Chapter 4

Newton's Second Law of Motion

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which has the greater mass?

A) a king-size pillow

B) an automobile battery

C) neither - both have the same

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

A) weight.

B) force.

C) mass.

D) gravity.

E) center of mass.

3) Compared to 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 these.

E) none of these.

4) Compared to 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 these.

E) none of these.

5) An object maintains its state of motion because it has

A) mass.

B) weight.

C) speed.

D) acceleration.

E) all of these.

6) 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 these.

E) none of these.

7) One object has twice as much mass as another object. The first object also has twice as much

A) inertia.

B) velocity.

C) gravitational acceleration.

D) volume.

E) all of these.

8) Compared to 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.

9) Strange as it may seem, it is just as hard to accelerate a car on the
moon as it is to accelerate the same car on Earth. This is because

A) the mass of the car is independent of gravity.

B) the weight of the car is independent of gravity.

C) ...Nonsense! A car is much more easily accelerated on the moon than on the Earth.

10) An empty roller-coaster car at an amusement park takes 3 minutes to make its ride from start to finish.
 Neglecting friction, a fully loaded car would take

A) less than 3 minutes. B) more than 3 minutes. C)   3 minutes.

11)   The newton is a unit of

A) force. B) mass. C) density. D) inertia.

12)   In which case would you have the largest mass of gold? If your chunk of gold weighed 1 N on the

A) moon. B) Earth. C) planet Jupiter.

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 to say

14)   An object's weight may properly be expressed in

A) meters per second. B)   kilograms.

C) newtons. D)   none of the above.

15)   A force is a vector quantity because it has both

A) magnitude and direction.

B) mass and acceleration.

C) action and reaction counterparts.

16)   A 10-kg brick and a 1-kg book are dropped in a vacuum. The force of gravity on the 10-kg brick is

A) the same as the force on the 1-kg book.

B) 10 times as much as the force on the 1-kg book.

C) zero.

17)   An object is propelled along a straight-line path by a force.
If the net force were doubled, the object's acceleration would

A) quadruple.

B) double.

C) stay the same.

D) halve.

E) none of these.

18)   If an object's mass is decreasing while a constant force is applied to the object, the acceleration

A) decreases. B) increases. C) remains the same.

19)   An object is propelled along a straight-line path in space by a force.
If the mass of the object somehow becomes twice as much, its acceleration

A) quadruples.

B) doubles.

C) stays the same.

D) halves.

E) none of these.

20)   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 these.

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

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

22)   A 10-N falling object encounters 4 N of air resistance. The net force on the object is

A) 0 N.

B) 4 N.

C) 6 N.

D) 10 N.

E) none of these.

23)   A 10-N falling object encounters 10 N of air resistance. The net force on the object is

A) 0 N.

B) 4 N.

C) 6 N.

D) 10 N.

E) none of these.

24) An apple weighs 1 N. When held at rest above your head, the net force on the apple is

A) 0 N.

B) 0.1 N.

C) 1 N.

D) 9.8 N.

E) none of these.

25) An apple weighs 1 N. The net force on the apple when it is in free fall is

A) 0 N.

B) 0.1 N.

C) 1 N.

D) 9.8 N.

E) none of these.

26) Which has zero acceleration? An object

A) at rest.

B) moving at constant velocity.

C) in mechanical equilibrium.

D) all of these.

E) none of these.

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

A) may be zero. B) is zero.

28) The maximum acceleration of a car while towing a second car twice its mass, compared to no towing, is

A) one half.

B) one third.

C) one fourth.

D) the same.

E) none of these.

29)   Suppose you're coasting on level ground in a car at 60 km/h and apply the brakes until you slow to 40 km/h. When you suddenly release the brake, the car tends to

A) momentarily regain its higher initial speed.

B) continue moving at 40 km/h in the absence of forces.

C) decrease in speed whether or not other forces act.

30)   A heavy block at rest is suspended by a vertical rope.
When the block is accelerated upward by the rope, the rope tension

A) increases. B) decreases. C) remains the same.

31)   A 1-kg mass at the earth's surface weighs

A) 1 N.

B) 4.9 N.

C) 9.8 N.

D) 10.8 N.

E) none of these.

32)   If a non-rotating object has no acceleration, then we can say for certain that it is

A) at rest.

B) moving at constant non-zero velocity.

C) in mechanical equilibrium.

D) all of these.

E) none of these.

33)   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.

34) 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.

35) A car has a mass of 1000 kg and accelerates at 2 meters per second per second.
What is the magnitude of the net force exerted on the car?

A) 500 N

B) 1000 N

C) 1500 N

D) 2000 N

E) none of these

36) A tow truck exerts a force of 3000 N on a car, accelerating it at 2 meters per second per
second.
   What is the mass of the car?

A) 500 kg

B) 1000 kg

C) 1500 kg

D) 3000 kg

E) none of these

37) A girl pulls on a 10-kg wagon with a constant horizontal force of 30 N.
If there are no other horizontal forces, what is the wagon's acceleration in meters per second
per second?

A) 0.3 B) 3.0 C) 10 D) 30 E) 300

38) If the mass of an object does not change, a constant net force on the object produces
constant

A) velocity. B) acceleration. C) both of these D) none of these.

39) A force of 1 N accelerates a mass of 1 kg at the rate of 1 m/s2.
The acceleration of a mass of 2 kg acted upon by a net force of 2 N is

A) half as much. B) twice as much. C) the same. D) none of these.

40) A bag of groceries has a mass of 10 kilograms and a weight of about

A) 1 N.

B) 10 N.

C) 100 N.

D) 1000 N.

E) more than 1000 N.

41) The mass of a pet turtle that weighs 10 N is about

A) 1 kg.

B) 10 kg.

C) 100 kg.

D) 1000 kg.

E) none of these.

42) The force required to maintain an object at a constant velocity in free space is equal to

A) zero.

B) the mass of the object.

C) the weight of the object.

D) the force required to stop it.

E) none of these.

43) An object following a straight-line path at constant speed

A) has a net force acting upon it in the direction of motion.

B) has zero acceleration.

C) must be moving in a vacuum or in the absence of air drag.

D) has no forces acting on it.

E) none of these.

44) 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 these.

45) Neglecting friction, a large block of ice and a small block of ice start sliding down an incline together.
The heavier block will get to the bottom

A) before the light block.

B) after the light block.

C) at the same time as the light block.

46) When a woman stands at rest with two feet on a scale, the scale reads 500 N. When she gently lifts one foot,
the scale reads

A) less than 500 N. B) more than 500 N. C) 500 N.

47) A push on a 1-kg brick accelerates the brick. Neglecting friction, to equally accelerate a 10-kg brick,
one would have to push with

A) just as much force.

B) 10 times as much force.

C) 100 times as much force.

D) one tenth the amount of force.

E) none of these.

48) A 10-N block and a 1-N block lie on a horizontal frictionless table. To push them with equal acceleration,
we would have to push with

A) equal forces on each block.

B) 10 times as much force on the heavier block.

C) 10 squared or 100 times as much force on the heavier block.

D) 1/10 as much force on the heavier block.

E) none of these.

49) A rocket becomes progressively easier to accelerate as it travels upward from the ground mainly because

A) gravity becomes weaker with increased distance.

B) the applied force on the rocket increases as burning of fuel progresses.

C) the mass of the rocket decreases as fuel is burned.

50)   A rock is thrown vertically into the air. At the very top of its trajectory the net force
on it is

A) less than its weight. B) more than its weight. C)   its weight.

51)   A rock is thrown vertically into the air. At the top of its path,
its acceleration in meters per second per second is

A) zero.

B) 9.8.

C) between 0 and 9.8.

D) greater than 9.8.

E) none of these.

52)   A block is dragged without acceleration in a straight-line path across a level surface by a
force of 6 N.
  What is the force of friction between the block and the surface?

A) less than 6 N B) more than 6 N

C) 6 N D) need more information to say

53)   Suppose a particle is being accelerated through space by a 10-N force. Suddenly the
particle
encounters a second force of 10 N in the opposite direction from the first force.
The particle with both forces acting on it

A) is brought to a rapid halt.

B) decelerates gradually to a halt.

C) continues at the speed it had when it encountered the second force.

D) theoretically tends to accelerate toward the speed of light.

E) none of these.

54)   A jumbo jet has a mass of 100,000 kg. The thrust for each of its four engines is 50,000 N.
What is the jet's acceleration in meters per second per second when taking off?

A) 0.25

B) 1

C) 2

D) 4

E) none of these

55) A 1-kg rock that weighs 9.8 N is thrown straight upward at 20 m/s. Neglecting air resistance,
the net force that acts on it when it is half way to the top of its path is

A) less than 9.8 N. B) 9.8 N. C) more than 9.8 N.

56) A 1-kg ball is thrown at 10 m/s straight upward. Neglecting air resistance, the net force that acts
on the stone when it is halfway to the top of its path is about

A) 1/2 N. B) 1 N. C) 5 N. D) 7.5 N. E) 10 N.

57) The brakes of a speeding truck are slammed on and it skids to a stop.
If the truck were heavily loaded so that it had twice the total mass, the skidding distance
would be

A) 1/2 as far.

B) 1 1/2 times as far.

C) 2 times as far.

D) 4 times as far.

E) the same.

58) A skydiver of mass 100 kg experiences air resistance of 500 N, and an acceleration of about

A) 0.2 g.

B) 0.3 g.

C) 0.4 g.

D) 0.5 g.

E) more than 0.5 g.

59) An object released from rest on another planet requires one second to fall a distance of 6 meters.
What is the acceleration in meters per second per second due to gravity on this planet?

A) 3

B) 6

C) 12

D) 15

E) none of these

60) A car traveling at 22 m/s comes to an abrupt halt in 0.1 second when it hits a tree.
What is the deceleration in meters per second per second of the car?

A) 110

B) 220

C) 800

D) 880

E) ...can't be solved without the mass of the car.

61) A 10-kilogram block with an initial velocity of 10 m/s slides 10 meters across a horizontal surface
and comes to rest. It takes the block 2 seconds to stop. The stopping force acting on the block
is about

A) 5 N.

B) 10 N.

C) 25 N.

D) 50 N.

E) none of these.

62) A 10-kilogram block is pushed across a horizontal surface with a horizontal force of 20 N against
a friction force of 10 N. The acceleration of the block in meters per second per second is

A) 1.

B) 2.

C) 5.

D) 10.

E) none of these.

63) If you are driving at 20 m/s and slam on your brakes and skid at 0.5 g to a full stop,
the skidding time in seconds is about

A) 3.

B) 4.

C) 5.

D) 6.

E) more than 6.

64) A 1000-kg automobile enters a freeway on-ramp at 20 m/s and accelerates uniformly up to 40
m/s in a time of 10 seconds. How far does the automobile travel during that time?

A) 100 m

B) 200 m

C) 300 m

D) 400 m

E) none of these

65)   A 2000-kg car experiences a braking force of 10,000 N and skids to a stop in 6 seconds.
The speed of the car just before the brakes were applied was

A) 1.2 m/s.

B) 15 m/s.

C) 30 m/s.

D) 45 m/s.

E) none of these.

66)   An astronaut on another planet drops a 1-kg rock from rest and finds that it falls a
vertical
distance of 2.5 meters in one second. On this planet, the rock has a weight of

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

67)   What horizontally-applied force will accelerate a 400-kg crate at 1 m/s2 across a factory
floor
against a friction force half its weight?

A) 600 N

B) 1600 N

C) 2000 N

D) 2400 N

E) none of these

68)   The human body can, under certain conditions, withstand an acceleration of 10 g. What net
force would produce this acceleration of a 50-kg person?

A) About 500 N.

B) About 2500 N.

C) About 5000 N.

D) About 25,000 N.

E) none of these.

69) If an object of constant mass experiences a constant net force, it will have a constant

A) velocity.

B) speed.

C) acceleration.

D) position.

E) more than one of the above.

70) If more horizontal force is applied to a sliding object than is needed to maintain a constant velocity,

A) the object accelerates in the direction of the applied force.

B) the object accelerates opposite the direction of the applied force.

C) the friction force increases.

D) two of the above.

E) none of the above.

71) If less horizontal force is applied to a sliding object than is needed to maintain a constant velocity,

A) the object accelerates in the direction of the applied force.

B) the friction force increases.

C) the object eventually slides to a stop.

D) none of the above.

72) Two factors that greatly affect air resistance on falling objects are the

A) size and mass of the object.

B) size and weight of the object.

C) size and speed of the object.

73) When a falling object has reached its terminal velocity, its acceleration is

A) constant. B) zero. C) g.

74) Two objects of the same size, but unequal weights are dropped from a tall tower. Taking air resistance into consideration, the object to hit the ground first will be the

A) lighter object. B) heavier object.

C) both hit at the same time. D) not enough information.

75)   A light woman and a heavy man jump from an airplane at the same time and open their same-size parachutes at the same time. Which person will get to a state of zero acceleration first?

A) the light woman B) the heavy man

C) both should at the same time D) not enough information

76)   A large and a small person wish to parachute at equal terminal velocities.
The larger person will have to

A) get a larger parachute.

B) jump lightly.

C) pull upward on the supporting strands to decrease the downward net force.

D) jump first from the plane.

E) none of these.

77)   A skydiver, who weighs 500 N, reaches terminal velocity of 90 km/h.
The air resistance on the diver is then

A) 90 N.

B) 250 N.

C) 410 N.

D) 500 N.

E) none of these.

78)   A sack of potatoes weighing 200 N falls from an airplane. As the velocity of fall increases, air resistance also increases. When air resistance equals 200 N, the sack's acceleration in meters per second per second is

A) 0.

B) 4.9.

C) 9.8.

D) infinite.

E) none of these.

79)   An elephant and a feather fall from a tree through the air to the ground below.
The amount of air-resistance force is greater on the

A) elephant. B) feather. C) is the same on each.

80) When an object falls through the air, its velocity increases and its acceleration

A) increases.

B) decreases.

C) remains the same whether in air or in vacuum.

81) A skydiver jumps from a high-flying plane. As her velocity of fall increases, her acceleration

A) increases.

B) decreases.

C) remains unchanged regardless of air resistance.

82) A skydiver steps from a helicopter and falls for 5 seconds before reaching her terminal velocity.
   During this 5-second interval, her acceleration

A) is constant.

B) increases.

C) decreases.

D) is zero.

E) none of these.

83) A 500-N parachutist opens his chute and experiences an air resistance force of 800 N. The net force on the parachutist is

A) 300 N downward.

B) 500 N downward.

C) 800 N downward.

D) 300 N upward.

E) 500 N upward.

84) A ball is thrown vertically into the air. Because of air resistance, its speed when it returns to its starting level compared to its initial speed is

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

85) A pair of tennis balls fall through the air from a tall building. One ball is regular and the
other is filled with lead pellets. The ball to reach the ground first is the

A) regular ball. B) lead-filled ball. C) same for both.

86) A pair of tennis balls fall through the air from a tall building. One ball is regular and

the
other is filled with lead pellets. Air resistance just before they hit is actually greater for the

A) regular ball. B) lead-filled ball. C)   same for both.

87)   A ball is thrown vertically into the air. Because of air resistance, its time coming down compared to its time going up is

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

88)   A ball thrown straight upward takes 10 seconds to go up and return to the ground. Because of air resistance, the time taken for the ball just to go up is

A) less than 5 s. B) more than 5 s. C) 5 s.

89)   A falling skydiver of mass 100 kg experiences 500 N air resistance. The acceleration of the skydiver is

A) 0.2 g.

B) 0.3 g.

C) 0.4 g.

D) 0.5 g.

E) more than 0.5 g.

90)   An astronaut on another planet drops a 1-kg rock from rest. The astronaut notices that the rock falls 2 meters straight down in one second. On this planet, how much does the rock weigh?

A) 1 N B) 4 N C) 4.9 N D) 5 N

91)   A feather and a coin will have equal accelerations when falling in a vacuum because

A) their velocities are the same.

B) the force of gravity is the same for each in a vacuum.

C) the force of gravity does not act in a vacuum.

D) the ratio of each object's weight to its mass is the same.

E) none of these.

92)   A skydiver's terminal velocity will be greatest if she falls

A) head first. B) lying flat on her back.

C) lying flat on her stomach. D) with her parachute open.

1) Answer: B	26) Answer: D	51) Answer: B	76) Answer: A
2) Answer: C	27) Answer: B	52) Answer: C	77) Answer: D
3) Answer: D	28) Answer: B	53) Answer: C	78) Answer: A
4) Answer: E	29) Answer: B	54) Answer: C	79) Answer: A
5) Answer: A	30) Answer: A	55) Answer: B	80) Answer: B
6) Answer: B	31) Answer: C	56) Answer: E	81) Answer: B
7) Answer: A	32) Answer: C	57) Answer: E	82) Answer: C
8) Answer: C	33) Answer: C	58) Answer: D	83) Answer: D
9) Answer: A	34) Answer: C	59) Answer: C	84) Answer: A
10) Answer: C	35) Answer: D	60) Answer: B	85) Answer: B
11) Answer: A	36) Answer: C	61) Answer: D	86) Answer: B
12) Answer: A	37) Answer: B	62) Answer: A	87) Answer: C
13) Answer: B	38) Answer: B	63) Answer: B	88) Answer: A
14) Answer: C	39) Answer: C	64) Answer: C	89) Answer: D
15) Answer: A	40) Answer: C	65) Answer: C	90) Answer: B
16) Answer: B	41) Answer: A	66) Answer: E	91) Answer: D
17) Answer: B	42) Answer: A	67) Answer: D	92) Answer: A
18) Answer: B	43) Answer: B	68) Answer: C	
19) Answer: D	44) Answer: B	69) Answer: C	
20) Answer: B	45) Answer: C	70) Answer: A	
21) Answer: C	46) Answer: C	71) Answer: C	
22) Answer: C	47) Answer: B	72) Answer: C	
23) Answer: A	48) Answer: B	73) Answer: B	
24) Answer: A	49) Answer: C	74) Answer: B	
25) Answer: C	50) Answer: C	75) Answer: A	