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Chapter 02: Motion, Forces, and Newton's Laws

## **MULTIPLE CHOICE**

NARRBEGIN: 2.2 2.2 What is Motion? NARREND

- 1. Which formula is dimensionally consistent with an expression yielding a value for velocity? (*a* is acceleration, *x* is distance, and *t* is time)
  - a.  $v/t^2$ c.  $v^2/t$ b.  $vx^2$ d. atANS: DPTS: 1DIF: 1
- 2. If *a* is acceleration, *v* is velocity, *x* is position, and *t* is time, then which equation is not dimensionally correct?

a. $t = x/v$ b. $a = v^2/x$		c. d.	$v = a/t$ $t^2 = 2x/a$
ANS: C	<b>PTS:</b> 1	DIF:	1

3. When we add a displacement vector to another displacement vector, the result is:

a.	a velocity.	с.	another displacement.
b.	an acceleration.	d.	a scalar.

ANS: C PTS: 1 DIF: 1

4. When NASA was communicating with astronauts on the Moon, the time from sending on the Earth to receiving on the moon was 1.33 s. Find the distance from Earth to the Moon. (The speed of radio waves is  $3.00 \times 10^8$  m/s.)

a. 240,000 km		с.	399,000 km
b. 384,000 km		d.	768,000 km
ANS: C	PTS: 1	DIF:	2

- 5. In which of the following cases is the displacement's magnitude half the distance traveled? a. 10 steps east followed by 3 steps west c. 5 steps east followed by 10 steps west
  - b. 22 steps east followed by 11 steps west d. 15 steps east followed by 5 steps west

ANS: D PTS: 1 DIF: 2

- 6. A change in a physical quantity w having initial value  $w_i$  and final value  $w_f$  is given by which of the following?
  - a.  $w_i w_f$ b.  $w_f - w_i$ c.  $(w_f + w_i)/2$ d. none of the above

ANS: B PTS: 1 DIF: 1

7. Displacement is which of the following types of quantities?

a. ve	ector		c.	magnitude
b. sc	alar		d.	dimensional
ANS:	А	PTS: 1	DIF:	1

8.	A truck moves 70 m east is chosen as the a. 40 m b40 m	west, th positive	en moves 120 direction, wha	m east, t is the c. d.	and finally moves west again a distance of 90 m. If truck's resultant displacement? 280 m -280 m
	ANS: B	PTS:	1	DIF:	2
9.	<ul><li>Which of the followi</li><li>a. temperature</li><li>b. velocity</li></ul>	ng is no	t a vector quan	tity? c. d.	acceleration displacement
	ANS: A	PTS:	1	DIF:	1
10.	In one-dimensional m then back to its origin a. It is positive. b. It is negative.	notion, t nal place	he average spe e has which of	ed of an the follo c. <b>d.</b>	n object that moves from one place to another and owing properties? It is zero. It can be positive, negative, or zero.
	ANS: A	PTS:	1	DIF:	2
11.	In one-dimensional revelocity of an object a. It is positive. b. It is negative.	notion v has whi	where the direct ch of the follow	ion is in wing pro c. <b>d.</b>	ndicated by a plus or minus sign, the average operties? It is zero. It can be positive, negative, or zero.
	ANS: D	PTS:	1	DIF:	1
12.	An object moves 20 west is chosen as the object?	m east i positive	n 30 s and then e direction, what	returns at is the	to its starting point taking an additional 50 s. If sign associated with the average velocity of the $0$ (as size)
	a. + b			с. <b>d.</b>	any of the above
	ANS: C	PTS:	1	DIF:	1
13.	An object moves 10 s west is chosen as the a. 0.20 m/s b0.20 m/s	m east i positive	n 30 s and then e direction, wha	returns at is the c. d.	to its starting point taking an additional 70 s. If average speed of the object? 0.50 m/s 0 m/s
	ANS: A	PTS:	1	DIF:	2
14.	A bird, accelerating the average velocity? a. 1.7 m/s b. 2.5 m/s	from res	t at a constant	rate, exj c. d.	periences a displacement of 37 m in 11 s. What is 3.4 m/s zero
	ANS: C	PTS:	1	DIF:	1
15.	Jeff throws a ball stra a. on the way up b. at the top	aight up	. For which sitt	ation is c. <mark>d.</mark>	s the vertical velocity zero? on the way back down none of the above
	ANS: B	PTS:	1	DIF:	1

16.	A railroad train trave	els forwa ) m Wł	ard along a stra	aight tra ge veloc	ck at 80.0 m/s for 1000 m and then travels at 40.0
	a. 60.0 m/s	5 111. 771		с.	63.7 m/s
	b. 37.5 m/s			d.	53.3 m/s
	ANS: D	PTS:	1	DIF:	3
17.	The distance of the F the speed of the Eart	Earth fro h in its (	om the Sun is 9 orbit about the	3,000,0 Sun.	00 miles. If there are $3.15 \times 10^7$ s in one year, find
	<ul><li>a. 9.28 miles/s</li><li>b. 18.6 miles/s</li></ul>			с. d.	37.2 miles/s
	ANS: B	PTS:	1	DIF:	2
18.	A ball is thrown vert	ically u velocit	pwards at 9.8 n v is:	n/s. Foi	t its complete trip (up and back down to the starting
	a. 19.6 m/s.		<i>J</i> ===	с.	4.90 m/s.
	b. 9.80 m/s.			d.	not given.
	ANS: D	PTS:	1	DIF:	1
19.	Changing the positiv	e direct	ion in a referen	nce fram	e to the opposite direction does not change the sign
	a. velocity			c.	speed
	b. average velocity			d.	displacement
	ANS: C	PTS:	1	DIF:	1
20.	On a position-time g	raph, th the inte	e slope of the s rval $\Delta t$ , is which	straight i the of the	line joining two points on the plotted curve that are collowing quantities?
	a. average steepnes	s	,	c.	instantaneous velocity
	b. average velocity			d.	average acceleration
	ANS: B	PTS:	1	DIF:	1
21.	A European sports c. km/hr in 8.00 s. If sc	ar deale ), what i	r claims that hi s the accelerati	s car wi on? ( <i>Hi</i>	Il accelerate at a constant rate from rest to 100 <i>int:</i> First convert speed to m/s.)
	a. $3.47 \text{ m/s}^2$			c.	11.4 m/s <sup>2</sup>
	b. $4.63 \text{ m/s}^2$			d.	$18.5 \text{ m/s}^2$
	ANS: A	PTS:	1	DIF:	2
22.	A European sports carspeed of 100 km/hr is convert the speed to	ar deale n 8.00 s m/s.)	r claims that hi s. What is the s	s produ peed aft	ct will accelerate at a constant rate from rest to a er the first 5.00 s of acceleration? ( <i>Hint:</i> First
	a. 34.7 m/s			с.	23.1 m/s
	b. 44.4 m/s			d.	1 / .4 m/s
	ANS: D	PTS:	1	DIF:	2
23.	An <i>x-t</i> graph is draw velocity of the ball is a. the slope of the c	n for a l s zero. V curve is	ball moving in We can be posit non-zero.	one dire tive that	ection. The graph starts at the origin and at $t = 6$ s the at $t = 6$ s,

- b. the acceleration is constant.
- c. the ball has stopped.d. none of the above answers is always correct.

ANS: C PTS: 1 DIF: 1

24.	A <i>v</i> - <i>t</i> graph is drav	vn for a ball moving in	n one direc	tion. The graph starts at the origin and at $t = 6$ s the	
	a the slope of the	e curve is non-zero	r that at $i = c$	the velocity of the ball is not changing	
	b. the curve is no	ot crossing the time axi	is. d.	the curve is at $v = 0, t = 0$ .	
			DIE	1	
	ANS: C	P15: 1	DIF:	1	
25.	The value of an ob following?	ject's acceleration ma	y be chara	cterized in equivalent words by which of the	
	a. displacement		с.	velocity	
	b. rate of change	of displacement	d.	rate of change of velocity	
	ANS: D	PTS: 1	DIF:	1	
26.	A 50-g ball traveli camera records thi the average acceler a. $714 \text{ m/s}^2$ b. $1430 \text{ m/s}^2$	ng at 25.0 m/s is bound s event. If the ball is ir ration of the ball durin	ced off a b n contact w ng this time c. d.	rick wall and rebounds at 20.0 m/s. A high-speed with the wall for 3.50 ms, what is the magnitude of interval? 6430 m/s <sup>2</sup> 12,900 m/s <sup>2</sup>	
	ANS: D	PTS: 1	DIF:	2	
27.	An object is dropp least at one point? a. Its velocity is 1 b. Its velocity is 1 c. Its velocity is 1 d. Its velocity is 1	ed from a height. Once more than its accelerat less than its acceleration the same as its acceleration never equal to its acceleration	ce it is mov tion. on. ation. leration.	ving, which of the following statements is true, at	
	ANS: D	PTS: 1	DIF:	2	
28.	<ul> <li>28. The slope of the acceleration-time curve represents:</li> <li>a. the velocity.</li> <li>b. the rate of change of acceleration.</li> <li>c. the rate of change of displacement.</li> <li>d. the area under the position vs. time curve.</li> </ul>				
	AINS. D	F15. 1	DIF.	1	
29.	A strobe photograp intervals between i a. the speed of th b. the average ve	ch shows equally space images is constant, wh ie car locity of the car	ed images hich of the c. d.	of a car moving along a straight road. If the time following cannot be positive? the acceleration of the car the direction of motion of the car	
	ANS: C	PTS: 1	DIF:	2	
30.	A strobe photograp image to be dimini following are nega a. the speed of th b. the average ve	oh of a car moving alo shing. If the direction ative? he car clocity of the car	ng a straig of motion c. <b>d.</b>	ht road shows the interval between each successive of the car is taken as positive, which of the the average acceleration of the car all of the above	
	ANS: C	DTC 1		2	
	AND: U	P15: 1	DIF	$\mathcal{L}$	

31. A ball is pushed downhill with an initial velocity of 3.0 m/s. The ball rolls down a hill with a constant acceleration of  $1.6 \text{ m/s}^2$ . The ball reaches the bottom of the hill in 6.0 s. What is the ball's velocity at the bottom of the hill?

a. 10 m/s		c. 16 m/s
b. 13 m/s		d. 17 m/s
ANS: B	<b>PTS:</b> 1	DIF: 2

32. A bird, accelerating from rest at a constant rate, experiences a displacement of 37 m in 11 s. What is the final velocity after 11 s?

a. 6.' b. 5.	7 m/s 1 m/s			c. d.	13 m/s zero
ANS:	А	PTS:	1	DIF:	2

33. A bird, accelerating from rest at a constant rate, experiences a displacement of 37 m in 11 s. What is its acceleration?

a. $0.20 \text{ m/s}^2$		c.	0.51 m/s <sup>2</sup>
b. $0.31 \text{ m/s}^2$		d.	0.61 m/s <sup>2</sup>
ANS: D	PTS: 1	DIF:	2

34. In the case of constant acceleration, the average velocity equals the instantaneous velocity:

- a. at the beginning of the time interval.
- b. at the end of the time interval.
- c. half-way through the time interval.
- d. three-fourths of the way through the time interval.

ANS: C PTS: 1 DIF: 2

35. A particle moves east at constant velocity  $\vec{\mathbf{v}}$  for a time interval  $\Delta t$ . It then moves north at a constant velocity, with the same speed as before, for another time interval  $\Delta t$  Finally it moves east again with the original velocity. At the instant an additional time interval  $\Delta t$  has elapsed, which of the following are true about the average velocity and the average acceleration for the motion described?

- a. The average velocity is  $\vec{\mathbf{v}}$  and the average acceleration is zero.
- b. The average velocity is  $\vec{\mathbf{v}}$  and the average acceleration is not zero.
- c. The average velocity is not  $\vec{\mathbf{v}}$  and the average acceleration is zero.
- d. The average velocity is not  $\vec{\mathbf{v}}$  and the average acceleration is not zero.

ANS: C PTS: 1 DIF: 3

36. The first displacement is 7 m and the second displacement is 3 m. They <u>cannot</u> add together to give a total displacement of:

a.	10 m.		с.	4 m
b.	7 m.		d.	3 m
AN	S: D	PTS: 1	DIF:	1

- 37. An object, initially moving in the negative *x* direction, is subjected to a change in velocity in the negative *y* direction. If the resulting velocity vector is drawn from the origin, into which quadrant does this vector point?
  - **a.** 1st
  - **b.** 2nd
  - **c.** 3rd
  - **d.** None, since the object is now moving in the negative *y* direction.

ANS: C PTS: 1 DIF: 2

38. A car is initially moving at 30 m/s east and a little while later it is moving at 10 m/s north. Which of the following best describes the orientation of the average acceleration during this time interval? a. north of west c. west b. northwest d. north of east ANS: A PTS: 1 DIF: 2 39. A hiker walks 200 m east and then walks 100 m north. In what direction is her resulting displacement? a. north c. northeast b. east **d.** None of the answers is correct. ANS: D PTS: 1 DIF: 2 40. An object moves at a constant velocity of 12 m/s to the southwest for an interval of 20 s. Halfway through this interval, what is the magnitude of its instantaneous velocity? a. It can be any value from 0 to 24 m/s. c. 12 m/s b. 6 m/s **d.** More information is needed. ANS: C PTS: 1 DIF: 1 41. Arvin the Ant is on a picnic table. He travels 30 cm eastward, then 20 cm northward, and finally 15 cm westward. What is the magnitude of Arvin's net displacement? a. 25 cm c. 50 cm b. 65 cm d. 29 cm ANS: A PTS: 1 DIF: 2 42. A jogger runs halfway around a circular path with a radius of 70 m. What, respectively, are the magnitude of the displacement and the distance jogged? a. 70 m, 220 m c. 140 m, 220 m b. 70 m, 440 m d. 140 m, 440 m ANS: C PTS: 1 DIF: 2

- 43. A runner circles a track of radius 100 m in 100 s moving at a constant rate. If the runner was initially moving east, what has been the runner's average acceleration when halfway around the track?
  - a. At a constant rate, the average acceleration would be zero.
  - b.  $0.13 \text{ m/s}^2$ , south
  - c.  $0.25 \text{ m/s}^2$ , west
  - **d.** No answer is correct.

ANS: C PTS: 1 DIF: 3

44. A car is moving along a straight highway and accelerates at a constant rate while going from point A to point B. If the acceleration is positive, increasing the speed of the car, where does the position where the instantaneous speed equals the average speed occur for the interval from A to B?

a.	inidway between	A and	D	С.	closer to D than to A
b.	closer to A than t	to B		d.	Any of the answers could be correct
					depending on the original speed.
AN	IS: B	PTS:	1	DIF:	2

- 45. A car is moving in the positive direction along a straight highway and accelerates at a constant rate while going from point A to point B. If the acceleration is positive, increasing the speed of the car, when does the position where the average speed equals the instantaneous speed occur during the time interval from A to B? Assume the time interval is T.
  - a. T/2 from the start of the interval
  - b. before T/2 from the start of the interval
- c. after T/2 from the start of the interval
- **d.** It depends on the speed at the start of the time interval.
- ANS: A PTS: 1 DIF: 2
- 46. Suppose a particle is moving along a straight line with a speed v for a time t, then stops for a time t, and then resumes moving along the original direction with speed v for time t. What has been the average speed of the particle for the total time period 3t?
  - a. vb. 2v/3ANS: B PTS: 1 DIF: 2
- 47. On a position-time graph for a particle, suppose the plot starts at some positive position and as the time goes on the curve gets steeper and steeper while curving upwards. Which of the following must be true?
  - a. The speed of the particle is constant.b. The acceleration of the particle is constant.c. The speed of the particle is decreasing.d. The acceleration of the particle is positive.

ANS: D PTS: 1 DIF: 2

- 48. On a velocity-time graph for a particle, suppose the plot starts at some positive velocity and then follows a straight line to zero at a later time. Which of the following must be true about a position vs. time graph for this same time interval?
  - a. The curve will start at a positive position value and follow a straight line to zero at the later time.
  - b. The curve will rise steeply at first and as time goes on will level out approaching its highest position value at the later time.
  - c. The curve will drop steeply at first and as time goes on will approach its lowest position value at the later time
  - d. The curve will start at the zero of position and follow a straight line to its highest position at the later time.

ANS: B PTS: 1 DIF: 2

NARRBEGIN: 2.3 2.3 The Principle of Inertia NARREND

- 49. A physics student is riding on a train traveling north. Having read about inertia, the student performs an experiment with a golf ball. He reaches over the aisle and drops the ball from rest. Instead of hitting the floor directly below the student's hand, it hits to the north, i.e., forward of that position. Which of the following might be the cause for this to happen?
  - a. The train is moving at constant velocity. c. The train is slowing down.
  - b. The train is speeding up. d.
- d. Whatever the cause, it cannot be any of the answers given.

ANS: C PTS: 1 DIF: 2

## NARRBEGIN: 2.4 2.4 Newton's Laws of Motion NARREND

50. Five boys are pushing on a snowball, and each is pushing with a force of 20.0 N. However, each boy is pushing in a different direction. They are pushing north, northeast, east, southeast, and south. (Each boy is pushing at an angle of 45.0° relative to his neighbor.) What is the magnitude of the total force on the ball?

a. 54.2 N	1		с.	24.1 N
b. 48.3 N	[		d.	0 N
ANS: B	PTS:	1	DIF:	2

51. The net force on an object in the positive *x* direction. Consider the following statements:

- i) The object can be moving in the negative *x* direction.
- ii) The object can be speeding up.
- iii) The object can be slowing down.
- iv) The object can be moving in the positive *y* direction.

Which of the statements are true?

- a. (i) and (ii)
- b. (ii) and (iii)
- c. (iii) and (iv)
- **d.** Choose this answer if all the statements are true.

ANS: D PTS: 1 DIF: 2

52. If we know an object is moving at constant velocity, we may assume:

- a. the net force acting on the object is zero. c. the object is accelerating.
- b. there are no forces acting on the object. d. the object is losing mass.

ANS: A PTS: 1 DIF: 1

- 53. Which of the following expresses a principle which was initially stated by Galileo and was later incorporated into Newton's laws of motion?
  - a. An object's acceleration is inversely proportional to its mass.
  - b. For every action there is an equal but opposite reaction.
  - c. The natural condition for a moving object is to remain in motion.
  - d. The natural condition for a moving object is to come to rest.

ANS: C PTS: 1 DIF: 1

54. A 7.0-kg bowling ball experiences a net force of 6.0 N. What will be its acceleration?

<ul> <li>a. 0.86 m/s<sup>2</sup></li> <li>b. 6.0 m/s<sup>2</sup></li> </ul>			c. d.	7.0 m/s <sup>2</sup> 42 m/s <sup>2</sup>
ANS: A	PTS:	1	DIF:	1

55. An astronaut applies a force of 500 N to an asteroid, and it accelerates at 3.00 m/s<sup>2</sup>. What is the asteroid's mass?

a. 1500 kg b. 135 kg			c. d.	600 kg 167 kg
ANS: D	PTS:	1	DIF:	1

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56.	Two forces act on a 6 what is the greatest p a. 33.0 N b. 23.0 N	6.00-kg object. One possible magnitude c	of the forc of the other c. d.	es is 11.0 N. If the object accelerates at 2.00 m/s <sup>2</sup> , force? 3.0 N 1.0 N
	ANS: B	PTS: 1	DIF:	2
57.	If we know that a nor regarding the object' a. at rest. b. moving with a co	nzero net force is ac s condition? The ob onstant velocity.	ting on an ject is: c. d.	object, which of the following must we assume being accelerated. losing mass.
	ANS: C	PTS: 1	DIF:	1
58.	An automobile of ma 10,000 N. How far da a. 40 m b. 80 m	ass 2000 kg moving oes the car travel be	at 20 m/s i fore stoppi c. d.	s braked suddenly with a constant braking force of ing? 120 m 160 m
	ANS: A	P1S: 1	DIF:	2
59.	The statement by Ne which of his laws of a. first b. second	wton that "for every motion?	action the c. d.	third fourth
	ANS: C	PTS: 1	DIF:	1
60.	An airplane of mass net forward thrust of a. 2.0 m/s <sup>2</sup> b. 3.0 m/s <sup>2</sup>	$1.2 \times 10^4$ kg tows a 5.4 $\times 10^4$ N. What i	glider of m s the glide c. d.	hass $0.6 \times 10^4$ kg. The airplane propellers provide a r's acceleration? $6.0 \text{ m/s}^2$ $9.8 \text{ m/s}^2$
	ANS: B	PTS: 1	DIF:	2
61.	A thrown stone hits a ground below the wir a. the force of the s b. the force of the s	a window but doesn' ndow. In this case, w stone on the glass > stone on the glass =	't break it. we know: the force the force	Instead, it reverses direction and ends up on the of the glass on the stone. of the glass on the stone.

- c. the force of the stone on the glass < the force of the glass on the stone.
- d. the stone didn't slow down as it hit the glass.

ANS: B PTS: 1 DIF: 2