General questions on Mechanics

1- physics

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Which of the following is an area of physics that studies motion and its causes?
a. quantum mechanics c. thermodynamics
b. optics d. mechanics

____ 2. Which of the following is an area of physics that studies heat and temperature?
a. quantum mechanics c. thermodynamics
b. optics d. mechanics

____ 3. Listening to your favorite radio station involves which area of physics?
a. vibrations and wave phenomena c. optics
b. relativity d. thermodynamics

____ 4. A baker makes a loaf of bread. Identify the area of physics that this involves.
a. mechanics c. optics
b. relativity d. thermodynamics

____ 5. A hiker uses a compass to navigate through the woods. Identify the area of physics that this involves.
a. electromagnetism c. thermodynamics
b. quantum mechanics d. relativity

____ 6. According to the scientific method, why does a physicist make observations and collect data?
a. to decide which parts of a problem are important
b. to ask a question
c. to make a conclusion
d. to solve all problems

____ 7. According to the scientific method, how does a physicist formulate and objectively test hypotheses?
a. by experiments c. by defending an opinion
b. by stating conclusions d. by interpreting graphs

____ 8. In the steps of the scientific method, what is the next step after formulating and objectively testing hypotheses?
a. interpreting results
b. stating conclusions
c. conducting experiments
d. making observations and collecting data

____ 9. According to the scientific method, how should conclusions be stated?
a. so that no one can refute the conclusion
b. so that it works with only one set of data
c. so that it is completely correct, with no mistakes
d. in a form that can be evaluated by others

____ 10. Diagrams are NOT designed to
a. measure an event or situation. c. show relationships between concepts.
b. label parts of a model. d. show setups of experiments.

____ 11. Why do physicists use models?
a. to explain the complex features of simple phenomena
b. to describe all aspects of a phenomenon
c. to explain the basic features of complex phenomena
d. to describe all of reality

____ 12. Which statement about models is NOT correct?
a. Models describe only part of reality.
b. Models help build hypotheses.
c. Models help guide experimental design.
d. Models manipulate a single variable or factor in an experiment.

____ 13. What two dimensions, in addition to mass, are commonly used by physicists to derive additional measurements?

a. length and time
b. velocity and time
c. length and width
d. area and mass

____ 14. The symbol mm represents a

a. megameter.
b. manometer.
c. micrometer.
d. millimeter.

____ 15. The symbols for units of length in order from smallest to largest are

a. km, mm, cm, and m.
b. mm, cm, m, and km.
c. m, cm, mm, and km.
d. mm, m, cm, and km.

____ 16. The SI base unit used to measure mass is the

a. kilogram.
b. liter.
c. meter.
d. second.

____ 17. The SI base unit for time is

a. 1 minute.
b. 1 second.
c. 1 day.
d. 1 hour.

____ 18. The most appropriate SI unit for measuring the length of an automobile is the

a. meter.
b. millimeter.
c. centimeter.
d. kilometer.

____ 19. If some measurements agree closely with each other but differ widely from the actual value, these measurements are

a. neither precise nor accurate.
b. accurate but not precise.
c. acceptable as a new standard of accuracy.
d. precise but not accurate.

____ 20. Poor precision in scientific measurements may arise from

a. significant figures.
b. human error.
c. scientific notation.
d. both significant figures and scientific notation.

____ 21. These values were obtained as the mass of a bar of metal: 8.83 g; 8.84 g; 8.82 g. The known mass is 10.68 g. The values are

a. both accurate and precise.
b. neither accurate nor precise.
c. accurate.
d. precise.

____ 22. Five darts strike near the center of a target. The dart thrower is

a. both accurate and precise.
b. neither accurate nor precise.
c. accurate.
d. precise.

____ 23. In a game of horseshoes, one horseshoe lands on the post. Four horseshoes land nowhere near the post. The one horseshoe on the post was thrown

a. both accurately and precisely.
b. neither accurately nor precisely.
c. accurately.
d. precisely.

____ 24. Calculate the following, and express the answer in scientific notation with the correct number of significant figures: 21.4 + 15 + 17.17 + 4.003

a. 57.6
b. 58
c. 57.573
d. 57.57

____ 25. Calculate the following, and express the answer in scientific notation with the correct number of significant figures: $10.5 \times 8.8 \times 3.14$

a. 290.1
b. 290
c. 2.9×10^2
d. 290.136

____ 26. Calculate the following, and express the answer in scientific notation with the correct number of significant figures: $(0.82 + 0.042) \times (4.4 \times 10^3)$

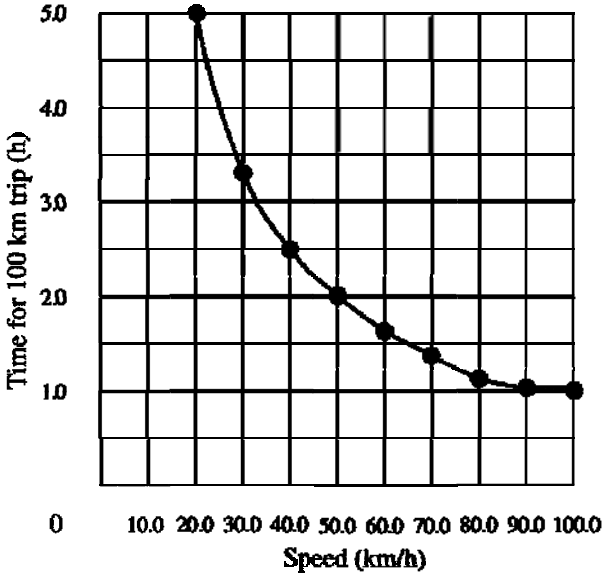
a. 3.784×10^3
b. 3784
c. 3.8×10^3
d. 3.78×10^3

Temperature (°C)	Hour
30.0	1:00

29.0	2:00
28.0	3:00
27.5	4:00
27.0	5:00
25.0	6:00

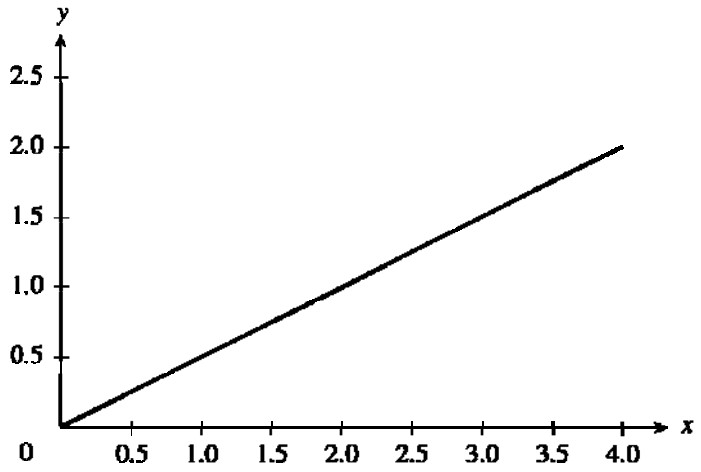
____ 27. A weather balloon records the temperature every hour. From the table above, the temperature

a. remains constant.
b. decreases and then increases.
c. increases.
d. decreases.



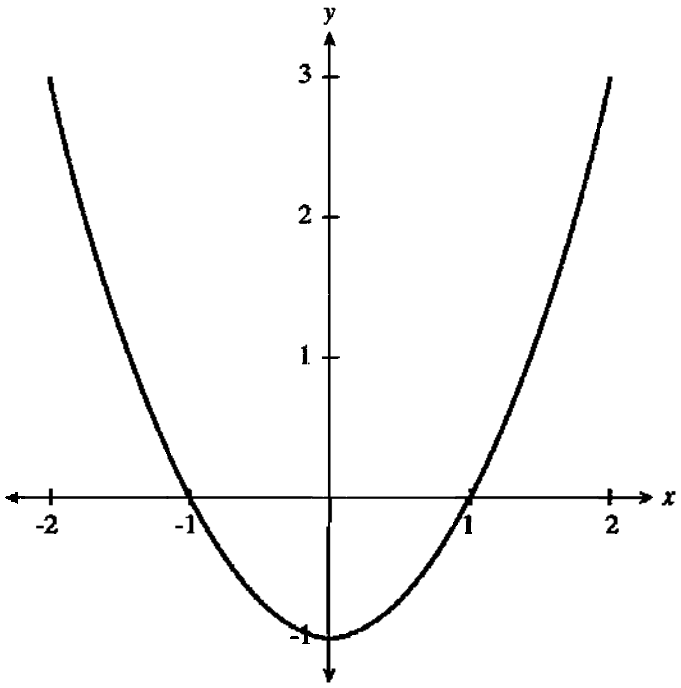
____ 28. The time required to make a trip of 100.0 km is measured at various speeds. From the graph above, what speed will allow the trip to be made in 2 hours?

a. 50.0 km/h
b. 90.0 km/h
c. 20.0 km/h
d. 40.0 km/h



____ 29. Which of the following equations best describes the graph above?

a. $y = x^2$
b. $y = \frac{1}{2}x$
c. $y = 2x$
d. $y = x$



____ 30. Which of the following equations best describes the graph above?

a. $y = -x^2 + 1$ c. $y = x^2 + 1$

b. $y = -x^2 - 1$ d. $y = x^2 - 1$

____ 31. The Greek letter *delta*, Δ, indicates a(n)

a. direct proportion. c. difference or change.

b. inverse proportion. d. sum or total.

____ 32. The Greek letter *sigma*, Σ, indicates a(n)

a. direct proportion. c. difference or change.

b. inverse proportion d. sum or total.

____ 33. What is the symbol for a time interval?

a. T c. t

b. Δt d. t

____ 34. What is the symbol for mass?

a. M c. m

b. Δm d. m

____ 35. What are the basic SI units?

a. meters, kilograms, seconds c. meters, kilograms, hours

b. feet, kilograms, seconds d. feet, pounds, seconds

____ 36. Which expression has the same dimensions as an expression yielding a value for acceleration (m/s^2)? (Δv has units of m/s.)

a. $\Delta v^2 / \Delta t$ c. $\Delta v / \Delta t^2$

b. $\Delta v^2 / \Delta x$ d. $\Delta v / \Delta x^2$

____ 37. Which expression has the same dimensions as an expression yielding a value for time? (v has units of m/s.)

a. $\Delta t / \Delta x$ c. $\Delta x / v$

b. $1 / v^2 \bullet \Delta t$ d. $\Delta x / v^2$

____ 38. Which of the following expressions gives units of $kg \bullet m^2/s^2$?

a. $m \bullet \Delta x^2/\Delta t$ c. $m^2 \bullet \Delta x/\Delta t^2$

b. $\Delta t^2 / m \bullet \Delta x^2$ d. $m \bullet \Delta x^2/\Delta t^2$

____ 39. If the change in position Δx is related to velocity v (with units of m/s) in the equation $\Delta x = Av$, the constant A has which dimension?

a. s c. m/s^2

b. m^2 d. m

____ 40. If a is acceleration (m/s^2), Δv is change in velocity (m/s), Δx is change in position (m), and Δt is the time interval (s), which equation is NOT dimensionally correct?

$\Delta v = a/\Delta t$ c. $\Delta t = \Delta x/v$ a.
$\Delta t^2 = 2\Delta x/a$ d. $a = v^2/\Delta x$ b.

____ 41. Which of the following equations gives units of s^2? (Δv has units of m/s)
$\Delta x^2/\Delta v^2$ c. $\Delta v^2/\Delta x^2$ a.
$m \bullet \Delta t^2/m \bullet \Delta v \bullet \Delta t^2$ d. $m \bullet \Delta v \bullet \Delta t^2/m$ b.

____ 42. Estimate the order of magnitude of the length of a football field.
10^4 m c. 10^{-1} m a.
10^6 m d. 10^2 m b.

____ 43. Estimate the order of magnitude of your age, measured in units of months.
10^2 months c. 10^{-1} months a.
10^3 months d. 10^1 month b.

____ 44. The sun is composed mostly of hydrogen. The mass of the sun is 2.0×10^{30} kg, and the mass of a hydrogen atom is 1.67×10^{-27} kg. Estimate the number of atoms in the sun.
10^{30} c. 10^3 a.
10^{75} d. 10^{57} b.

1- physics
Answer Section

1. ANS: B
2. ANS: A
3. ANS: C
4. ANS: B
5. ANS: C
6. ANS: B
7. ANS: C
8. ANS: A
9. ANS: D
10. ANS: C
11. ANS: C
12. ANS: D
13. ANS: C
14. ANS: B
15. ANS: D
16. ANS: C
17. ANS: D
18. ANS: C
19. ANS: D
20. ANS: B
21. ANS: B
22. ANS: C
23. ANS: A
24. ANS: D
25. ANS: A
26. ANS: A
27. ANS: B
28. ANS: C
29. ANS: D
30. ANS: B
31. ANS: A
32. ANS: B
33. ANS: D
34. ANS: B
35. ANS: C
36. ANS: D
37. ANS: A
38. ANS: B
39. ANS: C
40. ANS: C
41. ANS: C
42. ANS: B
43. ANS: C
44. ANS: B

2- Motion in one dimension

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. What is the speed of an object at rest?

9.8 m/s c. 0.0 m/s a.
9.81 m/s d. 1.0 m/s b.

____ 2. Which of the following is the expression for average velocity?

$v_{avg} = \Delta x \bullet \Delta t$ c. $v_{avg} = \frac{\Delta x}{\Delta t}$ a.

$v_{avg} = \frac{v_i + v_f}{2}$ d. $v_{avg} = \frac{\Delta t}{\Delta x}$ b.

____ 3. In addition to displacement, which of the following must be used for a more complete description of the average velocity of an object?

Δt c. *m* a.
Δx d. kg b.

____ 4. A dolphin swims 1.85 km/h. How far has the dolphin traveled after 0.60 h?

0.63 km c. 1.1 km a.
3.7 km d. 2.5 km b.

____ 5. A hiker travels south along a straight path for 1.5 h with an average velocity of 0.75 km/h, then travels south for 2.5 h with an average velocity of 0.90 km/h. What is the hiker's displacement for the total trip?

3.4 km to the south c. 1.1 km to the south a.
6.7 km to the south d. 2.2 km to the south b.

____ 6. Acceleration is

velocity. c. displacement. a.
the rate of change of velocity. d. the rate of change of displacement. b.

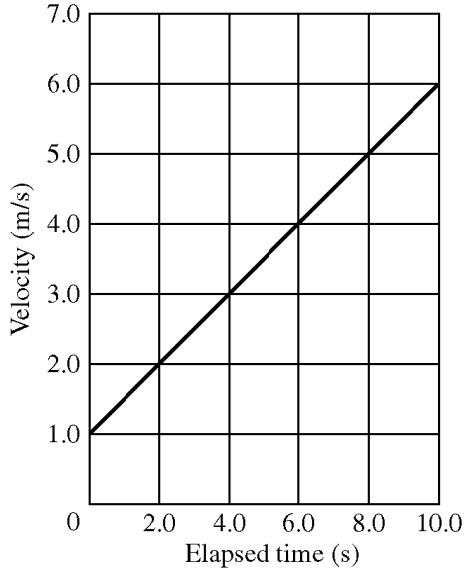
____ 7. Which of the following is the expression for acceleration?

$a = \Delta t \bullet \Delta v$ c. $a = \frac{\Delta t}{\Delta v}$ a.

$a = \frac{v_i - v_f}{t_i - t_f}$ d. $a = \frac{\Delta v}{\Delta t}$ b.

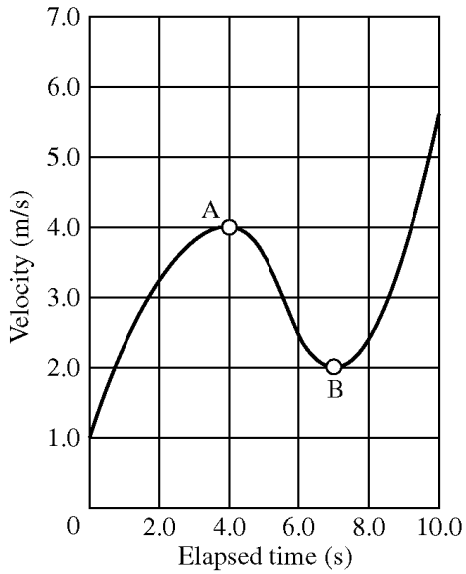
____ 8. When velocity is positive and acceleration is negative, what happens to the object's motion?

Nothing happens to the object. c. The object slows down. a.
The object remains at rest. d. The object speeds up. b.



____ 9. What does the graph above illustrate about acceleration?

The acceleration is constant. a.
The acceleration is zero. b.
The acceleration decreases. c.
There is not enough information to answer. d.



____ 10. What does the graph above illustrate about acceleration?

a. The acceleration varies.
b. The acceleration is zero.
c. The acceleration is constant.
d. The acceleration increases then becomes constant.

____ 11. A toy car is given an initial velocity of 5.0 m/s and experiences a constant acceleration of 2.0 m/s^2. What is the final velocity after 6.0 s?

a. 16 m/s
b. 17 m/s
c. 10.0 m/s
d. 12 m/s

____ 12. A shopping cart given an initial velocity of 2.0 m/s undergoes a constant acceleration of 3.0 m/s^2. What is the magnitude of the cart's displacement after the first 4.0 s of its motion?

a. 32 m
b. 80.0 m
c. 10.0 m
d. 55 m

____ 13. A race car accelerates from 0 m/s to 30.0 m/s with a displacement of 45.0 m. What is the vehicle's acceleration?

a. 10.0 m/s^2
b. 15.0 m/s^2
c. 2.00 m/s^2
d. 5.00 m/s^2

____ 14. A marble accelerates from rest at a constant rate and travels for a total displacement of 44 m in 20.0 s. What is the average velocity of the marble?

a. 4.4 m/s
b. 0.0 m/s
c. 1.1 m/s
d. 2.2 m/s

____ 15. A soccer ball is kicked horizontally. What is its average speed if its displacement is 21.0 m after 4.00 s?

a. 14.4 m/s
b. 2.63 m/s
c. 5.25 m/s
d. 8.75 m/s

____ 16. A curious kitten pushes a ball of yarn at rest with its nose, displacing the ball of yarn 17.5 cm in 2.00 s. What is the acceleration of the ball of yarn?

a. 14.4 cm/s^2
b. 4.38 cm/s^2
c. 11.0 cm/s^2
d. 8.75 cm/s^2

____ 17. A sports car accelerates at a constant rate from rest to a speed of 27.8 m/s in 8.00 s. What is the displacement of the sports car in this time interval?

a. 111 m
b. 222 m
c. 55.0 m
d. 77.0 m

____ 18. Which of the following units are used to measure free fall?

a. m•s
b. m^2/s^2
c. m/s
d. m/s^2

____ 19. Which of the following is a value for the acceleration of objects in free fall?

a. 9.80 m/s^2
b. –9.80 m/s^2
c. 9.81 m/s^2
d. –9.81 m/s^2

____ 20. Acceleration due to gravity is also called

free-fall acceleration. c. negative velocity. a.
instantaneous velocity. d. displacement. b.

____ 21. The baseball catcher throws a ball vertically upward and catches it in the same spot as it returns to the mitt. At what point in the ball's path does it experience zero velocity and nonzero acceleration at the same time?

midway on the way up a.
at the top of its trajectory b.
the instant it leaves the catcher's hand c.
the instant before it arrives in the catcher's mitt d.

____ 22. A rock is thrown straight upward with an initial velocity of 24.5 m/s where the downward acceleration due to gravity is 9.81 m/s^2. What is the rock's displacement after 1.00 s?

24.5 m c. 9.81 m a.
29.4 m d. 19.6 m b.

____ 23. A rock is thrown straight upward with an initial velocity of 19.6 m/s where the downward acceleration due to gravity is 9.81 m/s^2. What time interval elapses between the rock's being thrown and its return to the original launch point?

8.00 s c. 4.00 s a.
10.0 s d. 5.00 s b.

____ 24. A baseball is released at rest from the top of the Washington Monument. It hits the ground after falling for 6.00 s. What was the height from which the ball was dropped? (Disregard air resistance. g = 9.81 m/s^2.)

115 m c. 150.0 m a.
210.0 m d. 177 m b.

____ 25. A coin released at rest from the top of a tower hits the ground after falling 1.5 s. What is the speed of the coin as it hits the ground? (Disregard air resistance. g = 9.81 m/s^2.)

31 m/s c. 15 m/s a.
39 m/s d. 21 m/s b.

____ 26. A rock is thrown from the top of a cliff with an initial speed of 12 m/s. If the rock hits the ground after 2.0 s, what is the height of the cliff? (Disregard air resistance. g = 9.81 m/s^2.)

44 m c. 22 m a.
63 m d. 24 m b.

____ 27. A tourist accidentally drops a camera from a 40.0 m high bridge. If g = 9.81 m/s^2 and air resistance is disregarded, what is the speed of the camera as it hits the water?

56.0 m/s c. 28.0 m/s a.
784 m/s d. 31.0 m/s b.

____ 28. Human reaction time is usually about 0.20 s. If your lab partner holds a ruler between your finger and thumb and releases it without warning, how far can you expect the ruler to fall before you catch it? (Disregard air resistance. g = 9.81 m/s^2.)

at least 16.0 cm c. at least 4.0 cm a.
at least 19.6 cm d. at least 9.8 cm b.

____ 29. When there is no air resistance, objects of different masses

fall with equal accelerations with similar displacements. a.
fall with different accelerations with different displacements. b.
fall with equal accelerations with different displacements. c.
fall with different accelerations with similar displacements. d.

____ 30. Objects that are falling toward Earth move

at a constant velocity. c. faster and faster. a.
slower then faster. d. slower and slower. b.

____ 31. Which would hit the ground first if dropped from the same height in a vacuum, a feather or a metal bolt?

the feather a.
the metal bolt b.
They would hit the ground at the same time. c.
They would be suspended in a vacuum. d.

____ 32. Which would fall with greater acceleration in a vacuum, a leaf or a stone?

the leaf a.
the stone b.

They would accelerate at the same rate. c.
It is difficult to determine without more information. d.

2- Motion in one dimension
Answer Section

1.	ANS:	A	DIF:	I	OBJ:	2-1.1
2.	ANS:	A	DIF:	I	OBJ:	2-1.1
3.	ANS:	C	DIF:	I	OBJ:	2-1.1
4.	ANS:	A	DIF:	IIIA	OBJ:	2-1.2
5.	ANS:	C	DIF:	IIIB	OBJ:	2-1.2
6.	ANS:	D	DIF:	I	OBJ:	2-2.1
7.	ANS:	B	DIF:	I	OBJ:	2-2.1
8.	ANS:	A	DIF:	II	OBJ:	2-2.1
9.	ANS:	A	DIF:	II	OBJ:	2-2.2
10.	ANS:	A	DIF:	II	OBJ:	2-2.2
11.	ANS:	D	DIF:	IIIB	OBJ:	2-2.3
12.	ANS:	C	DIF:	IIIA	OBJ:	2-2.3
13.	ANS:	C	DIF:	IIIB	OBJ:	2-2.3
14.	ANS:	B	DIF:	IIIB	OBJ:	2-2.3
15.	ANS:	A	DIF:	IIIB	OBJ:	2-2.3
16.	ANS:	B	DIF:	IIIB	OBJ:	2-2.3
17.	ANS:	C	DIF:	IIIB	OBJ:	2-2.3
18.	ANS:	B	DIF:	I	OBJ:	2-3.1
19.	ANS:	B	DIF:	I	OBJ:	2-3.1
20.	ANS:	C	DIF:	I	OBJ:	2-3.1
21.	ANS:	B	DIF:	II	OBJ:	2-3.1
22.	ANS:	B	DIF:	IIIB	OBJ:	2-3.2
23.	ANS:	A	DIF:	IIIB	OBJ:	2-3.2
24.	ANS:	B	DIF:	IIIB	OBJ:	2-3.2
25.	ANS:	A	DIF:	IIIB	OBJ:	2-3.2
26.	ANS:	C	DIF:	IIIB	OBJ:	2-3.2
27.	ANS:	A	DIF:	IIIB	OBJ:	2-3.2
28.	ANS:	D	DIF:	IIIB	OBJ:	2-3.2
29.	ANS:	A	DIF:	I	OBJ:	2-3.3
30.	ANS:	A	DIF:	I	OBJ:	2-3.3
31.	ANS:	C	DIF:	I	OBJ:	2-3.3
32.	ANS:	C	DIF:	I	OBJ:	2-3.3

3-Vectors and 2 dimensional motion

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Which of the following is a physical quantity that has a magnitude but no direction?
a. resultant c. vector
b. frame of reference d. scalar

____ 2. Which of the following is a physical quantity that has both magnitude and direction?
a. resultant c. vector
b. frame of reference d. scalar

____ 3. Identify the following quantities as scalar or vector: the mass of an object, the number of leaves on a tree, wind velocity.
a. scalar, vector, scalar c. vector, scalar, scalar
b. vector, scalar, vector d. scalar, scalar, vector

____ 4. Identify the following quantities as scalar or vector: the speed of a snail, the time it takes to run a mile, the free-fall acceleration.

a. vector, scalar, vector
b. scalar, vector, vector
c. vector, scalar, scalar
d. scalar, scalar, vector

____ 5. Which of the following is an example of a vector quantity?

a. velocity
b. temperature
c. volume
d. mass

____ 6. For the winter, a duck flies 10.0 m/s due south against a gust of wind with a velocity of 2.5 m/s. What is the resultant velocity of the duck?

a. 12.5 m/s south
b. –12.5 m/s south
c. 7.5 m/s south
d. –7.5 m/s south

____ 7. A lightning bug flies at a velocity of 0.25 m/s due east toward another lightning bug seen off in the distance. A light easterly breeze blows on the bug at a velocity of 0.25 m/s. What is the resultant velocity of the lightning bug?

a. 0.50 m/s
b. 0.00 m/s
c. 0.75 m/s
d. 0.25 m/s

____ 8. A jogger runs 10.0 blocks due east, 5.0 blocks due south, and another 2.0 blocks due east. Assume all blocks are of equal size. Use the graphical method to find the magnitude of the jogger's net displacement.

a. 14.0 blocks
b. 8.0 blocks
c. 11.0 blocks
d. 13.0 blocks

____ 9. A cave explorer travels 3.0 m eastward, then 2.5 m northward, and finally 15 m westward. Use the graphical method to find the magnitude of the net displacement.

a. 12 m
b. 5.7 m
c. 18 m
d. 15 m

____ 10. A student adds two vectors with magnitudes of 200 and 40. Taking into account significant figures, which is the only possible choice for the magnitude of the resultant?

a. 160
b. 200
c. 300
d. 240

____ 11. A car travels down a road at a certain velocity, $\mathbf{v}_{car}$. The driver slows down so that the car is traveling only half as fast as before. Which of the following is the correct expression for the resulting velocity?

a. $2\mathbf{v}_{car}$
b. $\frac{1}{2}\mathbf{v}_{car}$
c. $-\frac{1}{2}\mathbf{v}_{car}$
d. $-2\mathbf{v}_{car}$

____ 12. A football player runs in one direction to catch a pass, then turns and runs twice as fast in the opposite direction toward the goal line. Which of the following is the correct expression for the original velocity and the resulting velocity?

a. $-\mathbf{v}_{player}$, $-2\mathbf{v}_{player}$
b. $\mathbf{v}_{player}$, $2\mathbf{v}_{player}$
c. $\mathbf{v}_{player}$, $-2\mathbf{v}_{player}$
d. $2\mathbf{v}_{player}$, $-\mathbf{v}_{player}$

____ 13. Multiplying or dividing vectors by scalars results in

a. vectors.
b. scalars.
c. vectors if multiplied or scalars if divided.
d. scalars if multiplied or vectors if divided.

____ 14. An airplane flying at 120 km/h due west moves into a region where the wind is blowing at 40 km/h due east. If the plane's original vector velocity is $\mathbf{v}_{plane}$, which of the following is the correct expression for the plane's resulting velocity?

a. $\frac{2}{3}\mathbf{v}_{plane}$
b. $-\frac{1}{3}\mathbf{v}_{plane}$
c. $\frac{3}{4}\mathbf{v}_{plane}$
d. $-\frac{2}{3}\mathbf{v}_{plane}$

____ 15. A student walks from the door of the house to the end of the driveway and realizes that he missed the bus. The student runs back to the house, traveling three times as fast. Which of the following is the correct expression for the resulting velocity?

a. $3\mathbf{v}_{student}$
b. $\frac{1}{3}\mathbf{v}_{student}$

$-3\mathbf{v}_{\text{student}}$ d. $\frac{1}{3}\mathbf{v}_{\text{student}}$ b.

____ 16. Which of the following is the best coordinate system to analyze a painter climbing a ladder at an angle of 60° to the ground?

x-axis: horizontal along the ground; *y*-axis: along the ladder a.
x-axis: up and down; *y*-axis: horizontal along the ground b.
x-axis: horizontal along the ground; *y*-axis: up and down c.
x-axis: along the ladder; *y*-axis: up and down d.

____ 17. Which of the following is the best coordinate system to analyze a car traveling northeast from one city to another?

positive *x*-axis pointing east; positive *y*-axis pointing south a.
positive *x*-axis pointing west; positive *y*-axis pointing east b.
positive *x*-axis pointing north; positive *y*-axis pointing south c.
positive *x*-axis pointing east; positive *y*-axis pointing north d.

____ 18. Which of the following is the best coordinate system to analyze an object thrown into the air?

x-axis: perpendicular to the ground; *y*-axis: up and down a.
x-axis: up and down; *y*-axis: parallel to the ground b.
x-axis: parallel to the ground; *y*-axis: perpendicular to the ground c.
x-axis: up and down; *y*-axis: perpendicular to the ground d.

____ 19. Which of the following is the best coordinate system to analyze the movement of a submarine diving at an angle of 45° to the surface of the water?

x-axis: horizontal at the water level; *y*-axis: up and down a.
x-axis: horizontal at the water level; *y*-axis: left and right b.
x-axis: left and right; *y*-axis: horizontal at the ocean bottom c.
x-axis: up and down; *y*-axis: horizontal at the ocean bottom d.

____ 20. An ant on a picnic table travels 3.0×10^1 cm eastward, then 25 cm northward, and finally 15 cm westward. What is the ant's directional displacement relative to its original position?

57 cm at 29° north of west c. 29 cm at 59° north of east a.
29 cm at 77° north of east d. 52 cm at 29° north of east b.

____ 21. A duck waddles 2.5 m east and 6.0 m north. What are the magnitude and direction of the duck's displacement with respect to its original position?

6.5 m at 67° north of east c. 3.5 m at 19° north of east a.
6.5 m at 72° north of east d. 6.3 m at 67° north of east b.

____ 22. A quarterback takes the ball from the line of scrimmage and runs backward for 1.0×10^1 m then sideways parallel to the line of scrimmage for 15 m. The ball is thrown forward 5.0×10^1 m perpendicular to the line of scrimmage. The receiver is tackled immediately. How far is the football displaced from its original position?

62 m c. 43 m a.
75 m d. 55 m b.

____ 23. A plane flies from city A to city B. City B is 1540 km west and 1160 km south of city A. What is the total displacement and direction of the plane?

1850 km, 37.0° south of west c. 1930 km, 43.0° south of west a.
1930 km, 37.0° south of west d. 1850 km, 43.0° south of west b.

____ 24. While following directions on a treasure map, a person walks 45.0 m south, then turns and walks 7.50 m east. Which single straight-line displacement could the treasure hunter have walked to reach the same spot?

45.6 m at 9.5° east of south c. 45.6 m at 9.5° south of east a.
45.6 m at 21° south of east d. 52.5 m at 21° east of south b.

____ 25. In a coordinate system, the *x*-component of a given vector is equal to that vector's magnitude multiplied by which trigonometric function, with respect to the angle between the vector and the *x*-axis?

the tangent of θ c. the cosine of θ a.
the cotangent of θ d. the sine of θ b.

____ 26. In a coordinate system, if the *x* component of a vector and the angle between the vector and *x*-axis are known, then the magnitude of the vector is calculated by which operation, taken with respect to the *x* component?

multiplying by the sine of θ c. dividing by the sine of θ a.

multiplying by the cosine of θ d. dividing by the cosine of θ b.

____ 27. A string attached to an airborne kite was maintained at an angle of 40.0° with the ground. If 120 m of string was reeled in to return the kite back to the ground, what was the horizontal displacement of the kite? (Assume the kite string did not sag.)

77 m c. 110 m a.
92 m d. 84 m b.

____ 28. An athlete runs 110 m across a level field at an angle of 30.0° north of east. What are the east and north components, respectively, of this displacement?

95 m; 55 m c. 64 m; 190 m a.
55 m; 95 m d. 190 m; 64 m b.

____ 29. A skateboarder rolls 25.0 m down a hill that descends at an angle of 20.0° with the horizontal. Find the horizontal and vertical components of the skateboarder's displacement.

23.5 m; 73.1 m c. 8.55 m; 23.5 m a.
73.1 m; 26.6 m d. 23.5 m; 8.55 m b.

____ 30. Find the resultant of these two vectors: 2.00×10^2 units due east and 4.00×10^2 units 30.0° north of west.

546 units 59.3° north of west c. 300 units 29.8° north of west a.
248 units 53.9° north of west d. 581 units 20.1° north of east b.

____ 31. Vector **A** is 3.2 units in length and points along the positive *y*-axis. Vector **B** is 4.6 units in length and points along a direction 195° counterclockwise from the positive *x*-axis. What is the magnitude of the resultant when vectors **A** and **B** are added?

4.8 units c. 1.2 units a.
5.6 units d. 6.2 units b.

____ 32. What is the resultant displacement of a dog looking for its bone in the yard, if the dog first heads 55° north of west for 10.0 m, and then turns and heads west for 5.00 m?

13.5 m at 37° north of east c. 11.2 m at 63° west of north a.
62.1 m at 74° north of west d. 13.5 m at 37° north of west b.

____ 33. A hiker walks 4.5 km at an angle of 45° north of west. Then the hiker walks 4.5 km south. What is the magnitude and direction of the hiker’s total displacement?

6.4 km, 45° north of west c. 3.5 km, 22° south of west a.
6.4 km, 22° south of west d. 3.5 km, 22° north of west b.

____ 34. Which of the following is the motion of objects moving in two dimensions under the influence of gravity?

parabola c. horizontal velocity a.
projectile motion d. directrix b.

____ 35. Which of the following is an example of projectile motion?

a jet lifting off a runway a.
a bullet being fired from a gun b.
dropping an aluminum can into the recycling bin c.
a space shuttle orbiting Earth d.

____ 36. Which of the following is NOT an example of projectile motion?

a hot-air balloon drifting toward Earth c. a volleyball served over a net a.
a long jumper in action d. a baseball hit by a bat b.

____ 37. What is the path of a projectile?

a wavy line a.
a parabola b.
a hyperbola c.
Projectiles do not follow a predictable path. d.

____ 38. Which of the following exhibits parabolic motion?

a person diving into a pool from a diving board a.
a space shuttle orbiting Earth b.
a leaf falling from a tree c.
a train moving along a flat track d.

____ 39. Which of the following does NOT exhibit parabolic motion?

a frog jumping from land into water a.
a basketball thrown to a hoop b.

a flat piece of paper released from a window c.
a baseball thrown to home plate d.

____ 40. A stone is thrown at an angle of 30.0° above the horizontal from the top edge of a cliff with an initial speed of 12 m/s. A stopwatch measures the stone's trajectory time from the top of the cliff to the bottom at 5.6 s. What is the height of the cliff? (Disregard air resistance. $g = 9.81\ m/s^2$.)

120 m c. 58 m a.
180 m d. 150 m b.

____ 41. A track star in the long jump goes into the jump at 12 m/s and launches herself at 20.0° above the horizontal. How long is she in the air before returning to Earth? ($g = 9.81\ m/s^2$)

1.5 s c. 0.42 s a.
1.2 s d. 0.83 s b.

____ 42. A model rocket flies horizontally off the edge of the cliff at a velocity of 50.0 m/s. If the canyon below is 100.0 m deep, how far from the edge of the cliff does the model rocket land?

337 m c. 112 m a.
400 m d. 225 m b.

____ 43. A firefighter 50.0 m away from a burning building directs a stream of water from a fire hose at an angle of 30.0° above the horizontal. If the velocity of the stream is 40.0 m/s, at what height will the stream of water strike the building?

18.7 m c. 9.60 m a.
22.4 m d. 13.4 m b.

____ 44. Which of the following is a coordinate system for specifying the precise location of objects in space?

frame of reference c. *x*-axis a.
diagram d. *y*-axis b.

____ 45. A passenger on a bus moving east sees a man standing on a curb. From the passenger's perspective, the man appears to

stand still. a.
move west at a speed that is less than the bus's speed. b.
move west at a speed that is equal to the bus's speed. c.
move east at a speed that is equal to the bus's speed. d.

____ 46. A piece of chalk is dropped by a teacher walking at a speed of 1.5 m/s. From the teacher's perspective, the chalk appears to fall

straight down and forward. c. straight down. a.
straight backward. d. straight down and backward. b.

____ 47. A jet moving at 500.0 km/h due east moves into a region where the wind is blowing at 120.0 km/h in a direction 30.0° north of east. What is the new velocity and direction of the aircraft relative to the ground?

550.0 km/h, 6.22° north of east c. 607 km/h, 5.67° north of east a.
588 km/h, 4.87° north of east d. 620.0 km/h, 7.10° north of east b.

____ 48. A boat moves at 10.0 m/s relative to the water. If the boat is in a river where the current is 2.00 m/s, how long does it take the boat to make a complete round trip of 1000.0 m upstream followed by 1000.0 m downstream?

208 s c. 199 s a.
251 s d. 203 s b.

____ 49. A superhero flying at treetop level sees the Eiffel Tower elevator begin to free fall. If the superhero is 1.00 km away from the tower and the elevator falls from a height of 240.0 m, how long does the superhero have to save the people in the elevator? What should the superhero's average velocity be?

7 s; 143 m/s c. 7 s; 333 m/s a.
9 s; 111 m/s d. 5 s; 200 m/s b.

____ 50. A small airplane flies at a velocity of 145 km/h toward the south as observed by a person on the ground. The airplane pilot measures an air velocity of 170.0 km/h south. What is the velocity of the wind that affects the plane?

315 km/h south c. 25 km/h south a.
315 km/h north d. 25 km/h north b.

3-Vectors an2 2 dimentional motion
Answer Section

1.	ANS:	B	DIF:	I	OBJ:	3-1.1
2.	ANS:	A	DIF:	I	OBJ:	3-1.1
3.	ANS:	B	DIF:	II	OBJ:	3-1.1
4.	ANS:	B	DIF:	II	OBJ:	3-1.1
5.	ANS:	A	DIF:	I	OBJ:	3-1.1
6.	ANS:	C	DIF:	II	OBJ:	3-1.2
7.	ANS:	B	DIF:	II	OBJ:	3-1.2
8.	ANS:	D	DIF:	IIIB	OBJ:	3-1.2
9.	ANS:	A	DIF:	IIIB	OBJ:	3-1.2
10.	ANS:	B	DIF:	IIIA	OBJ:	3-1.2
11.	ANS:	B	DIF:	II	OBJ:	3-1.3
12.	ANS:	C	DIF:	II	OBJ:	3-1.3
13.	ANS:	A	DIF:	I	OBJ:	3-1.3
14.	ANS:	A	DIF:	IIIA	OBJ:	3-1.3
15.	ANS:	D	DIF:	I	OBJ:	3-1.3
16.	ANS:	C	DIF:	I	OBJ:	3-2.1
17.	ANS:	D	DIF:	I	OBJ:	3-2.1
18.	ANS:	C	DIF:	I	OBJ:	3-2.1
19.	ANS:	A	DIF:	I	OBJ:	3-2.1
20.	ANS:	A	DIF:	IIIB	OBJ:	3-2.2
21.	ANS:	C	DIF:	IIIB	OBJ:	3-2.2
22.	ANS:	A	DIF:	IIIB	OBJ:	3-2.2
23.	ANS:	D	DIF:	IIIB	OBJ:	3-2.2
24.	ANS:	C	DIF:	IIIC	OBJ:	3-2.2
25.	ANS:	A	DIF:	II	OBJ:	3-2.3
26.	ANS:	B	DIF:	II	OBJ:	3-2.3
27.	ANS:	D	DIF:	IIIB	OBJ:	3-23
28.	ANS:	C	DIF:	IIIB	OBJ:	3-2.3
29.	ANS:	B	DIF:	IIIB	OBJ:	3-2.3
30.	ANS:	D	DIF:	IIIB	OBJ:	3-2.4
31.	ANS:	C	DIF:	IIIB	OBJ:	3-2.4
32.	ANS:	B	DIF:	II	OBJ:	3-2.4
33.	ANS:	A	DIF:	II	OBJ:	3-2.4
34.	ANS:	D	DIF:	I	OBJ:	3-3.1
35.	ANS:	B	DIF:	I	OBJ:	3-3.1
36.	ANS:	C	DIF:	I	OBJ:	3-3.1
37.	ANS:	B	DIF:	I	OBJ:	3-3.2
38.	ANS:	A	DIF:	I	OBJ:	3-3.2
39.	ANS:	C	DIF:	I	OBJ:	3-3.2
40.	ANS:	C	DIF:	II	OBJ:	3-3.3
41.	ANS:	B	DIF:	IIIB	OBJ:	3-3.3
42.	ANS:	B	DIF:	IIIB	OBJ:	3-3.3
43.	ANS:	C	DIF:	IIIB	OBJ:	3-3.3
44.	ANS:	C	DIF:	II	OBJ:	3-4.1
45.	ANS:	C	DIF:	I	OBJ:	3-4.1
46.	ANS:	A	DIF:	I	OBJ:	3-4.1
47.	ANS:	A	DIF:	IIIB	OBJ:	3-4.2
48.	ANS:	C	DIF:	IIIC	OBJ:	3-4.2
49.	ANS:	C	DIF:	IIIB	OBJ:	3-4.2
50.	ANS:	B	DIF:	II	OBJ:	3-4.2

4- Forces and laws of motion

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Which of the following is the cause of an acceleration or a change in an object's motion?
a. force
b. velocity
c. speed
d. inertia

____ 2. Which of the following statements does NOT describe force?
a. Force causes objects at rest to remain stationary.
b. Force causes objects to start moving.
c. Force causes objects to stop moving.
d. Force causes objects to change direction.

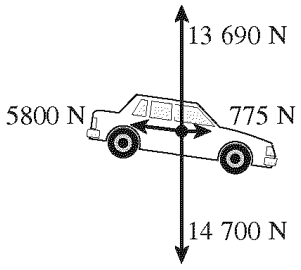
____ 3. What causes a moving object to change direction?
a. inertia
b. force
c. acceleration
d. velocity

____ 4. Which of the following forces arises from direct physical contact between two objects?
a. contact force
b. field force
c. gravitational force
d. fundamental force

____ 5. Which of the following forces exists between objects even in the absence of direct physical contact?
a. contact force
b. field force
c. frictional force
d. fundamental force

____ 6. Which of the following forces is an example of a contact force?
a. electric force
b. frictional force
c. gravitational force
d. magnetic force

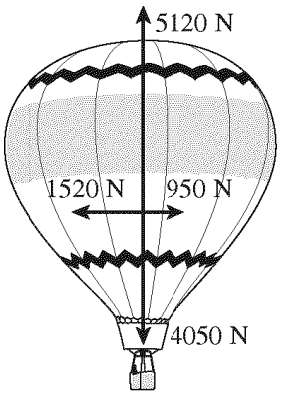
____ 7. Which of the following forces is an example of a field force?
a. normal force
b. tension
c. gravitational force
d. frictional force



____ 8. In the free-body diagram shown above, which of the following is the gravitational force acting on the car?
a. 14 700 N
b. 13 690 N
c. 5800 N
d. 775 N

____ 9. In the free-body diagram show above, the 5800 N force represents
a. the gravitational force acting on the car.
b. the backward force the road exerts on the car.
c. the upward force the road exerts on the car.
d. the force exerted by a towing cable on the car.

____ 10. A free-body diagram of a ball in free fall in the presence of air resistance would show
a. a downward arrow to represent the force of air resistance.
b. only a downward arrow to represent the force of gravity.
c. a downward arrow to represent the force of gravity and an upward arrow to represent the force of air resistance.
d. an upward arrow to represent the force of gravity and a downward arrow to represent the force of air resistance.



____ 11. In the free-body diagram shown above, which of the following is the gravitational force acting on the balloon?

a. 4050 N
b. 5120 N
c. 1520 N
d. 950 N

____ 12. Which of the following is the tendency of an object to maintain its state of motion?

a. force
b. velocity
c. acceleration
d. inertia

____ 13. A late traveler rushes to catch a plane, pulling a suitcase with a force directed 30.0° above the horizontal. If the horizontal component of the force on the suitcase is 60.6 N, what is the force exerted on the handle?

a. 65.2 N
b. 95.6 N
c. 53.0 N
d. 70.0 N

____ 14. A car goes forward along a level road at constant velocity. The additional force needed to bring the car into equilibrium is

a. greater than the normal force times the coefficient of static friction.
b. equal to the normal force times the coefficient of static friction.
c. the normal force times the coefficient of kinetic friction.
d. zero.

____ 15. A sled is pulled at a constant velocity across a horizontal snow surface. If a force of 8.0×10^1 N is being applied to the sled rope at an angle of 53° to the ground, what is the force of friction between the sled and the snow?

a. 48 N
b. 42 N
c. 83 N
d. 64 N

____ 16. A trapeze artist weighs 8.00×10^2 N. The artist is momentarily held to one side of a swing by a partner so that both of the swing ropes are at an angle of 30.0° with the vertical. In such a condition of static equilibrium, what is the horizontal force being applied by the partner?

a. 196 N
b. 462 N
c. 924 N
d. 433 N

____ 17. If a nonzero net force is acting on an object, then the object is definitely

a. being accelerated.
b. losing mass.
c. at rest.
d. moving with a constant velocity.

____ 18. A wagon with a weight of 300.0 N is accelerated across a level surface at 0.5 m/s^2. What net force acts on the wagon? (g = 9.81 m/s^2)

a. 150 N
b. 610 N
c. 9.0 N
d. 15 N

____ 19. Which statement about the acceleration of an object is correct?

a. The acceleration of an object is directly proportional to the net external force acting on the object and inversely proportional to the mass of the object.
b. The acceleration of an object is directly proportional to the net external force acting on the object and directly proportional to the mass of the object.
c. The acceleration of an object is inversely proportional to the net external force acting on the object and inversely proportional to the mass of the object.
d. The acceleration of an object is inversely proportional to the net external force acting on the object and directly proportional to the mass of the object.

____ 20. A small force acting on a human-sized object causes

a. a large acceleration.
c. a small acceleration.
b. equilibrium.
d. no acceleration.

____ 21. According to Newton's second law, when the same force is applied to two objects of different masses,

a. the object with greater mass will experience a great acceleration and the object with less mass will experience an even greater acceleration.
b. the object with greater mass will experience a smaller acceleration and the object with less mass will experience a greater acceleration.
c. the object with greater mass will experience a greater acceleration and the object with less mass will experience a smaller acceleration.
d. the object with greater mass will experience a small acceleration and the object with less mass will experience an even smaller acceleration.

____ 22. Two perpendicular forces, one of 45.0 N directed upward and the second of 60.0 N directed to the right, act simultaneously on an object with a mass of 35.0 kg. What is the magnitude of the resultant acceleration of the object?

a. 2.14 m/s^2
b. 3.00 m/s^2
c. 5.25 m/s^2
d. 1.41 m/s^2

____ 23. A sailboat with a mass of 2.0×10^3 kg experiences a tidal force of 3.0×10^3 N directed to the east and a wind force against its sails with a magnitude of 6.0×10^3 N directed toward the northwest (45° N of W). What is the magnitude of the resultant acceleration of the boat?

a. 1.5 m/s^2
c. 2.2 m/s^2
b. 4.4 m/s^2
d. 2.1 m/s^2

____ 24. An airplane with a mass of 1.2×10^4 kg tows a glider with a mass of 0.60×10^4 kg. If the airplane propellers provide a net forward thrust of 3.6×10^4 N, what is the acceleration of the glider?

a. 6.0 m/s^2
c. 2.0 m/s^2
b. 9.8 m/s^2
d. 3.0 m/s^2

____ 25. An elevator weighing 2.00×10^5 N is supported by a steel cable. What is the tension in the cable when the elevator is accelerated upward at a rate of 3.00 m/s^2? (g = 9.81 m/s^2)

a. 2.42×10^5 N
c. 1.39×10^5 N
b. 2.61×10^5 N
d. 2.31×10^5 N

____ 26. A hammer drives a nail into a piece of wood. Identify an action-reaction pair, and compare the forces exerted by each object.

a. The nail exerts a force on the hammer; the hammer exerts a force on the wood.
b. The hammer exerts a force on the nail; the wood exerts a force on the nail.
c. The hammer exerts a force on the nail; the nail exerts a force on the hammer.
d. The hammer exerts a force on the nail; the hammer exerts a force on the wood.

____ 27. A hockey stick hits a puck on the ice. Identify an action-reaction pair, and compare the forces exerted by each object.

a. The stick exerts a force on the puck; the puck exerts a force on the stick.
b. The stick exerts a force on the puck; the puck exerts a force on the ice.
c. The puck exerts a force on the stick; the stick exerts a force on the ice.
d. The stick exerts a force on the ice; the ice exerts a force on the puck.

____ 28. A leaf falls from a tree and lands on the sidewalk. Identify an action-reaction pair, and compare the forces exerted by each object.

a. The tree exerts a force on the leaf; the sidewalk exerts a force on the leaf.
b. The leaf exerts a force on the sidewalk; the sidewalk exerts a force on the leaf.
c. The leaf exerts a force on the tree; the sidewalk exerts a force on the leaf.
d. The leaf exerts a force on the sidewalk; the tree exerts a force on the leaf.

____ 29. A ball is dropped from a person's hand and falls to Earth. Identify an action-reaction pair, and compare the forces exerted by each object.

a. The hand exerts a force on the ball; Earth exerts a force on the hand.
b. Earth exerts a force on the ball; the hand exerts a force on Earth.
c. Earth exerts a force on the hand; the hand exerts a force on the ball.
d. Earth exerts a gravitational force on the ball; the ball exerts a gravitational force on Earth.

____ 30. The statement by Newton that for every action there is an equal but opposite reaction is which of his laws of motion?

a. third
b. fourth
c. first
d. second

____ 31. Which are simultaneous equal but opposite forces resulting from the interaction of two objects?

a. gravitational forces
b. action-reaction pairs
c. net external forces
d. field forces

____ 32. As a basketball player starts to jump for a rebound, the player begins to move upward faster and faster until his shoes leave the floor. At the moment the player begins to jump, the force of the floor on the shoes is

a. greater than the player's weight.
b. equal in magnitude and opposite in direction to the player's weight.
c. less than the player's weight.
d. zero.

____ 33. The magnitude of the force of gravity acting on an object is

a. inertia.
b. mass.
c. frictional force.
d. weight.

____ 34. A measure of the quantity of matter is

a. force.
b. mass.
c. density.
d. weight.

____ 35. A change in the force of gravity acting on an object will affect the object's

a. weight.
b. inertia.
c. mass.
d. frictional force.

____ 36. A weight of 5.00×10^3 N is suspended in equilibrium by two cables. Cable 1 applies a horizontal force to the right of the object and has a tension, $\mathbf{F_{T1}}$. Cable 2 applies a force upward and to the left at an angle of 37.0° to the negative *x*-axis and has a tension, $\mathbf{F_{T2}}$. What is $\mathbf{F_{T2}}$?

a. 8310 N
b. 3340 N
c. 4440 N
d. 6640 N

____ 37. A sled weighing 1.0×10^2 N is held in place on a frictionless 20.0° slope by a rope attached to a stake at the top. The rope is parallel to the slope. What is the normal force of the slope acting on the sled?

a. 37 N
b. 34 N
c. 94 N
d. 47 N

____ 38. A mule uses a rope to pull a box that weighs 3.0×10^2 N across a level surface with constant velocity. The rope makes an angle of 30.0° above the horizontal, and the tension in the rope is 1.0×10^2 N. What is the normal force of the floor on the box?

a. 50.0 N
b. 250 N
c. 300.0 N
d. 86 N

____ 39. A book with a mass of 2.0 kg is held in equilibrium on a board with a slope of 60.0° by a horizontal force. What is the normal force exerted by the book?

a. 15 N
b. 34 N
c. 39 N
d. 61 N

____ 40. A couch with a mass of 1×10^2 kg is placed on an adjustable ramp connected to a truck. As one end of the ramp is raised, the couch begins to move downward. If the couch slides down the ramp with an acceleration of 0.70 m/s^2 when the ramp angle is 25°, what is the coefficient of kinetic friction between the ramp and couch?
(g = 9.81 m/s^2)

a. 0.39
b. 0.12
c. 0.47
d. 0.42

____ 41. There are six books in a stack, and each book weighs 5 N. The coefficient of friction between the books is 0.2. With what horizontal force must one push to start sliding the top five books off the bottom one?

a. 3 N
b. 7 N
c. 1 N
d. 5 N

____ 42. A crate is carried in a pickup truck traveling horizontally at 15.0 m/s. The truck applies the brakes for a distance of 28.7 m while stopping with uniform acceleration. What is the coefficient of static friction between the crate and the truck bed if the crate does not slide?

0.892 c. 0.400 a.
0.656 d. 0.365 b.

____ 43. An ice skater moving at 10.0 m/s coasts to a halt in 1.0×10^2 m on a smooth ice surface. What is the coefficient of friction between the ice and the skates?

0.102 c. 0.025 a.
0.205 d. 0.051 b.

____ 44. An Olympic skier moving at 20.0 m/s down a 30.0° slope encounters a region of wet snow and slides 145 m before coming to a halt. What is the coefficient of friction between the skis and the snow?

0.116 c. 0.540 a.
0.470 d. 0.740 b.

4- Forces and laws of motion
Answer Section

1.	ANS:	C	DIF:	I	OBJ:	4-1.1
2.	ANS:	A	DIF:	I	OBJ:	4-1.1
3.	ANS:	D	DIF:	I	OBJ:	4-1.1
4.	ANS:	C	DIF:	I	OBJ:	4-1.2
5.	ANS:	D	DIF:	I	OBJ:	4-1.2
6.	ANS:	D	DIF:	I	OBJ:	4-1.2
7.	ANS:	A	DIF:	I	OBJ:	4-1.2
8.	ANS:	C	DIF:	I	OBJ:	4-1.3
9.	ANS:	D	DIF:	I	OBJ:	4-1.3
10.	ANS:	C	DIF:	I	OBJ:	4-1.3
11.	ANS:	C	DIF:	I	OBJ:	4-1.3
12.	ANS:	B	DIF:	I	OBJ:	4-2.1
13.	ANS:	B	DIF:	IIIB	OBJ:	4-2.2
14.	ANS:	D	DIF:	I	OBJ:	4-2.3
15.	ANS:	C	DIF:	IIIB	OBJ:	4-2.3
16.	ANS:	D	DIF:	IIIB	OBJ:	4-2.3
17.	ANS:	C	DIF:	I	OBJ:	4-3.1
18.	ANS:	B	DIF:	IIIB	OBJ:	4-3.1
19.	ANS:	A	DIF:	I	OBJ:	4-3.1
20.	ANS:	A	DIF:	I	OBJ:	4-3.1
21.	ANS:	B	DIF:	I	OBJ:	4-3.1
22.	ANS:	A	DIF:	IIIB	OBJ:	4-3.2
23.	ANS:	A	DIF:	IIIB	OBJ:	4-3.2
24.	ANS:	A	DIF:	IIIB	OBJ:	4-3.2
25.	ANS:	D	DIF:	IIIB	OBJ:	4-3.2
26.	ANS:	C	DIF:	I	OBJ:	4-3.3
27.	ANS:	A	DIF:	I	OBJ:	4-3.3
28.	ANS:	B	DIF:	I	OBJ:	4-3.3
29.	ANS:	D	DIF:	I	OBJ:	4-3.3
30.	ANS:	C	DIF:	I	OBJ:	4-3.3
31.	ANS:	D	DIF:	I	OBJ:	4-3.3
32.	ANS:	A	DIF:	IIIB	OBJ:	4-3.4
33.	ANS:	B	DIF:	I	OBJ:	4-4.1
34.	ANS:	D	DIF:	I	OBJ:	4-4.1
35.	ANS:	C	DIF:	I	OBJ:	4-4.1
36.	ANS:	C	DIF:	IIIB	OBJ:	4-4.2
37.	ANS:	A	DIF:	IIIB	OBJ:	4-4.2
38.	ANS:	D	DIF:	IIIB	OBJ:	4-4.2
39.	ANS:	A	DIF:	IIIA	OBJ:	4-4.2
40.	ANS:	C	DIF:	IIIC	OBJ:	4-4.4
41.	ANS:	B	DIF:	IIIB	OBJ:	4-4.4
42.	ANS:	A	DIF:	IIIB	OBJ:	4-4.4
43.	ANS:	B	DIF:	IIIB	OBJ:	4-4.4
44.	ANS:	B	DIF:	IIIC	OBJ:	4-4.4

5-Work and Energy

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. A force does work on an object if a component of the force
is perpendicular to the displacement of the object.

is parallel to the displacement of the object.

perpendicular to the displacement of the object moves the object along a path that returns the object to its starting position.
parallel to the displacement of the object moves the object along a path that returns the object to its starting position.

____ 2. What is the common formula for work?
$W = Fd^2$ $W = Fd(\sin \theta)$

$W = F^2d$ $W = Fd$

____ 3. Work is done when
the displacement is not zero.

the displacement is zero.

the force is zero.

the force and displacement are perpendicular.

____ 4. A 1.00×10^3 kg sports car accelerates from rest to 25.0 m/s in 7.50 s. What is the average power output of the automobile engine?
41.7 kW 20.8 kW

52.4 kW 30.3 kW

____ 5. The more powerful the motor is,
the longer the time interval for doing the work is.

the shorter the time interval for doing the work is.

the greater the ability to do the work is.

the shorter the workload is.

____ 6. The magnitude of the component of the force that does the work is 43.0 N. How much work is done on a bookshelf being pulled 5.00 m at an angle of 37.0° from the horizontal?
129 J 172 J

792 J 215 J

____ 7. A worker pushes a wheelbarrow with a horizontal force of 50.0 N over a level distance of 5.0 m. If a frictional force of 43 N acts on the wheelbarrow in a direction opposite to that of the worker, what net work is done on the wheelbarrow?
35 J 250 J

10.0 J 0.0 J

____ 8. A hill is 100 m long and makes an angle of 12° with the horizontal. As a 50 kg jogger runs up the hill, how much work does gravity do on the jogger?

–10 000 J
50 000 J

0.0 J
10 000 J

____ 9. A child moving at constant velocity carries a 2 N ice-cream cone 1 m across a level surface. What is the net work done on the ice-cream cone?
2 J
0 J

20 J
0.5 J

____ 10. A construction worker pushes a wheelbarrow 5.0 m with a horizontal force of 50.0 N. How much work is done by the worker on the wheelbarrow?
250 J
10 J

55 J
1250 J

____ 11. A horizontal force of 200 N is applied to move a 55 kg television set across a 10 m level surface. What is the work done by the 200 N force on the television set?
2000 J
4000 J

6000 J
5000 J

____ 12. A flight attendant pulls a 50.0 N flight bag a distance of 250.0 m along a level airport floor at a constant speed. A 30.0 N force is exerted on the bag at an angle of 50.0° above the horizontal. How much work is done on the flight bag?
4820 J
12 500 J

8040 J
7510 J

____ 13. Which of the following energy forms is the sum of kinetic energy and all forms of potential energy?
nonmechanical energy
total energy

mechanical energy
sum (Σ) energy

____ 14. Which of the following energy forms is involved in winding a pocket watch?
gravitational potential energy
electrical energy

elastic potential energy
nonmechanical energy

____ 15. Which of the following energy forms is NOT involved in hitting a tennis ball?
gravitational potential energy
kinetic energy

elastic potential energy
chemical potential energy

____ 16. Which of the following energy forms is involved in a pencil falling from a desk?
kinetic energy

nonmechanical energy

gravitational potential energy

elastic potential energy and kinetic energy

____ 17. A 3.00 kg toy falls from a height of 10.0 m. Just before hitting the ground, what will be its kinetic energy? (Disregard air resistance. $g = 9.81\ m/s^2$.)
29.4 J
98.0 J

294 J 0.98 J

____ 18. If the only force acting on an object is friction during a given physical process, which of the following assumptions must be made in regard to the object's kinetic energy?
The kinetic energy decreases.

The kinetic energy increases.

The kinetic energy remains constant.

The kinetic energy decreases and then increases.

____ 19. What is the kinetic energy of a 0.135 kg baseball thrown at 40.0 m/s?
108 J 54.0 J

216 J 87.0 J

____ 20. If both the mass and the velocity of a ball are tripled, the kinetic energy of the ball is increased by a factor of
9. 3.

27. 6.

____ 21. Which of the following energy forms is associated with an object in motion?
nonmechanical energy potential energy

kinetic energy elastic potential energy

____ 22. Which of the following energy forms is associated with an object due to its position?
total potential

kinetic positional

____ 23. The main difference between kinetic energy and potential energy is that
kinetic energy involves position and potential energy involves motion.

kinetic energy involves motion and potential energy involves position.

although both energies involve motion, only kinetic involves position.

although both energies involve position, only potential involves motion.

____ 24. Which of the following energy forms is associated with an object due to its position relative to Earth?
gravitational potential energy potential energy

kinetic energy elastic potential energy

____ 25. Which of the following energy forms is stored in any compressed or stretched object?
gravitational potential energy nonmechanical energy

kinetic energy elastic potential energy

____ 26. The equation for determining gravitational potential energy is $PE_g = mgh$. Which factor(s) in this equation is (are) NOT a property of an object?
m *g*

both *g* and *h* *h*

____ 27. Which of the following parameters does not express how resistant a spring is to being compressed or stretched?

spring constant
compression distance
stretching distance
relaxed length

____ 28. Which form of energy is involved in weighing fruit on a spring scale?

gravitational potential energy
kinetic energy
elastic potential energy
nonmechanical energy

____ 29. Which of the following energy forms is associated with an object's interaction with the environment?

mechanical energy
potential energy
nonmechanical energy
kinetic energy

____ 30. As an object is lowered into a deep hole in the ground, which of the following assumptions must be made in regard to the object's potential energy?

The potential energy increases.

The potential energy decreases.

The potential energy remains constant.

The potential energy increases and then decreases.

____ 31. A 40.0 N crate is pulled up a 5.0 m inclined plane at a constant velocity. If the plane is inclined at an angle of 37° to the horizontal and there is a constant force of friction of 10.0 N between the crate and the surface, what is the net gain in potential energy by the crate?

210 J
120 J
–210 J
–120 J

____ 32. A 0.002 kg coin, which has zero potential energy at rest, is dropped into a 10.0 m well. After the coin comes to a stop in the mud, what is its potential energy?

–0.196 J
0.000 J
0.020 J
0.196 J

____ 33. An 80.0 kg climber with a 20.0 kg pack climbs 8848 m to the top of Mount Everest. What is the climber's potential energy?

2.47×10^6 J
6.94×10^6 J
1.00×10^6 J
4.16×10^6 J

____ 34. A 5.00×10^2 N crate is at the top of a 5.00 m ramp, which is inclined at 20.0° with the horizontal. What is its potential energy? (g = 9.81 m/s^2.)

815 J
855 J
8390 J
2350 J

____ 35. In the presence of frictional force,

nonmechanical energy is negligible and mechanical energy is no longer conserved.
nonmechanical energy is negligible and mechanical energy is conserved.

nonmechanical energy is no longer negligible and mechanical energy is conserved.
nonmechanical energy is no longer negligible and mechanical energy is no longer conserved.

____ 36. Why doesn't the principle of mechanical energy conservation hold in situations when frictional forces are present?
Kinetic energy is not simply converted to a form of potential energy.

Potential energy is simply converted to a form of gravitational energy.

Chemical energy is not simply converted to electrical energy.

Kinetic energy is simply converted to a form of gravitational energy.

____ 37. Which of the following are examples of conservable quantities?
mechanical energy and mass
potential energy and length

kinetic energy and mass
mechanical energy and length

____ 38. A 16.0 kg child on roller skates, initially at rest, rolls 2.0 m down an incline at an angle of 20.0° with the horizontal. If there is no friction between incline and skates, what is the kinetic energy of the child at the bottom of the incline? (g = 9.81 m/s^2.)
11 J
210 J

110 J
610 J

____ 39. Old Faithful geyser in Yellowstone National Park shoots water every hour to a height of 40.0 m. With what velocity does the water leave the ground? (Disregard air resistance. g = 9.81 m/s^2.)
19.8 m/s
7.00 m/s

28.0 m/s
14.0 m/s

____ 40. A pole vaulter clears 6.00 m. With what velocity does the vaulter strike the mat in the landing area? (Disregard air resistance. g = 9.81 m/s^2.)
10.8 m/s
2.70 m/s

21.6 m/s
5.40 m/s

____ 41. A bobsled zips down an ice track starting at 150 m vertical distance up the hill. Disregarding friction, what is the velocity of the bobsled at the bottom of the hill?
(g = 9.81 m/s^2.)
45 m/s
27 m/s

54 m/s
36 m/s

____ 42. A professional skier starts from rest and reaches a speed of 56 m/s on a ski slope 30.0° above the horizontal. Using the work–kinetic energy theorem and disregarding friction, find the minimum distance along the slope the skier would have to travel in order to reach this speed.
320 m
110 m

640 m
160 m

____ 43. A 40.0 N crate starting at rest slides down a rough 6.0 m long ramp inclined at 30.0° with the horizontal. The force of friction between the crate and ramp is 6.0 N. Using the work–kinetic energy theorem, find the velocity of the crate at the bottom of the incline.
4.5 m/s
8.7 m/s

6.4 m/s
3.3 m/s

____ 44. A 15.0 kg crate, initially at rest, slides down a ramp 2.0 m long and inclined at an angle of 20.0° with the horizontal. Using the work–kinetic energy theorem and disregarding friction, find the velocity of the crate at the bottom of the ramp. (g = 9.81 m/s^2.)

9.7 m/s

6.1 m/s

8.3 m/s

3.7 m/s

____ 45. A parachutist with a mass of 50.0 kg jumps out of an airplane at an altitude of 1.00×10^3 m. After the parachute deploys, the parachutist lands with a velocity of 5.00 m/s. Using the work–kinetic energy theorem, find the energy that was lost to air resistance during this jump. (g = 9.81 m/s^2.)

198 000 J

49 300 J

489 000 J

98 800 J

____ 46. A horizontal force of 2.00×10^2 N is applied to a 55.0 kg cart across a 10.0 m level surface, accelerating it 2.00 m/s^2. Using the work–kinetic energy theorem, find the force of friction that slows the motion of the cart? (Disregard air resistance. g = 9.81 m/s^2.)

80.0 N

110 N

70.0 N

90.0 N

____ 47. A child riding a bicycle has a total mass of 40.0 kg. The child approaches the top of a hill that is 10.0 m high and 100.0 m long at 5.0 m/s. If the force of friction between the bicycle and the hill is 20.0 N, what is the child's velocity at the bottom of the hill? (Disregard air resistance. g = 9.81 m/s^2.)

5.0 m/s

10.0 m/s

11 m/s

The child stops before reaching the bottom.

____ 48. Which of the following is the rate at which energy is transferred?

mechanical energy

potential energy

power

kinetic energy

____ 49. Which of the following equations is NOT an equation for power?

$P = Fv$

$P = F\dfrac{d}{\Delta t}$

$P = \dfrac{Fv}{\Delta t}$

$P = \dfrac{W}{\Delta t}$

____ 50. What is the average power supplied by a 60.0 kg secretary running up a flight of stairs rising vertically 4.0 m in 4.2 s?

610 W

380 W

670 W

560 W

____ 51. What is the average power output of a weight lifter who can lift 250 kg 2.0 m in 2.0 s?

4.9 kW

5.0×10^2 W

9.8 kW

2.5 kW

____ 52. A jet engine develops 1.0×10^5 N of thrust to move an airplane forward at a speed of 9.0×10^2 km/h. What is the power output of the engine?

25 MW

550 kW

5.0 MW

1.0 MW

____ 53. Water flows over a section of Niagara Falls at a rate of 1.20×10^6 kg/s and falls 50.0 m. What is the power of the waterfall?

147 MW

589 MW

60.0 MW

294 MW

5-Work and Energy
Answer Section

1.	ANS:	B	DIF:	I	OBJ:	5-1.2
2.	ANS:	A	DIF:	I	OBJ:	5-1.2
3.	ANS:	A	DIF:	I	OBJ:	5-1.2
4.	ANS:	C	DIF:	IIIB	OBJ:	5-4.3
5.	ANS:	B	DIF:	I	OBJ:	5-4.4
6.	ANS:	B	DIF:	IIIB	OBJ:	5-1.4
7.	ANS:	C	DIF:	IIIA	OBJ:	5-1.4
8.	ANS:	C	DIF:	IIIA	OBJ:	5-1.4
9.	ANS:	A	DIF:	IIIA	OBJ:	5-1.4
10.	ANS:	C	DIF:	IIIA	OBJ:	5-1.4
11.	ANS:	C	DIF:	IIIA	OBJ:	5-1.4
12.	ANS:	C	DIF:	IIIB	OBJ:	5-1.4
13.	ANS:	D	DIF:	I	OBJ:	5-2.1
14.	ANS:	D	DIF:	I	OBJ:	5-2.1
15.	ANS:	B	DIF:	I	OBJ:	5-2.1
16.	ANS:	C	DIF:	I	OBJ:	5-2.1
17.	ANS:	D	DIF:	IIIA	OBJ:	5-2.2
18.	ANS:	A	DIF:	I	OBJ:	5-2.2
19.	ANS:	C	DIF:	IIIA	OBJ:	5-2.2
20.	ANS:	D	DIF:	II	OBJ:	5-2.2
21.	ANS:	D	DIF:	I	OBJ:	5-2.3
22.	ANS:	A	DIF:	I	OBJ:	5-2.3
23.	ANS:	B	DIF:	I	OBJ:	5-2.3
24.	ANS:	C	DIF:	I	OBJ:	5-2.4
25.	ANS:	B	DIF:	I	OBJ:	5-2.4
26.	ANS:	D	DIF:	I	OBJ:	5-2.4
27.	ANS:	C	DIF:	I	OBJ:	5-2.4
28.	ANS:	D	DIF:	I	OBJ:	5-2.4
29.	ANS:	A	DIF:	I	OBJ:	5-2.5
30.	ANS:	B	DIF:	I	OBJ:	5-2.5
31.	ANS:	A	DIF:	IIIB	OBJ:	5-2.5
32.	ANS:	C	DIF:	IIIB	OBJ:	5-2.5
33.	ANS:	A	DIF:	IIIB	OBJ:	5-2.5
34.	ANS:	A	DIF:	IIIB	OBJ:	5-2.5
35.	ANS:	D	DIF:	I	OBJ:	5-3.1
36.	ANS:	A	DIF:	I	OBJ:	5-3.2
37.	ANS:	C	DIF:	I	OBJ:	5-3.2
38.	ANS:	D	DIF:	IIIA	OBJ:	5-3.3
39.	ANS:	D	DIF:	IIIB	OBJ:	5-3.3
40.	ANS:	C	DIF:	IIIB	OBJ:	5-3.3
41.	ANS:	D	DIF:	IIIB	OBJ:	5-3.3
42.	ANS:	C	DIF:	IIIB	OBJ:	5-4.1
43.	ANS:	D	DIF:	IIIB	OBJ:	5-4.1
44.	ANS:	B	DIF:	IIIB	OBJ:	5-4.1
45.	ANS:	D	DIF:	IIIB	OBJ:	5-4.1
46.	ANS:	B	DIF:	IIIB	OBJ:	5-4.1
47.	ANS:	C	DIF:	IIIB	OBJ:	5-4.1
48.	ANS:	D	DIF:	I	OBJ:	5-4.2
49.	ANS:	D	DIF:	I	OBJ:	5-4.2
50.	ANS:	B	DIF:	IIIB	OBJ:	5-4.3

51. ANS: B DIF: IIIB OBJ: 5-4.3
52. ANS: C DIF IIIC OBJ: 5-4.3
53. ANS: A DIF: IIIC OBJ: 5-4.3

6- Momentum and collision

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Which of the following has the greatest momentum?
truck with a mass of 2250 kg moving at a velocity of 25 m/s

car with a mass of 1210 kg moving at a velocity of 51 m/s

truck with a mass of 6120 kg moving at a velocity of 10 m/s

car with a mass of 1540 kg moving at a velocity of 38 m/s

____ 2. Which of the following has the greatest momentum?
tortoise with a mass of 270 kg moving at a velocity of 0.5 m/s

hare with a mass of 2.7 kg moving at a velocity of 7 m/s

turtle with a mass of 91 kg moving at a velocity of 1.4 m/s

roadrunner with a mass of 1.8 kg moving at a velocity of 6.7 m/s

____ 3. What velocity must a 1340 kg car have in order to have the same momentum as a 2680 kg truck traveling at a velocity of 15 m/s to the west?
3.0×10^1 m/s to the west 6.0×10^1 m/s to the west

3.0×10^1 m/s to the east 6.0×10^1 m/s to the east

____ 4. A child with a mass of 23 kg rides a bike with a mass of 5.5 kg at a velocity of 4.5 m/s to the south. Compare the momentum of the child with the momentum of the bike.
Both the child and the bike have the same momentum.

The bike has a greater momentum than the child.

The child has a greater momentum than the bike.

Neither the child nor the bike has momentum.

____ 5. When comparing the momentum of two moving objects, which of the following is correct?
The object with the higher velocity will have less momentum if the masses are equal.
The more massive object will have less momentum if its velocity is greater.

The less massive object will have less momentum if the velocities are the same.
The more massive object will have less momentum if the velocities are the same.

____ 6. A baseball is pitched very fast. Another baseball of equal mass is pitched very slowly. Which of the following statements is correct?
The fast-moving baseball is harder to stop because it has more momentum.

The slow-moving baseball is harder to stop because it has more momentum.

The fast-moving baseball is easier to stop because it has more momentum.

The slow-moving baseball is easier to stop because it has more momentum.

____ 7. A roller coaster climbs up a hill at 4 m/s and then zips down the hill at 30 m/s. The momentum of the roller coaster

remains the same throughout the ride.

is zero throughout the ride.

is greater up the hill than down the hill.

is greater down the hill than up the hill.

____ 8. A person sitting in a chair with wheels stands, causing the chair to roll backward across the floor. The momentum of the chair

was zero while stationary and increased when the person stood.

was greatest while the person sat in the chair.

remained the same.

was zero when the person got out of the chair and increased while the person sat.

____ 9. A student walks to class at a velocity of 3 m/s. To avoid walking into a door as it opens, the student slows to a velocity of 0.5 m/s. Now late for class, the student runs down the corridor at a velocity of 7 m/s. The student had the least momentum

while walking at a velocity of 3 m/s.

while dodging the opening door.

immediately after the door opened.

while running to class at a velocity of 7 m/s.

____ 10. An ice skater initially skating at a velocity of 3 m/s speeds up to a velocity of 5 m/s. The momentum of the skater

remains the same.

decreases.

becomes zero.

increases.

____ 11. If a force is exerted on an object, which statement is true?

A large force always produces a large change in the object's momentum.

A large force produces a large change in the object's momentum only if the force is applied over a very short time interval.

A small force applied over a long time interval can produce a large change in the object's momentum.

A small force produces a large change in the object's momentum.

____ 12. The change in an object's momentum is equal to

the product of the mass of the object and the time interval.

the product of the force applied to the object and the time interval.

the time interval divided by the net external force.

the net external force divided by the time interval.

____ 13. A force is applied to stop a moving shopping cart. Increasing the time interval over which the force is applied

requires a smaller force. requires a greater force.

requires the same force. has no effect on the force needed.

____ 14. Which of the following situations is an example of a visible change in momentum?
A volleyball hits a mosquito in the air. A hiker walks through a spider's web.
A baseball is hit by a bat. A car drives over a pebble.

____ 15. Which of the following situations is an example of change in momentum?
A tennis ball is hit into a net.

A helium-filled balloon rises upward into the sky.

An airplane flies into some scattered white clouds.

A bicyclist rides over a leaf on the pavement.

____ 16. A 6.0×10^{-2} kg tennis ball moves at a velocity of 12 m/s. The ball is struck by a racket, causing it to rebound in the opposite direction at a speed of 18 m/s. What is the change in the ball's momentum?
–1.1 kg•m/s –0.38 kg•m/s

–1.8 kg•m/s –0.72 kg•m/s

____ 17. A rubber ball with a mass of 0.30 kg is dropped onto a steel plate. The ball's velocity just before impact is 4.5 m/s and just after impact is 4.2 m/s. What is the change in the ball's momentum?
–4.0 kg•m/s –0.09 kg•m/s

–12 kg•m/s –2.6 kg•m/s

____ 18. A 0.2 baseball if pitched with a velocity of 40 m/s and is then batted to the pitcher with a velocity of 60 m/s. What is the magnitude of change in the ball's momentum?
2 kg•m/s 4 kg•m/s

20 kg•m/s 8 kg•m/s

____ 19. A ball with a momentum of 4.0 kg•m/s hits a wall and bounces straight back without losing any kinetic energy. What is the change in the ball's momentum?
8.0 kg•m/s 0.0 kg•m/s

–8.0 kg•m/s –4.0 kg•m/s

____ 20. A softball with a mass of 0.11 kg moves at a speed of 12 m/s. Then the ball is hit by a bat and rebounds in the opposite direction at a speed of 15 m/s. What is the change in momentum of the ball?
–0.33 kg•m/s –1.3 kg•m/s

–3.0 kg•m/s –1.6 kg•m/s

____ 21. A ball with a mass of 0.15 kg and a velocity of 5.0 m/s strikes a wall and bounces straight back with a velocity of 3.0 m/s. What is the change in momentum of the ball?
–0.15 kg•m/s –0.30 kg•m/s

–7.50 kg•m/s –1.20 kg•m/s

____ 22. The impulse experienced by a body is equivalent to the body's change in
momentum. velocity.

force. kinetic energy.

____ 23. A moderate force will break an egg. However, an egg dropped on the road usually breaks, while one dropped on the grass usually does not break because for the egg dropped on the grass,

the time interval for stopping is greater.	the change in momentum is greater.
the time interval for stopping is less.	the change in momentum is less.

____ 24. Which of the following statements properly relates the variables in the equation $\mathbf{F}\Delta t = \Delta\mathbf{p}$?

A large constant force changes an object's momentum over a long time interval.

A large constant force acting over a long time interval causes a large change in momentum.

A large constant force changes an object's momentum at various time intervals.

A large constant force does not necessarily cause a change in an object's momentum.

____ 25. A large moving ball collides with a small stationary ball. The momentum

of the large ball decreases, and the momentum of the small ball increases.

of the small ball decreases, and the momentum of the large ball increases.

of the large ball increases, and the momentum of the small ball decreases.

does not change for either ball.

____ 26. A 75 kg person walking around a corner bumped into an 80 kg person who was running around the same corner. The momentum of the 80 kg person

remained the same.	increased.
was conserved.	decreased.

____ 27. A 20 kg shopping cart moving at a velocity of 0.5 m/s collides into a store wall and stops. The momentum of the shopping cart

remains the same.	increases.
is conserved.	decreases.

____ 28. A rubber ball moving at a speed of 5 m/s hit a flat wall and returned to the thrower at 5 m/s. The magnitude of the momentum of the rubber ball

remained the same.	increased.
was not conserved.	decreased.

____ 29. Two objects with different masses collide and bounce back after an elastic collision. Before the collision, the two objects were moving at velocities equal in magnitude but opposite in direction. After the collision,

the less massive object had gained momentum.

the more massive object had gained momentum.

both objects had the same momentum.

both objects lost momentum.

____ 30. Two skaters stand facing each other. One skater's mass is 60 kg, and the other's mass is 72 kg. If the skaters push away from each other without spinning,

the 60 kg skater travels at a lower momentum.

their momenta are equal but opposite.

their total momentum doubles.

their total momentum decreases.

____ 31. Two swimmers relax close together on air mattresses in a pool. One swimmer's mass is 48 kg, and the other's mass is 55 kg. If the swimmers push away from each other,

their total momentum doubles.

their total momentum triples.

their total momentum decreases.

their momenta are equal but opposite.

____ 32. A soccer ball collides with another soccer ball at rest. The total momentum of the balls

remains constant.

is zero.

decreases.

increases.

____ 33. Paint is splattered on a canvas. After the paint sticks to the canvas, the total momentum of the paint and canvas

is equal and opposite.

is zero.

decreases.

increases.

____ 34. In a two-body collision,

momentum is conserved.

kinetic energy is conserved.

neither momentum nor kinetic energy is conserved.

both momentum and kinetic energy are conserved.

____ 35. The law of conservation of momentum states that

the total initial momentum of all objects interacting with one another usually equals the total final momentum.

the total initial momentum of all objects interacting with one another does not equal the total final momentum.

the total momentum of all objects interacting with one another is zero.

the total momentum of all objects interacting with one another remains constant regardless of the nature of the forces between the objects.

____ 36. Which of the following statements about the conservation of momentum is NOT correct?

Momentum is conserved for a system of objects pushing away from each other.

Momentum is not conserved for a system of objects in a head-on collision.

Momentum is conserved when two or more interacting objects push away from each other.

The total momentum of a system of interacting objects remains constant regardless of forces between the objects.

____ 37. A swimmer with a mass of 75 kg dives off a raft with a mass of 500 kg. If the swimmer's speed is 4 m/s immediately after leaving the raft, what is the speed of the raft?

0.6 m/s

0.2 m/s

4.0 m/s

0.5 m/s

____ 38. An astronaut with a mass of 70.0 kg is outside a space capsule when the tether line breaks. To return to the capsule, the astronaut throws a 2.0 kg wrench away from the capsule at a speed of 14 m/s. At what speed does the astronaut move toward the capsule?

3.5 m/s

5.0 m/s

7.0 m/s

0.4 m/s

____ 39. A bullet with a mass of 5.00×10^{-3} kg is loaded into a gun. The loaded gun has a mass of 0.52 kg. The bullet is fired, causing the empty gun to recoil at a speed of 2.1 m/s. What is the speed of the bullet?

120 m/s

48 m/s

360 m/s

220 m/s

____ 40. A 65.0 kg ice skater standing on frictionless ice throws a 0.15 kg snowball horizontally at a speed of 32.0 m/s. At what velocity does the skater move backward?

0.15 m/s

0.07 m/s

1.20 m/s

0.30 m/s

____ 41. Two skaters, each with a mass of 50 kg, are stationary on a frictionless ice pond. One skater throws a 0.2 kg ball at 5 m/s to the other skater, who catches it. What are the velocities of the skaters when the ball is caught?

0.02 m/s moving toward each other

0.02 m/s moving apart

0.04 m/s moving toward each other

0.04 m/s moving apart

____ 42. Two carts with masses of 1.5 kg and 0.7 kg, respectively, are held together by a compressed spring. When released, the 1.5 kg cart moves to the left with a velocity of 7 m/s. What is the velocity of the 0.7 kg cart? (Disregard the mass of the spring.)

7 m/s to the right

15 m/s to the right

7 m/s to the left

15 m/s to the left

____ 43. Each croquet ball in a set has a mass of 0.50 kg. The green ball travels at 10.5 m/s and strikes a stationary red ball. If the green ball stops moving, what is the final speed of the red ball after the collision?

12.0 m/s

10.5 m/s

9.6 m/s

6.0 m/s

____ 44. A diver with a mass of 80.0 kg jumps from a dock into a 130.0 kg boat at rest on the west side of the dock. If the velocity of the diver in the air is 4.10 m/s to the west, what is the final velocity of the diver after landing in the boat?

1.56 m/s to the west

2.52 m/s to the west

1.56 m/s to the east

2.52 m/s to the east

____ 45. Two objects move separately after colliding, and both the total momentum and total kinetic energy remain constant. Identify the type of collision.

inelastic

elastic

perfectly inelastic

perfectly elastic

____ 46. Two objects stick together and move with the same velocity after colliding. Identify the type of collision.

inelastic

elastic

perfectly inelastic perfectly elastic

____ 47. After colliding, objects are deformed and lose some kinetic energy. Identify the type of collision.
inelastic elastic

perfectly inelastic perfectly elastic

____ 48. Two billiard balls collide. Identify the type of collision.
inelastic elastic

perfectly inelastic perfectly elastic

____ 49. Two balls of dough collide and stick together. Identify the type of collision.
inelastic elastic

perfectly inelastic perfectly elastic

____ 50. Two snowballs with masses of 0.40 kg and 0.60 kg, respectively, collide head-on and combine to form a single snowball. The initial speed for each is 15 m/s. If the velocity of the snowball with a mass of 1.0 kg is 3.0 m/s after the collision, what is the decrease in kinetic energy?
60 J zero

90 J 110 J

____ 51. A 1.5×10^3 kg truck moving at 15 m/s strikes a 7.5×10^2 kg automobile stopped at a traffic light. The vehicles hook bumpers and skid together at 10.0 m/s. What is the decrease in kinetic energy?
1.7×10^5 J 1.1×10^5 J

6.0×10^4 J 1.2×10^4 J

____ 52. A clay ball with a mass of 0.35 kg has an initial speed of 4.2 m/s. It strikes a 3.5 kg clay ball at rest, and the two balls stick together and remain stationary. What is the decrease in kinetic energy of the 0.35 kg ball?
3.1 J 1.6 J

6.4 J 4.8 J

____ 53. An infant throws 5 g of applesauce at a velocity of 0.2 m/s. All of the applesauce collides with a nearby wall and sticks. What is the decrease in kinetic energy of the applesauce?
1×10^{-3} J 2×10^{-4} J

1×10^{-4} J 0.5×10^{-4} J

____ 54. In an elastic collision between two objects with unequal masses,
the total momentum of the system will increase.

the total momentum of the system will decrease.

the kinetic energy of one object will increase by the amount that the kinetic energy of the other object decreases.
the momentum of one object will increase by the amount that the momentum of the other object decreases.

____ 55. A billiard ball collides with a stationary identical billiard ball in an elastic head-on collision. After the collision, which is true of the first ball?
It comes to rest. It maintains its initial velocity.

It moves in the opposite direction. It has one-half its initial velocity.

____ 56. A billiard ball collides with a second identical ball in an elastic head-on collision. What is the kinetic energy of the system after the collision compared with the kinetic energy before the collision?

two times as great | unchanged

four times as great | one-fourth as great

____ 57. Which of the following best describes the kinetic energy of each object after a two-body collision if the momentum of the system is conserved?

might also be conserved | must be less

is doubled in value | must also be conserved

____ 58. Which of the following best describes the momenta of two bodies after a two-body collision if the kinetic energy of the system is conserved?

might also be conserved | must be less

is doubled in value | must also be conserved

____ 59. An object with a mass of 0.10 kg makes an elastic head-on collision with a stationary object with a mass of 0.15 kg. The final velocity of the 0.10 kg object after the collision is –0.045 m/s and the final velocity of the 0.15 kg object after the collision is 0.16 m/s. What was the initial velocity of the 0.10 kg object?

0.20 m/s | 0.16 m/s

–0.20 m/s | –1.06 m/s

____ 60. A bowling ball with a mass of 7.0 kg strikes a pin that has a mass of 2.0 kg. The pin flies forward with a velocity of 6.0 m/s, and the ball continues forward at 4.0 m/s. What was the original velocity of the ball?

6.6 m/s | 4.0 m/s

3.3 m/s | 5.7 m/s

____ 61. A 90 kg halfback runs north and is tackled by a 120 kg opponent running south at 4 m/s. The collision is perfectly inelastic. Just after the tackle, both players move at a velocity of 2 m/s north. Calculate the velocity of the 90 kg player just before the tackle.

10 m/s north | 3 m/s south

12 m/s north | 4 m/s south

____ 62. A clay ball with a mass of 0.35 kg strikes another 0.35 kg clay ball at rest, and the two balls stick together. The final velocity of the balls is 2.1 m/s north. What was the first ball's initial velocity?

2.1 m/s to the north | 4.2 m/s to the north

4.2 m/s to the south | 2.1 m/s to the south

____ 63. A 2 kg mass moving to the right makes an elastic head-on collision with a 4 kg mass moving to the left at 4 m/s. The 2 kg mass reverses direction after the collision and moves at 3 m/s. The 4 kg mass moves to the left at 1 m/s. What was the initial velocity of the 2 kg mass?

4 m/s to the left | 3 m/s to the right

4 m/s to the right | 1 m/s to the left

____ 64. A 15 g marble moves to the right at 3.5 m/s and makes an elastic head-on collision with a 22 g marble. The final velocity of the 15 g marble is 5.4 m/s to the left, and the final velocity of the 22 g marble is 2.0 m/s to the right. What is the initial velocity of the 22 g marble?

4.0 m/s to the left | 5.3 m/s to the left

4.0 m/s to the right

5.3 m/s to the right

6- Momentum and collision
Answer Section

1.	ANS:	B	DIF:	IIIB	OBJ:	6-1.1
2.	ANS:	A	DIF:	IIIB	OBJ:	6-1.1
3.	ANS:	C	DIF:	IIIB	OBJ:	6-1.1
4.	ANS:	C	DIF:	II	OBJ:	6-1.1
5.	ANS:	C	DIF:	II	OBJ:	6-1.1
6.	ANS:	A	DIF:	II	OBJ:	6-1.2
7.	ANS:	B	DIF:	II	OBJ:	6-1.2
8.	ANS:	A	DIF:	II	OBJ:	6-1.2
9.	ANS:	B	DIF:	II	OBJ:	6-1.2
10.	ANS:	B	DIF:	II	OBJ:	6-1.2
11.	ANS:	C	DIF:	II	OBJ:	6-1.3
12.	ANS:	B	DIF:	I	OBJ:	6-1.3
13.	ANS:	C	DIF:	II	OBJ:	6-1.3
14.	ANS:	D	DIF:	II	OBJ:	6-1.3
15.	ANS:	A	DIF:	II	OBJ:	6-1.3
16.	ANS:	D	DIF:	IIIB	OBJ:	6-1.3
17.	ANS:	B	DIF:	IIIB	OBJ:	6-1.3
18.	ANS:	D	DIF:	IIIB	OBJ:	6-1.3
19.	ANS:	D	DIF:	IIIA	OBJ:	6-1.3
20.	ANS:	D	DIF:	IIIB	OBJ:	6-1.3
21.	ANS:	B	DIF:	IIIB	OBJ:	6-1.3
22.	ANS:	C	DIF:	I	OBJ:	6-1.4
23.	ANS:	C	DIF:	I	OBJ:	6-1.4
24.	ANS:	B	DIF:	I	OBJ:	6-1.4
25.	ANS:	A	DIF:	II	OBJ:	6-2.1
26.	ANS:	B	DIF:	II	OBJ:	6-2.1
27.	ANS:	B	DIF:	II	OBJ:	6-2.1
28.	ANS:	C	DIF:	II	OBJ:	6-2.1
29.	ANS:	A	DIF:	II	OBJ:	6-2.1
30.	ANS:	B	DIF:	II	OBJ:	6-2.2
31.	ANS:	B	DIF:	II	OBJ:	6-2.2
32.	ANS:	C	DIF:	II	OBJ:	6-2.2
33.	ANS:	A	DIF:	II	OBJ:	6-2.2
34.	ANS:	A	DIF:	I	OBJ:	6-2.3
35.	ANS:	D	DIF:	I	OBJ:	6-2.3
36.	ANS:	B	DIF:	I	OBJ:	6-2.3
37.	ANS:	C	DIF:	IIIB	OBJ:	6-2.4
38.	ANS:	B	DIF:	IIIB	OBJ:	6-2.4
39.	ANS:	B	DIF:	IIIC	OBJ:	6-2.4
40.	ANS:	A	DIF:	IIIB	OBJ:	6-2.4
41.	ANS:	A	DIF:	IIIB	OBJ:	6-2.4
42.	ANS:	A	DIF:	IIIA	OBJ:	6-2.4
43.	ANS:	A	DIF:	IIIB	OBJ:	6-2.4
44.	ANS:	C	DIF:	IIIB	OBJ:	6-2.4
45.	ANS:	A	DIF:	I	OBJ:	6-3.1
46.	ANS:	D	DIF:	I	OBJ:	6-3.1
47.	ANS:	C	DIF:	I	OBJ:	6-3.1
48.	ANS:	A	DIF:	I	OBJ:	6-3.1
49.	ANS:	D	DIF:	I	OBJ:	6-3.1
50.	ANS:	B	DIF:	IIIB	OBJ:	6-3.2

51.	ANS:	D	DIF:	IIIC	OBJ:	6-3.2
52.	ANS:	C	DIF:	IIIC	OBJ:	6-3.2
53.	ANS:	D	DIF:	II	OBJ:	6-3.2
54.	ANS:	D	DIF:	IIIB	OBJ:	6-3.3
55.	ANS:	C	DIF:	I	OBJ:	6-3.3
56.	ANS:	A	DIF:	I	OBJ:	6-3.3
57.	ANS:	C	DIF:	I	OBJ:	6-3.3
58.	ANS:	B	DIF:	I	OBJ:	6-3.3
59.	ANS:	C	DIF:	IIIC	OBJ:	6-3.4
60.	ANS:	B	DIF:	IIIB	OBJ:	6-3.4
61.	ANS:	C	DIF:	IIIB	OBJ:	6-3.4
62.	ANS:	A	DIF:	IIIB	OBJ:	6-3.4
63.	ANS:	A	DIF:	IIIB	OBJ:	6-3.4
64.	ANS:	C	DIF:	IIIC	OBJ:	6-3.4

7-Rotational Motion and gravity

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Which of the following angles equals 2π rad?
0° 360°

3.14° 180°

____ 2. One radian is equal to
57.3°. 60°.

56°. 58°.

____ 3. How would an angle in radians be converted to an angle in degrees?
The angle in radians would be multiplied by $180°/\pi$.

The angle in radians would be multiplied by $360°/\pi$.

The angle in radians would be multiplied by $180°/2\pi$.

The angle in radians would be multiplied by $2\pi/360°$.

____ 4. How would you convert an angle in degrees to an angle in radians?
multiply the angle measured in degrees by $2\pi/180°$

multiply the angle measured in degrees by $2\pi/360°$

multiply the angle measured in degrees by $\pi/360°$

multiply the angle measured in degrees by $2\pi r°$

____ 5. A cave dweller rotates a pebble in a sling with a radius of 0.30 m counterclockwise through an arc length of 0.96 m. What is the angular displacement of the pebble?
3.2 rad 1.6 rad

–3.2 rad –1.6 rad

____ 6. Earth has an equatorial radius of approximately 6380 km, and it rotates 360° every 24 h. What is the angular displacement of a person standing at the equator for 3.0 h?

0.78 rad 0.26 rad

0.39 rad 0.52 rad

____ 7. A child sits on a carousel at a distance of 3.5 m from the center and rotates through an arc length of 6.5 m. What is the angular displacement of the child?

3.0 rad 1.9 rad

5.0 rad 0.93 rad

____ 8. A bucket on the circumference of a water wheel travels an arc length of 18 m. If the radius of the wheel is 4.1 m, what is the angular displacement of the bucket?

3.7 rad 1.0 rad

2.3 rad 4.4 rad

____ 9. What is the approximate angular speed of a wheel rotating at the rate of 5.0 rev/s?

16 rad/s 3.2 rad/s

31 rad/s 1.6 rad/s

____ 10. A grinding wheel initially at rest with a radius of 0.15 m rotates until it reaches an angular speed of 12.0 rad/s in 4.0 s. What is the wheel's average angular acceleration?

3.0 rad/s^2 96 rad/s^2

0.33 rad/s^2 48 rad/s^2

____ 11. A potter's wheel moves from rest to an angular speed of 0.54 rad/s in 30.0 s. What is the angular acceleration of the wheel?

0.018 rad/s^2 16 rad/s^2

0.042 rad/s^2 1.3 rad/s^2

____ 12. A record player is turned on and reaches an angular velocity of 4.7 rad/s in 1.37 s. What is the average angular acceleration of the record?

6.4 rad/s^2 3.4 rad/s^2

0.29 rad/s^2 4.3 rad/s^2

____ 13. A Ferris wheel initially at rest accelerates to a final angular speed of 0.70 rad/s and rotates through an angular displacement of 4.90 rad. What is the Ferris wheel's average angular acceleration?

1.80 rad/s^2 0.10 rad/s^2

0.60 rad/s^2 0.05 rad/s^2

____ 14. A Ferris wheel rotates with an initial angular speed of 0.50 rad/s and accelerates over a 7.00 s interval at a rate of 4.0×10^{-2} rad/s^2. What is its angular speed?

0.46 rad/s 0.20 rad/s

0.78 rad/s 0.30 rad/s

____ 15. An automobile tire with a radius of 0.30 m starts at rest and accelerates at a constant angular acceleration of 2.0 rad/s^2 for 5.0 s. What is the angular displacement of the tire?

2.0 rad 12 rad

0.50 rad 25 rad

____ 16. A bicycle wheel rotates with a constant angular acceleration of 3.0 rad/s^2. If the initial angular speed of the wheel is 1.5 rad/s, what is the angular displacement of the wheel after 4.0 s?

3.0×10^1 rad

6.0 rad

36 rad

24 rad

____ 17. A gear in a machine accelerates at 11.2 rad/s^2. If the wheel's initial angular speed is 5.40 rad/s, what is the wheel's angular speed after exactly 3.0 seconds?

209 rad/s

39.0 rad/s

28.2 rad/s

13.6 rad/s

____ 18. A ball rolls downhill with an angular speed of 2.5 rad/s and has a constant angular acceleration of 2.0 rad/s^2. If the ball takes 11.5 s to reach the bottom of the hill, what is the final angular speed of the ball?

33 rad/s

13 rad

25.5 rad/s

31 rad/s

____ 19. A helicopter has 3.0 m long rotor blades that are rotating at an angular speed of 63 rad/s. What is the tangential speed of each blade tip?

21 m/s

99 m/s

66 m/s

190 m/s

____ 20. The end of the cord on a weed cutter is 0.15 m in length. If the motor rotates at the rate of 126 rad/s, what is the tangential speed of the cord?

19 m/s

628 m/s

63 m/s

25 m/s

____ 21. A point on the rim of a 0.30 m radius rotating wheel has a tangential speed of 4.0 m/s. What is the tangential speed of a point 0.20 m from the center of the same wheel?

2.6 m/s

0.8 m/s

8.0 m/s

1.3 m/s

____ 22. A cylinder with a diameter of 0.150 m rotates in a lathe at a constant angular speed of 35.6 rad/s. What is the tangential speed of the surface of the cylinder?

2.37×10^2 m/s

2.67 m/s

4.75×10^2 m/s

5.34 m/s

____ 23. A wheel with a radius of 1.2 m rotates at a constant angular speed of 10.5 rad/s. What is the tangential speed of a point 0.55 m from the wheel's axis?

13 m/s

19 m/s

8.7 m/s

5.8 m/s

____ 24. An automobile tire with a radius of 0.3 m accelerates from rest at a constant 2 rad/s^2 over a 5 s interval. What is the tangential component of acceleration for a point on the outer edge of the tire?

0.6 m/s^2

30 m/s^2

0.3 m/s^2

7 m/s^2

____ 25. A hamster gets on a stationary wheel with a radius of 0.15 m and runs until the wheel rotates at an angular speed of 12.0 rad/s in 4.0 s. What is the tangential acceleration of the wheel's edge?

0.65 rad/s^2 0.45 rad/s^2

1.30 rad/s^2 0.6 rad/s^2

____ 26. A flywheel with a radius of 0.30 m starts from rest and accelerates with a constant angular acceleration of 0.50 rad/s^2. What is the tangential acceleration of the flywheel?

0.65 m/s^2 0.63 m/s^2

1.30 m/s^2 0.15 m/s^2

____ 27. A contestant in a game show spins a stationary wheel with a radius of 0.50 m so that it has a constant angular acceleration of 0.40 rad/s^2. What is the tangential acceleration of a point on the edge of the wheel?

1.3 m/s^2 0.20 m/s^2

0.73 m/s^2 0.60 m/s^2

____ 28. A stone on the edge of the tire of a unicycle wheel with a radius of 0.25 m has a centripetal acceleration of 4.0 m/s^2. What is the tire's angular speed?

3.2 rad/s 1.0 rad/s

4.0 rad/s 2.0 rad/s

____ 29. A point on the rim of a rotating wheel with a 0.37 m radius has a centripetal acceleration of 19.0 m/s^2. What is the angular speed of the wheel?

3.2 rad/s 0.89 m/s

7.2 rad/s 1.6 rad/s

____ 30. A lapidary plate at rest is turned on to cut a gemstone. The plate rotates until it reaches an angular speed of 12.0 rad/s in 4.0 s. What is the centripetal acceleration of a point 0.10 m from the center of the plate?

14 m/s^2 0.45 m/s^2

29 m/s^2 7.2 m/s^2

____ 31. If the distance from the center of a merry-go-round to the edge is 1.2 m, what centripetal acceleration does a passenger experience when the merry-go-round rotates at an angular speed of 0.5 rad/s?

0.3 m/s^2 1.7 m/s^2

0.6 m/s^2 0.9 m/s^2

____ 32. A 80.0 kg passenger is seated 12 m from the center of the loop of a roller coaster. What centripetal force does the passenger experience when the roller coaster reaches an angular speed of 3.14 rad/s?

7.2×10^3 N 1.7×10^3 N

9.5×10^3 N 6.9×10^3 N

____ 33. A 0.40 kg ball on a 0.50 m string rotates in a circular path in a vertical plane. If the angular speed of the ball at the bottom of the circle is 8.0 rad/s, what is the force that maintains circular motion?

13 N 5.6 N

20.0 N 11 N

____ 34. A 0.40 kg ball on a 0.50 m string rotates in a circular path in a vertical plane. If a constant angular speed of 8.0 rad/s is maintained, what is the tension in the string when the ball is at the top of the circle?

13 N

9.0 N

10.0 N

11 N

____ 35. A roller coaster loaded with passengers has a mass of 2.0×10^3 kg; the radius of curvature of the track at the lowest point of the track is 24 m. If the vehicle has a tangential speed of 18 m/s at this point, what force is exerted on the vehicle by the track?

3.0×10^4 N

2.3×10^4 N

2.7×10^4 N

4.7×10^4 N

____ 36. What is the gravitational force between two trucks, each with a mass of 2.0×10^4 kg, that are 2.0 m apart? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

6.7×10^{-3} N

5.7×10^{-2} N

1.2×10^{-7} N

1.3×10^{-2} N

____ 37. The gravitational force between two masses is 36 N. What is the gravitational force if the distance between them is tripled? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

18 N

4.0 N

27 N

9.0 N

____ 38. Two small masses that are 10.0 cm apart attract each other with a force of 10.0 N. When they are 5.0 cm apart, these masses will attract each other with what force?
($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

20.0 N

5.0 N

40.0 N

2.5 N

7-Rotational Motion and gravity
Answer Section

1.	ANS:	A	DIF:	I	OBJ:	7-1.1
2.	ANS:	C	DIF:	IIIA	OBJ:	7-1.1
3.	ANS:	A	DIF:	II	OBJ:	7-1.1
4.	ANS:	B	DIF:	I	OBJ:	7-1.1
5.	ANS:	C	DIF:	IIIB	OBJ:	7-1.2
6.	ANS:	C	DIF:	IIIA	OBJ:	7-1.2
7.	ANS:	A	DIF:	IIIB	OBJ:	7-1.2
8.	ANS:	B	DIF:	IIIB	OBJ:	7-1.2
9.	ANS:	D	DIF:	IIIA	OBJ:	7-1.3
10.	ANS:	C	DIF:	IIIA	OBJ:	7-1.3
11.	ANS:	C	DIF:	IIIB	OBJ:	7-1.3
12.	ANS:	A	DIF:	IIIA	OBJ:	7-1.3
13.	ANS:	B	DIF:	IIIB	OBJ:	7-1.3
14.	ANS:	D	DIF:	IIIB	OBJ:	7-1.4
15.	ANS:	B	DIF:	I	OBJ:	7-1.4
16.	ANS:	C	DIF:	IIIB	OBJ:	7-1.4
17.	ANS:	A	DIF:	IIIB	OBJ:	7-1.4
18.	ANS:	D	DIF:	IIIB	OBJ:	7-1.4
19.	ANS:	B	DIF:	IIIC	OBJ:	7-2.1
20.	ANS:	C	DIF:	IIIB	OBJ:	7-2.1
21.	ANS:	C	DIF:	IIIA	OBJ:	7-2.1
22.	ANS:	A	DIF:	IIIA	OBJ:	7-2.1
23.	ANS:	B	DIF:	IIIC	OBJ:	7-2.1
24.	ANS:	C	DIF:	IIIB	OBJ:	7-2.2
25.	ANS:	A	DIF:	IIIB	OBJ:	7-2.2
26.	ANS:	B	DIF:	IIIC	OBJ:	7-2.2
27.	ANS:	A	DIF:	IIIB	OBJ:	7-2.2
28.	ANS:	D	DIF:	IIIB	OBJ:	7-2.3
29.	ANS:	D	DIF:	IIIB	OBJ:	7-2.3
30.	ANS:	C	DIF:	IIIB	OBJ:	7-2.3
31.	ANS:	C	DIF:	IIIB	OBJ:	7-2.3
32.	ANS:	D	DIF:	IIIA	OBJ:	7-3.1
33.	ANS:	C	DIF:	IIIC	OBJ:	7-3.1
34.	ANS:	A	DIF:	IIIC	OBJ:	7-3.1
35.	ANS:	D	DIF:	IIIB	OBJ:	7-3.1
36.	ANS:	C	DIF:	IIIB	OBJ:	7-3.3
37.	ANS:	A	DIF:	IIIA	OBJ:	7-3.3
38.	ANS:	D	DIF:	II	OBJ:	7-3.3

8-ROTATIONAL MOTION AND DYNAMICS

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. If a net torque is applied to an object, that object will experience which of the following?

a constant moment of inertia

a constant angular speed

an increasing moment of inertia

an angular acceleration

____ 2. Which of the following quantities measures the ability of a force to rotate or accelerate an object around an axis?

moment arm

axis of rotation

torque

lever arm

____ 3. Which of the following statements is correct?

The farther the force is from the axis of rotation, the more torque is produced.

The closer the force is to the axis of rotation, the more torque is produced.

The closer the force is to the axis of rotation, the easier it is to rotate the object.

The farther the force is from the axis of rotation, the less torque is produced.

____ 4. Where should a force be applied on a lever arm to produce the most torque?

closest to the axis of rotation

farthest from the axis of rotation

in the middle of the lever arm

It doesn't matter where the force is applied.

____ 5. To warm up before a game, a baseball pitcher tosses a 0.15 kg ball by rotating his forearm, which is 0.32 m in length, to accelerate the ball. The ball starts at rest and is thrown at a speed of 12 m/s in 0.40 s. While the ball is in the pitcher's hand, what torque is applied to the ball to produce the angular acceleration?

7.2 N•m

1.1 N•m

1.4 N•m

11 N•m

____ 6. A bucket filled with water has a mass of 23 kg and is attached to a rope that is wound around a cylinder with a radius of 0.050 m at the top of a well. What torque does the weight of the water and bucket produce on the cylinder? (g = 9.81 m/s^2.)

11 N•m

34 N•m

23 N•m

17 N•m

____ 7. A force of 4.0 N is applied to a door at an angle of 60.0° and a distance of 0.30 m from the hinge. What is the torque produced?

0.87 N•m

1.0 N•m

0.22 N•m

0.75 N•m

____ 8. A heavy bank-vault door is opened by the application of a force of 3.0×10^2 N directed perpendicular to the plane of the door at a distance of 0.80 m from the hinges. What is the torque?

300 N•m

120 N•m

360 N•m

240 N•m

____ 9. Suppose a doorknob is placed at the center of a door. Compared with a door whose knob is located at the edge, what amount of force must be applied to this door to produce the torque exerted on the other door?

one-fourth as much

one-half as much

four times as much

two times as much

____ 10. If you want to open a swinging door with the least amount of force, where should you push on the door?

as far from the hinges as possible

close to the hinges

It does not matter where you push.

in the middle

____ 11. If you cannot exert enough force to loosen a bolt with a wrench, which of the following should you do?

Use a wrench with a longer handle.

Tie a rope to the end of the wrench and pull on the rope.

Use a wrench with a shorter handle.

You should exert a force on the wrench closer to the bolt.

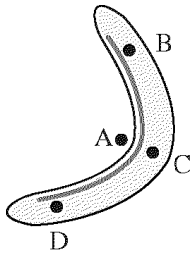
____ 12. If the torque required to loosen a nut on a wheel has a magnitude of 40.0 N•m and the force exerted by a mechanic is 133 N, how far from the nut must the mechanic apply the force?

30.0 cm

60.0 cm

1.20 m

15.0 cm



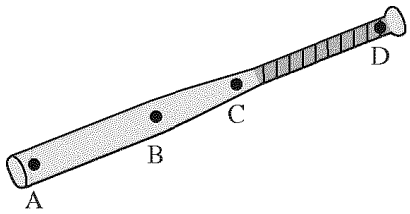
____ 13. At which point in the figure above is the approximate center of mass?

C

A

D

B



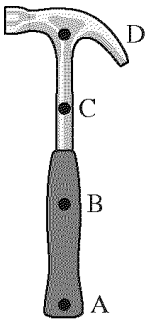
____ 14. At which point on the baseball bat above is the approximate center of mass?

C

A

D

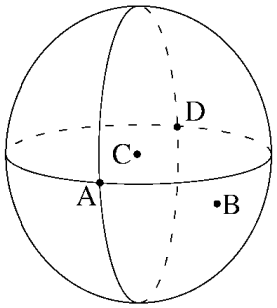
B



____ 15. At which point on the hammer above is the approximate center of mass?

C A

D B



____ 16. At which point on the hollow sphere above is the approximate center of mass?

C A

D B

____ 17. Which of the following is NOT an intrinsic property of an object?

center of mass mass

center of gravity moment of inertia

____ 18. Which of the following statements is correct?

The farther the center of mass of an object is from the axis of rotation, the less difficult it is to rotate the object.

The farther the center of mass of an object is from the axis of rotation, the smaller the object's moment of inertia is.

The farther the center of mass of an object is from the axis of rotation, the greater the object's moment of inertia is.

The farther the center of mass of an object is from the axis of rotation, the greater the object's moment of inertia is, but the less difficult it is to rotate the object.

____ 19. The dependence of equilibrium on the absence of net torque is

rotational equilibrium. the first condition of equilibrium.

translational equilibrium. the second condition of equilibrium.

____ 20. A uniform bridge span weighs 5.00×10^4 N and is 40.0 m long. An automobile weighing 1.50×10^4 N is parked with its center of gravity located 12.0 m from the right pier. What upward support force is provided by the left pier?

6.50×10^4 N 2.95×10^4 N

3.25×10^4 N 3.55×10^4 N

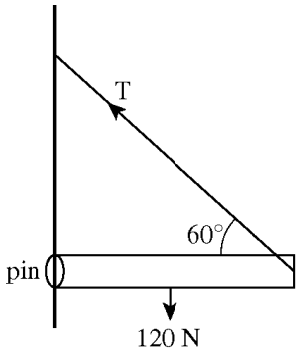
____ 21. A meterstick supported by a knife edge at the 50 cm mark has masses of 0.40 kg and 0.60 kg hanging from the 20 cm and 80 cm marks, respectively. At what mark should a third mass of 0.30 kg be hung to keep the stick balanced?

30 cm

20 cm

25 cm

70 cm



____ 22. A uniform horizontal beam with a length of 6.0 m and a weight of 120 N is attached at one end to a wall by a pin connection so that the beam can rotate. The opposite end of the beam is supported by a cable attached to the wall above the pin. The cable makes an angle of 60.0° with the beam. What is the tension in the cable needed to maintain the beam in equilibrium?

6.0×10^1 N

35 N

120 N

69 N

____ 23. A child with a weight of 4.50×10^2 N sits on a seesaw 0.60 m from the axis of rotation. How far from the axis of rotation on the other side should a child with a weight of 6.00×10^2 N sit so the seesaw will remain balanced?

0.45 m

0.30 m

0.50 m

0.40 m

____ 24. According to Newton's second law, the angular acceleration experienced by an object is directly proportional to which of the following?

the size of the object

the object's moment of inertia

the mass of the object

the net applied torque

____ 25. Which of the following statements is correct?

With a net positive torque, the angular acceleration of an object is clockwise.

With a net positive torque, the angular acceleration of an object is counterclockwise.

With a net negative torque, the angular acceleration of an object is counterclockwise.

The net force of an object is not related to the translational acceleration given to the object.

____ 26. Which of the following represents Newton's second law for rotating objects?

net torque = moment of inertia × angular acceleration

net torque = moment of inertia ÷ angular acceleration

force = mass × acceleration

force = mass ÷ acceleration

____ 27. A grinding wheel with a moment of inertia of 2.0 kg•m^2 is initially at rest. What angular momentum will the wheel have 10.0 s after a 2.5 N•m torque is applied to it?

4.0 kg•m^2/s

25 kg•m^2/s

0.25 kg•m^2/s

7.5 kg•m^2/s

____ 28. A bowling ball has a mass of 7.0 kg, a moment of inertia of 2.8×10^{-2} kg•m^2, and a radius of 0.10 m. If it rolls down the lane without slipping at an angular speed of 4.0×10^{1} rad/s, what is its angular momentum?

11 kg•m^2/s

0.80 kg•m^2/s

1.1 kg•m^2/s

1.4 kg•m^2/s

____ 29. A figure skater with arms drawn in spins on the ice at a rate of 5.0 rad/s and has a moment of inertia of 1.875 kg•m^2. What is the angular momentum of the skater?

9.4 kg•m^2/s

2.5 kg•m^2/s

12 kg•m^2/s

3.8 kg•m^2/s

____ 30. The moment of inertia of a cylinder is 0.016 kg•m^2. If the angular speed is 15.7 rad/s, what is the angular momentum of the cylinder?

19.2 kg•m^2/s

0.25 kg•m^2/s

28.6 kg•m^2/s

12.1 kg•m^2/s

____ 31. A 2.50 N•m torque is applied to a grinding wheel that has a moment of inertia of 2.00 kg•m^2. What is the final kinetic energy of the grinding wheel 10.0 s after beginning from rest?

156 J

312 J

106 J

237 J

____ 32. The total kinetic energy of a baseball thrown with a spinning motion is a function of which of the following?

the ball's linear speed only

the ball's rotational speed only

both the ball's linear and rotational speeds

neither the ball's linear nor the ball's rotational speed

____ 33. A bowling ball has a mass of 7.0 kg, a moment of inertia of 2.8×10^{-2} kg•m^2, and a radius of 0.10 m. If it rolls down the lane without slipping at a linear speed of 4.0 m/s, what is its total kinetic energy?

11 J

45 J

78 J

32 J

____ 34. A bucket filled with water has a mass of 23 kg and is attached to a rope that is wound with a crank around a 0.05 m radius cylinder at the top of a well. The moment of inertia of the cylinder and crank is 0.12 kg•m^2. The bucket and water are first raised to the top of the well and then released to fall back into the well. What is the rotational kinetic energy of the cylinder and crank at the instant the bucket is moving at a speed of 7.9 m/s?

7.0×10^{2} J

2.1×10^{3} J

4.0×10^{2} J

1.5×10^{3} J

____ 35. A solid sphere with a mass of 4.0 kg and a radius of 0.12 m starts from rest at the top of a ramp inclined at 15° and rolls to the bottom. The upper end of the ramp is 1.2 m higher than the lower end. What is the total kinetic energy of the sphere when it reaches the bottom? (Assume that the sphere rolls without slipping and that $g = 9.81\ m/s^2$.)

18 J

70 J

8.8 J

47 J

8-ROTATIONAL MOTION AND DYNAMICS
Answer Section

1.	ANS:	B	DIF:	I	OBJ:	8-1.2
2.	ANS:	D	DIF:	I	OBJ:	8-1.2
3.	ANS:	A	DIF:	I	OBJ:	8-1.2
4.	ANS:	B	DIF:	I	OBJ:	8-1.2
5.	ANS:	D	DIF:	IIIB	OBJ:	8-1.3
6.	ANS:	C	DIF:	IIIB	OBJ:	8-1.3
7.	ANS:	A	DIF:	IIIB	OBJ:	8-1.3
8.	ANS:	B	DIF:	IIIB	OBJ:	8-1.3
9.	ANS:	B	DIF:	II	OBJ:	8-1.4
10.	ANS:	C	DIF:	I	OBJ:	8-1.4
11.	ANS:	A	DIF:	II	OBJ:	8-1.4
12.	ANS:	C	DIF:	IIIA	OBJ:	8-1.4
13.	ANS:	A	DIF:	II	OBJ:	8-2.1
14.	ANS:	B	DIF:	II	OBJ:	8-2.1
15.	ANS:	D	DIF:	II	OBJ:	8-2.1
16.	ANS:	C	DIF:	II	OBJ:	8-2.1
17.	ANS:	B	DIF:	I	OBJ:	8-2.2
18.	ANS:	C	DIF:	I	OBJ:	8-2.2
19.	ANS:	B	DIF:	I	OBJ:	8-2.3
20.	ANS:	A	DIF:	IIIB	OBJ:	8-2.4
21.	ANS:	C	DIF:	IIIB	OBJ:	8-2.4
22.	ANS:	B	DIF:	IIIB	OBJ:	8-2.4
23.	ANS:	C	DIF:	IIIA	OBJ:	8-2.4
24.	ANS:	B	DIF:	I	OBJ:	8-3.1
25.	ANS:	B	DIF:	I	OBJ:	8-3.1
26.	ANS:	A	DIF:	I	OBJ:	8-3.1
27.	ANS:	A	DIF:	I	OBJ:	8-3.2
28.	ANS:	D	DIF:	IIIA	OBJ:	8-3.2
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32.	ANS:	C	DIF:	I	OBJ:	8-3.3
33.	ANS:	D	DIF:	IIIB	OBJ:	8-3.3
34.	ANS:	B	DIF:	IIIC	OBJ:	8-3.3
35.	ANS:	B	DIF:	IIIA	OBJ:	8-3.3