) 10 N.

Answer: C

Diff: 1

Objective: 2.8

28) A 300-kg bear grasping a vertical tree slides down at constant velocity. The friction force between the tree and the bear is

- A) 30 N.
- B) 300 N.
- C) 3000 N.
- D) more than 3000 N.

Answer: C

Diff: 3

Objective: 2.8

29) Where is friction most evident?

- A) on the road
- B) in a cup of coffee
- C) in the atmosphere
- D) everywhere

Answer: A

Diff: 2

Objective: IS 2A

30) The two measurements necessary for calculating average speed are

- A) acceleration and time.
- B) velocity and time.
- C) distance and time.
- D) distance and acceleration.
- E) velocity and distance.

Answer: C

Diff: 1

Objective: 2.9

31) The average speed of a horse that gallops a distance of 10 km in a time of 30 min is

- A) 10 km/h.
- B) 20 km/h.
- C) 30 km/h.
- D) more than 30 km/h.

Answer: B

Diff: 1

Objective: 2.9

32) What is the acceleration of a car that maintains a constant velocity of 100 km/h for 10 s?

- A) 0 m/s<sup>2</sup>
- B) 10 km/h/s
- C) 10 m/s<sup>2</sup>
- D) 1000 km/h/s

Answer: A

Diff: 1

Objective: 2.9

33) As an object freely falls, its

- A) velocity increases.
- B) acceleration increases.
- C) both of the above
- D) none of the above

Answer: A

Diff: 1

Objective: 2.9

34) The gain in speed each second for a freely falling object is about

- A) 0 m/s.
- B) 5 m/s.
- C) 10 m/s.
- D) 20 m/s.
- E) depends on the initial speed

Answer: C

Diff: 1

Objective: 2.9

35) If a freely falling object were somehow equipped with a speedometer, its speed reading would increase each second by about

- A) 5 m/s.
- B) 10 m/s.
- C) 15 m/s.
- D) a variable amount
- E) depends on its initial speed

Answer: B

Diff: 1

Objective: 2.9

36) If a freely falling object were somehow equipped with a speedometer on a planet where the acceleration due to gravity is  $20 \text{ m/s}^2$ , then its speed reading would increase each second by

- A) 10 m/s.
- B) 20 m/s.
- C) 30 m/s.
- D) 40 m/s.
- E) depends on its initial speed

Answer: B

Diff: 1

Objective: 2.9

37) If a freely falling object were somehow equipped with an odometer to measure the distance it travels, then the amount of distance it travels each succeeding second would be

- A) constant.
- B) less and less.
- C) greater than the second before.

Answer: C

Diff: 1

Objective: 2.9



38) Ten seconds after starting from rest, a freely falling object on Earth will have a speed of about

- A) 10 m/s.
- B) 50 m/s.
- C) 100 m/s.
- D) more than 100 m/s.

Answer: C

Diff: 1

Objective: 2.9

39) A car accelerates from rest at  $2 \text{ m/s}^2$ . What is its speed 3 s after the car starts moving?

- A) 2 m/s
- B) 3 m/s
- C) 4 m/s
- D) 6 m/s
- E) none of the above

Answer: D

Diff: 2

Objective: 2.10

40) An object travels 8 m in the 1st second of travel, 8 m again during the 2<sup>nd</sup> second of travel, and 8 m again during the 3<sup>rd</sup> second. Its acceleration is therefore

- A)  $0 \text{ m/s}^2$ .
- B)  $5 \text{ m/s}^2$ .
- C)  $8 \text{ m/s}^2$ .
- D)  $10 \text{ m/s}^2$ .
- E) more than  $10 \text{ m/s}^2$ .

Answer: A

Diff: 2

Objective: 2.10

41) An object is in free fall. At one instant, it travels at a speed of 50 m/s. Exactly 1 s later, its speed is about

- A) 25 m/s.
- B) 50 m/s.
- C) 55 m/s.
- D) 60 m/s.
- E) 100 m/s.

Answer: D

Diff: 2

Objective: 2.10

42) Disregarding air resistance, objects fall at constant

- A) velocity.
- B) speed.
- C) acceleration.
- D) distances each successive second.

Answer: C

Diff: 2

Objective: 2.10

43) A ball is thrown upward and caught when it comes back down. In the presence of air resistance, the speed with which it is caught is

- A) more than the speed it had when thrown upward.
- B) less than the speed it had when thrown upward.
- C) the same as the speed it had when thrown upward.

Answer: B

Diff: 2

Objective: 2.10

44) Starting from rest, the distance a freely falling object will fall in 10 s is about

- A) 10 m.
- B) 50 m.
- C) 100 m.
- D) 500 m.

Answer: D

Diff: 2

Objective: 2.10

45) Starting from rest, the distance a freely falling object will fall in 0.5 s is about

- A) 0.5 m.
- B) 1.0 m.
- C) 1.25 m.
- D) 5.0 m.
- E) none of the above

Answer: C

Diff: 2

Objective: 2.10

46) One-half second after starting from rest, a freely falling object will have a speed of about

- A) 20 m/s.
- B) 10 m/s.
- C) 5 m/s.
- D) 2.5 m/s.
- E) none of the above

Answer: C

Diff: 2

Objective: 2.10

47) An apple falls from a tree and hits the ground 5 m below. It hits the ground with a speed of about

- A) 5 m/s.
- B) 10 m/s.
- C) 15 m/s.
- D) 20 m/s.
- E) not enough information given to estimate

Answer: B

Diff: 2

Objective: 2.10

48) It takes 6 s for a stone to fall to the bottom of a mine shaft. How deep is the shaft?

- A) about 60 m
- B) about 120 m
- C) about 180 m
- D) more than 200 m

Answer: C

Diff: 2

Objective: 2.10

49) In each second of fall, the distance a freely falling object will fall is

- A) about 5 m.
- B) about 10 m.
- C) the same, but not 5 m or 10 m.
- D) increasing.
- E) none of the above

Answer: D

Diff: 2

Objective: 2.10

50) A car accelerates at  $2 \text{ m/s}^2$ . Assuming the car starts from rest, how far will it travel in 10 s?

- A) 2 m
- B) 10 m
- C) 40 m
- D) 100 m
- E) 200 m

Answer: D

Diff: 2

Objective: 2.10

51) The muzzle velocity of a certain gun is 100 m/s. Neglecting air resistance, at the end of 1 s a bullet fired straight up into the air will have traveled a distance of about

- A)  $(100 - 5)$  m.
- B)  $(100 + 5)$  m.
- C) 100 m.
- D) 5 m.
- E) none of the above

Answer: A

Diff: 3

Objective: 2.10

52) A bullet is dropped into a river from a very high bridge. At the same time, another bullet is fired from a gun, straight down towards the water. Neglecting air resistance, the acceleration just before striking the water

- A) is greater for the dropped bullet.
- B) is greater for the fired bullet.
- C) is the same for each bullet.
- D) depends on how high they started.
- E) none of the above

Answer: C

Diff: 3

Objective: 2.10

53) Someone standing at the edge of a cliff throws one ball straight up and another ball straight down at the same initial speed. Neglecting air resistance, the ball to hit the ground below the cliff with the greatest speed will be the one initially thrown

- A) upward.
- B) downward.
- C) They will both hit with the same speed.

Answer: C

Diff: 3

Objective: 2.10

54) A ball is thrown upward. Neglecting air resistance, what initial upward speed does the ball need to remain in the air for a total time of 10 s?

- A) 50 m/s
- B) 60 m/s
- C) 80 m/s
- D) 100 m/s
- E) 110 m/s

Answer: A

Diff: 3

Objective: 2.10

55) A ball is thrown 125 m upward and then falls the same distance back to the Earth. Neglecting air resistance, its total time in the air is about

- A) 5 s.
- B) 10 s.
- C) 15 s.
- D) more than 20 s.

Answer: B

Diff: 3

Objective: 2.10

56) A pot falls from a ledge and hits the ground 45 m below. The speed with which it hits the ground is about

- A) 30 m/s.
- B) 60 m/s.
- C) 120 m/s.
- D) more than 120 m/s.

Answer: A

Diff: 3

Objective: 2.10

57) If a car increases its velocity from zero to 60 km/h in 10 s, its acceleration is

- A) 3 km/h · s
- B) 6 km/h · s
- C) 10 km/h · s
- D) 60 km/h · s
- E) 600 km/h · s

Answer: B

Diff: 3

Objective: 2.10

58) Consider drops of water that leak from a dripping faucet. As the drops fall, they

- A) get closer together.
- B) get farther apart.
- C) remain at a relatively fixed distance from one another.

Answer: B

Diff: 3

Objective: 2.10

59) Disregarding air drag, how fast must you toss a ball straight upward in order for the ball to remain in the air for a total time of 2 s?

- A) 5 m/s
- B) 7.5 m/s
- C) 10 m/s
- D) 15 m/s
- E) 20 m/s

Answer: C

Diff: 3

Objective: 2.10

60) If a baseball being thrown goes from zero to 30 m/s in 0.1 s, what is its average acceleration?

- A) 3 m/s<sup>2</sup>
- B) 30 m/s<sup>2</sup>
- C) 300 m/s<sup>2</sup>
- D) 3000 m/s<sup>2</sup>
- E) none of the above

Answer: C

Diff: 3

Objective: 2.10

61) If a rocket initially at rest accelerates at a rate of 50 m/s<sup>2</sup> for 1 min, its speed will be

- A) 50 m/s.
- B) 500 m/s.
- C) 3000 m/s.
- D) 3600 m/s.
- E) none of the above

Answer: C

Diff: 3

Objective: 2.10

62) If a rocket accelerates from rest at a rate of 50 m/s<sup>2</sup> for 10 s, the distance it will cover during this time is about

- A) 250 m.
- B) 500 m.
- C) 2500 m.
- D) 5000 m.
- E) none of the above

Answer: C

Diff: 3

Objective: 2.10

63) The vertical height attained by a basketball player who achieves a hang time of a full 1 s is about

- A) 0.8 m.
- B) 1 m.
- C) 1.2 m.
- D) 2.5 m.
- E) more than 2.5 m.

Answer: C

Diff: 3

Objective: IS 2B

64) Drop a rock from a 5-m height and it accelerates at  $10 \text{ m/s}^2$  and strikes the ground 1 s later. Drop the same rock from a height of 2.5 m and its acceleration of fall is

- A) about half.
- B) the same.
- C) twice as much.

Answer: B

Diff: 2

Objective: 2.10

65) A ball tossed vertically upward rises, reaches its highest point, and then falls back to its starting point. During this time, the acceleration of the ball is always

- A) in the direction of motion.
- B) opposite its velocity.
- C) directed upward.
- D) directed downward.

Answer: D

Diff: 2

Objective: IS 2B

66) While a car travels around a circular track at constant speed, its

- A) acceleration is zero.
- B) velocity is zero.
- C) both A and B
- D) none of the above

Answer: D

Diff: 2

Objective: 2.10

67) The hang time of professional basketball players is typically

- A) less than 1 s.
- B) 1 s.
- C) more than 1 s.
- D) more than 2 s.

Answer: A

Diff: 2

Objective: IS 2B

68) Suppose a jumper claims a hang time of 2 s. Then that jumper must be able to jump a height of

- A) 1 m.
- B) 2 m.
- C) 3 m.
- D) 4 m.
- E) 5 m.

Answer: E

Diff: 3

Objective: IS 2B

69) When a basketball player jumps to make a shot, once his or her feet are off the ground, the jumper's acceleration

- A) depends on launch speed.
- B) varies with body orientation.
- C) is usually greater for taller players (but not always).
- D) depends on all the above.
- E) is  $g$ , no more, no less.

Answer: E

Diff: 2

Objective: IS 2B

### Essay Questions

1) Clearly distinguish between mass, weight, and volume.

Answer: Mass has to do with the quantity of matter in a body. The more matter, or the more the number of its atoms, the more mass. Mass is measured in kilograms. Weight is the gravitational force on the matter in a body. Weight is measured in newtons. In the same locality, mass and weight are directly proportional. That is, twice the mass has twice the weight. Volume is a measure of a body's size—its physical dimensions. Volume is measured in such units as cubic meters.

Diff: 1

Objective: 2.3

2) What does it mean to say  $\Sigma F = 0$  for an object in equilibrium?

Answer: It means that if the object is not accelerating, all the forces acting on it combine to be zero.

Diff: 1

Objective: 2.5



3) If you stand on a pair of bathroom scales, explain how the readings change as you shift your weight gradually from side to side. What rule governs the readings on the scales?

Answer: The equilibrium rule guides the scale readings. That is, the total of the readings adds to equal your weight. Then the net force on you is zero at all times. The scales push up as much as gravity pulls you down. For example, stand evenly and the readings are the same. Shift more weight on your left foot and the reading on the left scale increases. Its gain is equal to the loss of reading on the scale supporting your right foot.

Diff: 2

Objective: 2.5

4) Distinguish between velocity and acceleration, and apply each to a ball tossed straight upward.

Answer: Velocity has to do with how fast a body travels; acceleration has to do with how quickly a body changes velocity. An upward thrown ball has an initial velocity that decreases with time. This rate of decrease is the acceleration,  $g$ , which remains the same during the time the ball is in the air. When the ball gets to the top its velocity is instantaneously zero but its acceleration is still  $g$ . As the ball returns, its velocity picks up at the same rate it decreased while ascending (barring air drag). So during the ball toss, velocity changes with time while acceleration doesn't.

Diff: 1

Objective: 2.10

5) Does a car undergo acceleration when it moves at constant speed in a straight-line direction?

When it rounds a corner at constant speed? Explain.

Answer: No, a car does not accelerate at constant speed in a straight line because its velocity doesn't change. But when it rounds a corner it is changing direction at every instant. This means a change in velocity, which by definition, means an acceleration. (Later we will learn that whenever a net force acts on something, that something accelerates in the direction of the net force. In the case of a car rounding a curve, the force that acts is friction on the tires.)

Diff: 2

Objective: 2.10