Exam 1 Review Questions
PHY 2425 - Exam 1

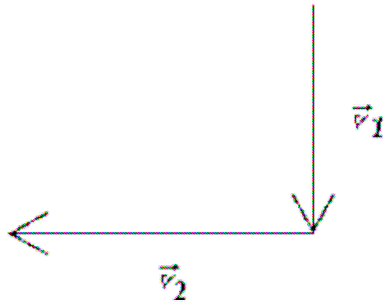
10) Three vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$ have the following x and y components:

	$\vec{A}$	$\vec{B}$	$\vec{C}$
x component	+6	−3	+2
y component	−3	+4	+5

The angle that the resultant makes with the positive direction of the x axis is
A) 1.2° B) 36° C) 50° D) 40° E) 70°
Ans: C

Section: 1–7 Topic: General Properties of Vectors Type: Numerical

11)



A car proceeding due south at 60 km/h ($\vec{v}_1$) makes a right turn, after which it is traveling due west at 80 km/h ($\vec{v}_2$). What is its change in velocity ($\vec{v}_2 - \vec{v}_1$)?
A) 100 km/h 37° north of west
B) 100 km/h 37° south of west
C) 20 km/h west
D) 20 km/h 37° north of west
E) 20 km/h 37° south of west
Ans: A

Section: 1–7 Topic: General Properties of Vectors Type: Numerical

13) Vector $\vec{A}$ has components $A_x = +4.0$ units and $A_y = +3.2$ units, whereas vector $\vec{B}$ has components $B_x = +2.5$ units and $B_y = +5.5$ units. The angle between the two vectors is
A) 24° B) 65° C) 27° D) 39° E) 14°
Ans: C

Section: 1–7 Topic: General Properties of Vectors Type: Numerical

14) Vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$ have the following components, expressed in arbitrary units:

	$\vec{A}$	$\vec{B}$	$\vec{C}$
x component	+4.60	–3.10	+5.30
y component	–3.10	+2.30	–2.50

Vector $\vec{D}$ is defined so that

$$\vec{A} + \vec{B} + \vec{C} + \vec{D} = 0$$

The magnitude and direction of $\vec{D}$ relative to the positive x axis are

A) 7.6 units at –26°
B) 7.6 units at 154°
C) 14 units at 26°
D) 3.5 units at 29°
E) 10 units at 29°

Ans: B

Section: 1–7 Topic: General Properties of Vectors Type: Numerical

15) Vectors $\vec{A}$ and $\vec{B}$ have the following components:

$A_x = 5$ units $A_y = 2$ units
$B_x = 3$ units $B_y = 4$ units

The angle between the positive x axis and the vector $\vec{A} - \vec{B}$ is

A) –45° B) 194° C) 37° D) –54° E) 86°

Ans: A

Section: 1–7 Topic: General Properties of Vectors Type: Conceptual

1 Given vector $\vec{A}$, the vector $3\vec{A}$

A) has a magnitude 3 times that of $\vec{A}$.
B) points in the same direction as $\vec{A}$.
C) has components each of which is 3 times those of $\vec{A}$.
D) makes the same angle with a given axis as does $\vec{A}$.
E) is described by all of these.

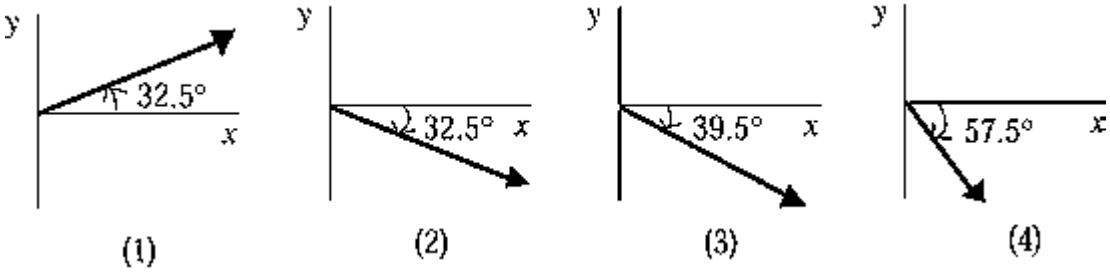
Ans: E

Section: 1–7 Topic: General Properties of Vectors Type: Numerical

2 What angle does the vector $\vec{A} = 5\hat{i} - 12\hat{j}$ make with the positive x axis?
A) 67.4° B) 22.6° C) 36.9° D) 53.1° E) 24.6°
Ans: A

Section: 1–7 Topic: General Properties of Vectors Type: Conceptual

3



(1) (2) (3) (4)

A velocity vector has an x component of +5.5 m/s and a y component of –3.5 m/s. The diagram that gives the direction of the vector is
A) 1 B) 2 C) 3 D) 4 E) None of these is correct.
Ans: B

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

4 A particle moves from $x_0 = 30$ cm to $x = -40$ cm in 5 s. The average velocity of the particle during this time interval is

A) 2 cm/s. B) –2 cm/s. C) 14 cm/s. D) –14 cm/s. E) –140 cm/s.

Ans: D

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

5 You drive for 30 min at 100 km/h and then stop for 15 min. You then drive for 45 min at 80 km/h. Your average speed for the entire trip is

A) 73 km/h. B) 83 km/h. C) 88 km/h. D) 90 km/h. E) 97 km/h.

Ans: A

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

6 You drive for 30 min for 30 km East and then another 30 min for 40 km North. Your average speed for the entire trip is

A) 40 km/h. B) 50 km/h. C) 60 km/h. D) 70 km/h. E) 80 km/h.

Ans: D

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

7 You drive for 30 min for 30 km East and then another 30 min for 40 km North. Your average velocity for the entire trip is

A) 40 km/h. B) 50 km/h. C) 60 km/h. D) 70 km/h. E) 80 km/h.

Ans: B

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

8 Assume that the Deschutes River has straight and parallel banks and that the current is 0.75 m/s. Drifting down the river, you fall out of your boat and immediately grab a piling of the Warm Springs Bridge. You hold on for 40 s and then swim after the boat with a speed relative to the water of 0.95 m/s. The distance of the boat downstream from the bridge when you catch it is

A) 67 m. B) 90 m. C) 78 m. D) 54 m. E) 120 m.

Ans: D

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

9 A river 1.00 mile wide flows with a constant speed of 1.00 mi/h. A woman leaves from a point on the river bank. The woman rows a boat 1.00 mi directly upstream and returns to the starting point. Her speed in still water is 2.00 mi/h. The travel time for the woman is

A) 2.00 h. B) 1.15 h. C) 1.00 h. D) 1.33 h. E) 0.67 h.

Ans: D

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

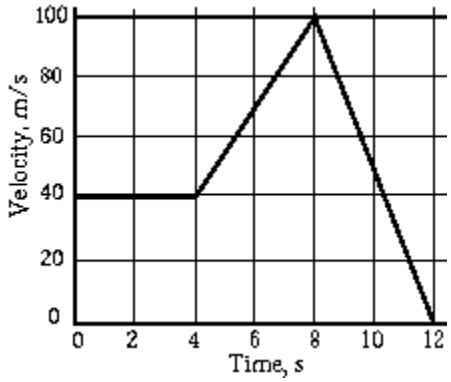
10 A river 1.00 mile wide flows with a constant speed of 1.00 mi/h. A man can row a boat at 2.00 mi/h. He crosses the river in a direction that puts him directly across the river from the starting point, and then he returns in a direction that puts him back at the starting point in the shortest time possible. The travel time for the man is

A) 2.00 h. B) 1.15 h. C) 1.00 h. D) 1.33 h. E) 0.67 h.

Ans: B

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Numerical

11



The graph shows the velocity of a particle as a function of time. In the 12 s shown, the particle travels

A) 0 m. B) 1200 m. C) 640 m. D) 440 m. E) 200 m.

Ans: C

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

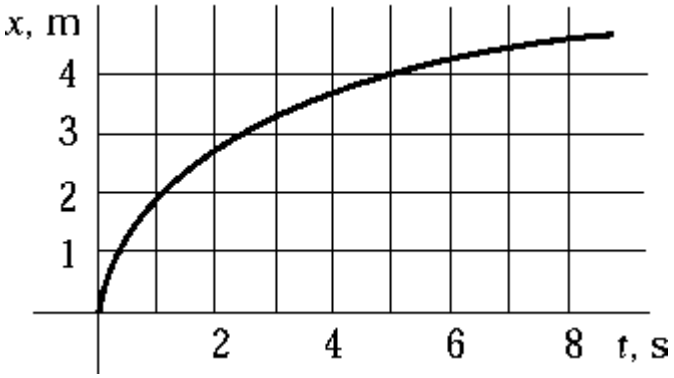
12 If an object is moving at uniform speed in a straight line, its instantaneous velocity halfway through any time interval is

A) greater than its average velocity.
B) less than its average velocity.
C) the same as its average velocity.
D) half of its average velocity.
E) twice its average velocity.

Ans: C

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

13



The graph shows how the position of a particle depends on time. Which choice is closest to the instantaneous speed of the particle at $t = 3$ s?

A) 0.40 m/s B) 0.67 m/s C) 0.75 m/s D) 1.50 m/s E) 2.22 m/s

Ans: A

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

14 On a graph that shows position on the vertical axis and time on the horizontal axis, a straight line with a positive slope represents

A) a constant positive acceleration.
B) a constant negative acceleration.
C) zero velocity.
D) a constant positive velocity.
E) a constant negative velocity.

Ans: D

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

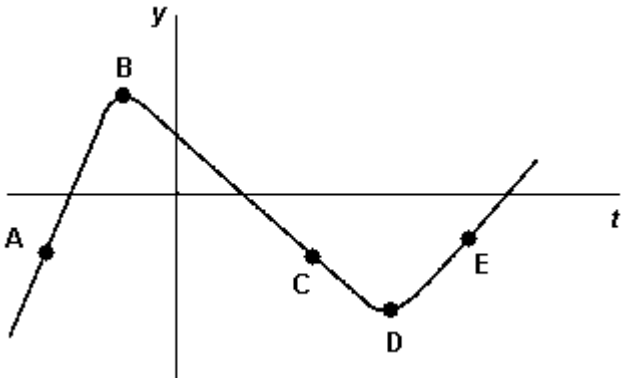
15 On a graph that shows position on the vertical axis and time on the horizontal axis, a straight line with a negative slope represents

A) a constant positive acceleration.
B) a constant negative acceleration.
C) zero velocity.
D) a constant positive velocity.
E) a constant negative velocity.

Ans: E

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

16



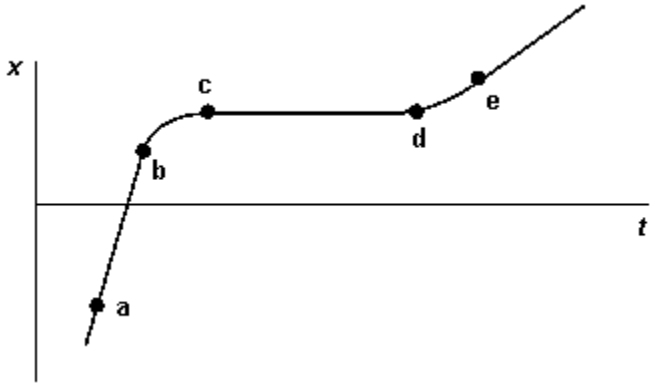
The graph shows the displacement of a particle along the *y* axis as a function of time. The points at which the velocity is the same are

A) A and C. B) A and E. C) B and D. D) A, C, and E. E) B, C, and D.

Ans: C

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

17



The graph represents the displacement of a particle along the *x* axis as a function of time. The interval in which the velocity of this particle is negative is

A) a–b B) b–c C) d–e D) c–d E) none of these is correct.

Ans: E

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

18 For this problem, refer to the figure in problem 31. Which point has the highest instantaneous velocity?

A) a B) b C) c D) d E) e

Ans: A

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

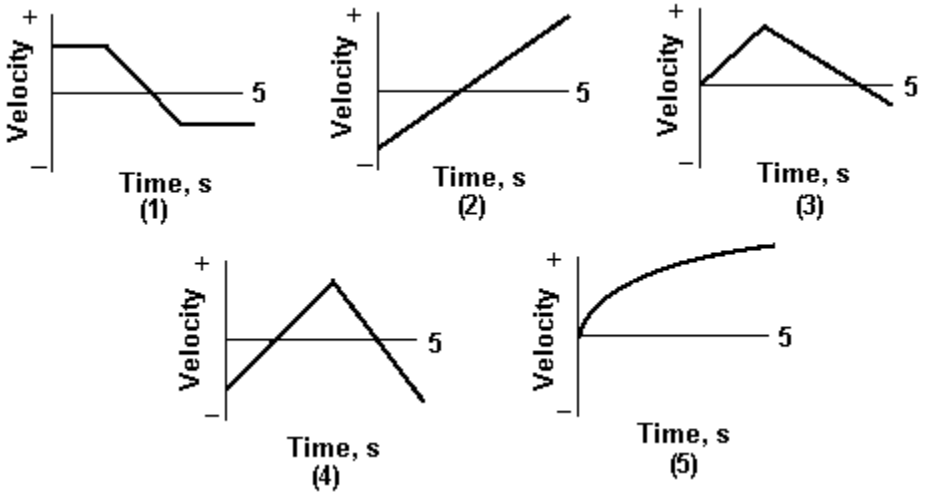
19 For this problem, refer to the figure in problem 31. Which interval has the highest magnitude in acceleration?

A) a-b B) b-c C) c-d D) d-e E) they have equal acceleration

Ans: B

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

20



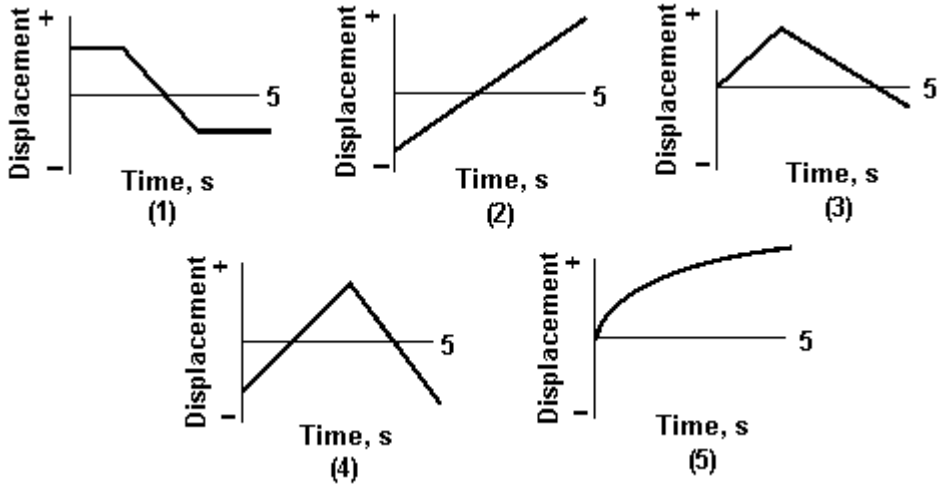
In which graph is the particle the farthest from the origin at $t = 5$ s?

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

Ans: E

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

21



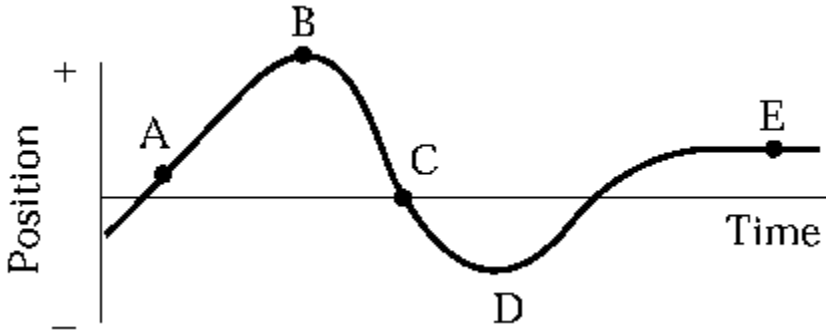
In which graph is the particle the closest to the origin at $t = 5$ s?

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

Ans: C

Section: 2–1 Topic: Displacement, Velocity, and Speed Type: Conceptual

22



An object moves along the *x* axis as shown in the diagram. At which point or points is the object instantaneously at rest?

A) A and E
B) B, D, and E
C) C only
D) E only
E) None of these is correct.

Ans: B

Section: 2–1 Status: New to 5th edition
Topic: Displacement, Velocity, and Speed Type: Numerical

23 A Ford truck enters a highway and travels at a uniform speed of 50 mph. Half an hour later a Jaguar enters the highway at the same junction and heads in the same direction at 55 mph. How long after the Ford entered the highway does the Jaguar catch up with the truck?

A) 5.0 hrs B) 6.0 hrs C) 1.0 hrs D) 1.6 hrs E) 5.5 hrs

Ans: E

Section: 2–2 Topic: Acceleration Type: Numerical

24 A car accelerates uniformly from rest to a speed of 20 m/s at the end of 1 min; it then accelerates uniformly to a speed of 40 m/s at the end of the next minute. During this 2-min period, the average speed of the car is

A) 7.5 m/s B) 30 m/s C) 15 m/s D) 20 m/s E) 40 m/s

Ans: D

Section: 2–2 Topic: Acceleration Type: Numerical

25 An object is moving in a straight line. At $t = 0$, its speed is 5.0 m/s. From $t = 0$ to $t = 4.0$ s, its acceleration is 2.5 m/s^2. From $t = 4.0$ s to $t = 11.0$ s, its speed is constant. The average speed over the entire time interval is

A) 9.5 m/s B) 15 m/s C) 13 m/s D) 21 m/s E) 8.2 m/s

Ans: C

Section: 2–2 Topic: Acceleration Type: Numerical

26 A particle that is moving along a straight line decelerates uniformly from 40 cm/s to 20 cm/s in 5.0 s and then has a constant acceleration of 20 cm/s^2 during the next 4.0 s. The average speed over the whole time interval is

A) 57 cm/s B) 140 cm/s C) 86 cm/s D) 43 cm/s E) 97 cm/s

Ans: D

Section: 2–2 Topic: Acceleration Type: Numerical

27 A particle decelerates uniformly from a speed of 30 cm/s to rest in a time interval of 5.0 s. It then has a uniform acceleration of 10 cm/s^2 for another 5.0 s. The particle moves in the same direction along a straight line. The average speed over the whole time interval is

A) 20 cm/s B) 35 cm/s C) 38 cm/s D) 100 cm/s E) 12 cm/s

Ans: A

Section: 2–2 Status: New to 5th edition Topic: Acceleration Type: Numerical

28 A Lamborghini sports car can accelerate from zero to 60 mph in 4 seconds. It can decelerate from 60 mph to rest in 120 ft. What is the ratio of average acceleration over average deceleration? (1 mile = 5280 ft)

A) 1.74×10^{-5} B) 1.47 C) 0.682 D) 0.0114 E) 0.688

Ans: C

Section: 2–2 Status: New to 5th edition Topic: Acceleration Type: Numerical

29 If we assume that a spaceship could accelerate from rest at a constant rate of 9.81 m/s^2, then how long would it take to reach 1% of the speed of light? (Assume the speed of light = 3.0×10^8 m/s)

A) 1.8 days B) 3.5 days C) 3.1×10^4 s D) 3.1×10^6 s E) 7.1 days

Ans: B

Section: 2–2 Status: New to 5th edition Topic: Acceleration Type: Numerical

30 If we assume that a spaceship could accelerate from rest up to 1% of the speed of light at a constant rate of 9.81 m/s^2, how many times the radius of our Solar System (i.e., the distance from the Sun to Pluto = 5.9×10^9 km) would the spaceship have traveled?

A) 78 B) 7.8×10^{-2} C) 2.6×10^{-10} D) 2.6×10^{-7} E) 7.8×10^{-1}

Ans: B

Section: 2–2 Status: New to 5th edition Topic: Acceleration Type: Numerical

31 A common statistic in car tests is the standing (starting from rest) quarter-mile performance. A modern sports car can achieve a terminal speed (speed at the end of the quarter-mile) of 120 mph (193 km/h). How does the average acceleration compare to g? (0.25 mile = 402 m)

A) 0.36 g B) 2.8 g C) 0.067 g D) 15.0 g E) 0.73 g

Ans: A

Section: 2–2 Status: New to 5th edition Topic: Acceleration Type: Numerical

32 A racecar starts from rest and accelerates at a constant rate and reaches a speed of 160 km/h (100 mph) in 6.0 seconds. It continues at this speed for another 5 seconds. What is the car's average speed during the first 11 seconds?

A) 34.3 m/s B) 29.3 m/s C) 22.2 m/s D) 32.3 m/s E) 44.4 m/s

Ans: D

Section: 2–2 Status: New to 5th edition Topic: Acceleration Type: Numerical

33 A car is traveling at 120 km/h (75 mph). When applied the braking system can stop the car with a deceleration rate of 9.0 m/s^2. The typical reaction time for an alert driver is 0.5 s versus 2 s for a sleepy driver. Assuming a typical car length of 5 m, calculate the number of additional car lengths it takes the sleepy driver to stop compared to the alert driver.

A) 13 B) 3.0 C) 10 D) 16 E) 26

Ans: C

Section: 2–3 Topic: Motion with Constant Acceleration Type: Numerical

34 A projectile is fired vertically upward with a speed of 62 m/s. In the absence of air resistance, the maximum height the projectile attains is

A) 25 km B) 98 m C) 200 m D) 19 km E) 3 m

Ans: C

Section: 2–3 Topic: Motion with Constant Acceleration Type: Numerical

35 A ball is dropped from the top of a building. In the absence of air resistance, the ball will hit the ground with a speed of 49 m/s. The height of the building is

A) 25 m B) 5 m C) 240 m D) 120 m E) 10 m

Ans: D

Section: 2–3 Topic: Motion with Constant Acceleration Type: Numerical

36 A ball is thrown upward from an 80-ft tower with an initial vertical speed of 40 ft/s. If air resistance is ignored, the ball's speed when it reaches the ground will be

A) 67 ft/s B) 1.3×10^2 ft/s C) 1.2×10^2 ft/s D) 49 ft/s E) 82 ft/s

Ans: E

Section: 2–3 Topic: Motion with Constant Acceleration Type: Numerical

37 A balloon is ascending at a rate of 16 ft/s at a height of 32 ft above the ground when a package is dropped. The time taken, in the absence of air resistance, for the package to reach the ground is

A) 1.0 s B) 1.5 s C) 2.0 s D) 2.5 s E) 3.0 s

Ans: C

Section: 2–3 Topic: Motion with Constant Acceleration Type: Numerical

38 An object is thrown upward with a velocity of 32 ft/s from a stationary balloon which is 48 ft above the ground. If air resistance is ignored, the total time until the object impacts the ground is

A) 1.0 s B) 2.0 s C) 3.0 s D) 4.0 s E) 6.0 s

Ans: C

Section: 2–3 Status: New to 5th edition

Topic: Motion with Constant Acceleration Type: Numerical

39 A baseball is thrown vertically up to a height of 30 m on Earth. If the same ball is thrown up on the moon with the same initial speed how much further will it travel up? (Assume $g_{moon} = g_{earth}/6$)

A) 5.0 m B) 25 m C) 12 m D) 180 m E) 150 m

Ans: E

Section: 2–3 Status: New to 5th edition

Topic: Motion with Constant Acceleration Type: Numerical

40 Two baseballs are thrown vertically up from the ground at the same speed, one on Earth, and one on Mars. The baseball on Earth reaches a maximum height of 25 m. Which ball hits the ground first and by what time difference? ($g_{Mars} = 0.38\ g_{Earth}$)

A) Mars by 7.4 s
B) Earth by 7.4 s
C) Earth by 3.7 s
D) Mars by 3.7 s
E) Earth by 2.7 s

Ans: B

Section: 2–3 Status: New to 5th edition

Topic: Motion with Constant Acceleration Type: Numerical

41 A sandbag is released from a rising air balloon and hits the ground 7 seconds later. From what height was the sandbag dropped from if at the moment of release the balloon was traveling upward at 3 m/s.

A) 219 m B) 240 m C) 459 m D) 261 m E) 55 m

Ans: A

Section: 2–4 Topic: Integration Type: Numerical

42 The relationship between the velocity of a body moving along the x axis and time is given by $v = 3t^2 - 2t$, where the units are SI units. The total distance the body travels between the times $t = 2$ s and $t = 4$ s is

A) 12 m B) 60 m C) 48 m D) 34 m E) 44 m

Ans: E

Section: 2–4 Topic: Integration Type: Numerical

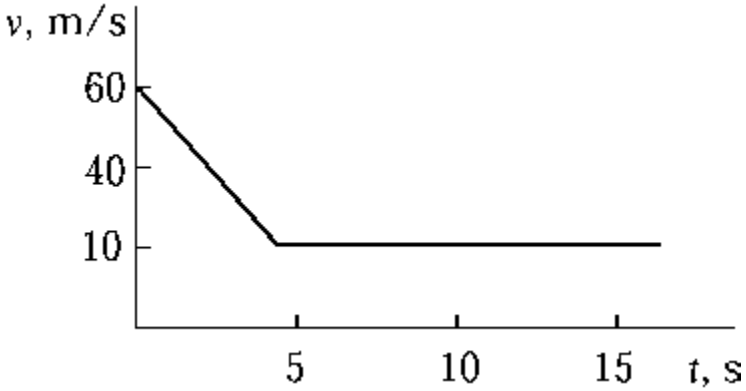
43 The relationship between the velocity of a body moving along the x axis and time is given by $v = 2t^3 + 2t$, where the units are SI units. The total distance the body travels between the times $t = 2$ s and $t = 4$ s is

A) 132 m B) 144 m C) 136 m D) 120 m E) 156 m

Ans: A

Section: 2–4 Topic: Integration Type: Numerical

44



The graph shows the instantaneous velocity of a car during 15 s of its motion. The distance traveled by this car during this 15-s interval is

A) 80 mm B) 1.2 km C) 600 m D) 400 m E) 200 m

Ans: D

Section: 2–4 Topic: Integration Type: Numerical

45 The velocity of a particle is given by v(t) = 3t. The average velocity for the particle between t = 2 and 4 s is

A) 4 m/s
B) 6 m/s
C) 9 m/s
D) 12 m/s
E) 18 m/s

Ans: C

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

46 You walk 5 km north and then 12 km east. Your resultant displacement is

A) 13 km at an angle of 22.6º north of east.
B) 13 km at an angle of 67.4º north of east.
C) 17 km at an angle of 22.6º north of east.
D) 17 km at an angle of 67.4º north of east.
E) None of these is correct.
Ans: A

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

47 A vector has an *x* component of –5.51 units and a *y* component of +9.52 units. The angle between the positive direction of the vector and the positive direction of the *x* axis is

A) 125º B) 60º C) 120º D) 150º E) –60º
Ans: C

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

48 A vector has an *x* component of 5.51 units and a *y* component of –9.52 units. The angle between the positive direction of the vector and the positive direction of the *x* axis is approximately

A) 30º B) –30º C) 60º D) –60º E) None of these is correct.
Ans: D

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

49 The position vector of an object is given by $\vec{r}_1 = 2\hat{i} + 3\hat{j}$ and 4 s later, its position vector is $\vec{r}_2 = -2\hat{i} + 7\hat{j}$. The units are in m. The change in the position vector $\Delta\vec{r}$, in m, is

A) $4\hat{i} - 4\hat{j}$ B) $-10\hat{j}$ C) $-4\hat{i} - 4\hat{j}$ D) $-4\hat{i} + 4\hat{j}$ E) None of the above
Ans: D

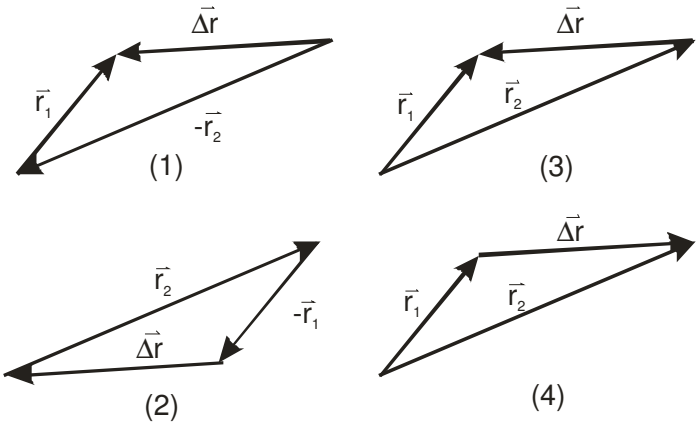
Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

50 The position vector of an object is given by $\vec{r}_1 = 2\hat{i} + 3\hat{j}$ and 4 s later, its position vector is $\vec{r}_2 = -2\hat{i} + 7\hat{j}$. The units are in m. The magnitude of the change in the position vector $\Delta\vec{r}$ is

A) 0 m B) $2\sqrt{2}$ m C) $4\sqrt{2}$ m D) 10 m E) $8\sqrt{2}$ m
Ans: C

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Conceptual

51 Which of the vector diagrams below best represent the change in position vector from P_1 to P_2?



A) (1) B) (2) C) (3) D) (4) E) None of these is correct.
Ans: D

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

52 A particle has an initial velocity of 4.8 m/s toward the south and a final velocity of 7.1 m/s toward the east. The particle was subject to a constant acceleration for 0.25 s. The magnitude and the direction of the acceleration must have been

A) 8.6 m/s^2 at 34.1° north of east
B) 260 m/s^2 at 34.1° south of east
C) 34 m/s^2 at 34.1° north of east
D) 34 m/s^2 at 34.1° south of east
E) 8.6 m/s^2 at 34.1° south of east

Ans: C

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Conceptual

53 A river is 0.76 km wide. The banks are straight and parallel. The current is 5.0 km/h and is parallel to the banks. A boat has a maximum speed of 3 km/h in still water. The pilot of the boat wishes to travel on a straight line from A to B, where AB is perpendicular to the banks. The pilot should

A) head directly across the river.
B) head 68° upstream from the line AB.
C) head 22° upstream from the line AB.
D) give up. The trip from A to B is not possible with this boat.
E) do none of these.

Ans: D

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

54 A car is traveling east at 50 km/h. It rounds a curve, and 5 s later it is traveling north at 50 km/h. The magnitude of the average acceleration of the car is

A) zero
B) 20 km/h · s
C) 10 km/h · s
D) 50 km/h · s
E) None of these is correct.

Ans: E

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

55 A pilot wants the heading of an airplane to be 37º east of north. The wind is from the east at 37 km/h. The airplane has a speed relative to the air of 370 km/h. Approximately what heading should the pilot maintain? (**Hint**: Sketch the problem graphically and select the best answer from the list given.)

A) 318º B) 4.6º C) 122º D) 32º E) 42º

Ans: E

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

56 A pilot wants the heading of an airplane to be 45º east of north. The wind is from 270º at 32 km/h, and the speed of the airplane through the air is 320 km/h. The pilot should maintain a heading of approximately

A) 15º B) 49º C) 41º D) 4º E) 131º

Ans: C

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

57 A car is at position $(x_1, y_1) = (4 \text{ m}, 5 \text{ m})$ at time $t_1 = 1$ s. If 10 seconds later the car moving in a straight line is at position $(x_2, y_2) = (204 \text{ m}, 305 \text{ m})$, calculate the distance traveled by the car in this interval.

A) 367 m B) 500 m C) 373 m D) 509 m E) 361 m

Ans: E

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

58 A car is at position $(x_1, y_1) = (4 \text{ m}, 5 \text{ m})$ at time $t_1 = 1$ s. If 10 seconds later the car moving in a straight line is at position $(x_2, y_2) = (204 \text{ m}, 305 \text{ m})$, calculate the magnitude of the average velocity during this interval.

A) 36.1 m/s B) 32.8 m/s C) 36.7 m/s D) 50.0 m/s E) 40.1 m/s

Ans: A

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

59 A car is at position $(x_1, y_1) = (4 \text{ m}, 5 \text{ m})$ at time $t_1 = 1$ s. If 10 seconds later the car moving in a straight line is at position $(x_2, y_2) = (204 \text{ m}, 305 \text{ m})$, find the (size of the) component of the average velocity along the x-axis.

A) 30.0 m/s B) 36.1 m/s C) 20.0 m/s D) 18.2 m/s E) 22.2 m/s

Ans: C

Section: 3–1 Topic: Position, Velocity, and Acceleration Type: Numerical

60 A train, starting from rest, accelerates along the platform at a uniform rate of 0.6 m/s^2. A passenger standing on the platform is 5 m away from the door when the train starts to pull away and heads toward the door at acceleration of 1.2 m/s^2. How far away from the door is the passenger after 3 seconds?

A) 2.7 m B) 5.4 m C) 0.40 m D) 2.3 m E) 0.90 m

Ans: D

Section: 3–2 Topic: Projectile Motion Type: Numerical

61 If a baseball is thrown at an angle of elevation of 30º, its range in the absence of air resistance is less than that of one thrown at

A) 0º B) 80º C) 20º D) 55º E) 90º

Ans: D

Section: 3–2 Topic: Projectile Motion Type: Numerical

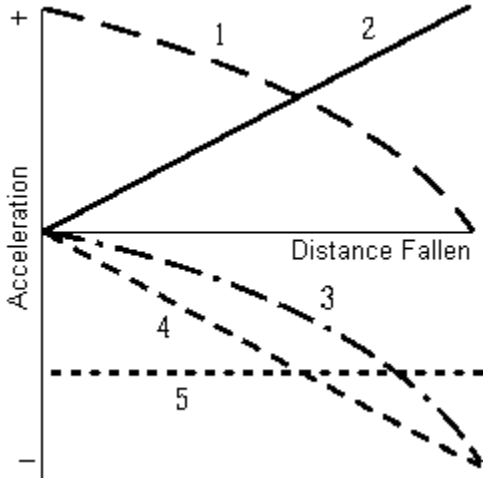
62 A projectile is fired with an initial speed of 1000 m/s at an angle of 37º above the horizontal. If air resistance is neglected, the horizontal component of the projectile's velocity after 20 s is approximately

A) 600 m/s B) 800 m/s C) 640 m/s D) 40 m/s E) 160 m/s

Ans: B

Section: 3–2 Topic: Projectile Motion Type: Conceptual

63



A ball is thrown horizontally from a cliff with a velocity $\vec{v}_0$. A graph of the acceleration of the ball versus the distance fallen could be represented by curve

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

Ans: E

Section: 3–2 Topic: Projectile Motion Type: Conceptual

64 Which of the following statements is not true of a projectile moving near the surface of the earth against negligible air resistance?

A) The horizontal velocity is constant.
B) The vertical acceleration is constant.
C) The horizontal displacement is directly proportional to the time of flight.
D) The vertical velocity at any given time is independent of the angle of projection.
E) The horizontal acceleration is constant.

Ans: D

Section: 3–2 Topic: Projectile Motion Type: Conceptual

65 The maximum horizontal range of a rock which is thrown at the same speed but different angles with the horizon and which lands at a level, H, below the initial level occurs when the angle is

A) less than 0°
B) 0°
C) greater than 0° and less than 45° (actual value depends on the value of H)
D) 45°
E) greater than 45°

Ans: C

Section: 3–2 Topic: Projectile Motion Type: Conceptual

66 A baseball is thrown with a velocity $\vec{v}$ at an angle θ with the horizontal. The horizontal component of its velocity in the absence of air resistance is

A) $v \cos \theta$ B) $v \cos \theta - gt$ C) $v^2 + 2gx$ D) $v^2 - 2gx$ E) $v \sin \theta - gt$

Ans: A

Section: 3–2 Topic: Projectile Motion Type: Conceptual

67 A stone with a mass *m* is dropped from an airplane that has a horizontal velocity *v* at a height *h* above a lake. If air resistance is neglected, the horizontal distance *R* from the point on the lake directly below the point of release to the point where the stone strikes the water is given by which formula?

A) $R = v(2h/g)^2$

B) $R = (1/2)gt^2$

C) $R = 2mv\sqrt{(2h/g)}$

D) $R = v\sqrt{(2h/g)}$

E) None of these is correct.

Ans: D

Section: 3–2 Topic: Projectile Motion Type: Numerical

68 A plane is flying horizontally at a height of 500 m and a constant speed of 429 km/h when an object is projected vertically downward at an initial speed of 35.0 m/s. If air resistance is neglected, the average vertical component of velocity between the object's release and its striking the ground is

A) 70.0 m/s B) 5.50×10^3 m/s C) 140 m/s D) 105 m/s E) 35.0 m/s

Ans: A

Section: 3–2 Topic: Projectile Motion Type: Conceptual

69 A projectile is shot at an angle of 45º to the horizontal near the surface of Earth but in the absence of air resistance. When it reaches the highest point of its trajectory, its speed is 150 m/s. In a second trial with the same projectile, the initial speed is the same but the angle is now 37º with the horizontal. At its highest point in this trajectory, the speed of the projectile would be

A) 150 m/s (sin 45º/sin 36º)

B) 150 m/s (cos 37º/cos 45º)

C) 150 m/s (sin 37º/sin 45º)

D) 150 m/s (37/45)

E) None of these is correct.

Ans: B

Section: 3–2 Topic: Projectile Motion Type: Numerical

70 A rescue airplane is diving at an angle of 37º below the horizontal with a speed of 250 m/s. It releases a survival package when it is at an altitude of 600 m. If air resistance is ignored, the horizontal distance of the point of impact from the plane at the moment of the package's release is

A) 2.80×10^3 m B) 720 m C) 6.80×10^3 m D) 420 m E) 5.50×10^3 m

Ans: B

Section: 3–2 Topic: Projectile Motion Type: Numerical

71 A particle initially moving at 4.0 m/s along the *x* axis is uniformly accelerated at 3.0 m/s^2 along the *y* axis for 2.0 s. The final speed of the particle is

A) –2.0 m/s B) 8.2 m/s C) 6.0 m/s D) 10 m/s E) None of these is correct.

Ans: E

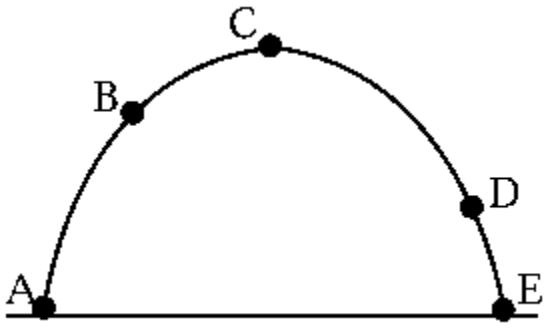
Section: 3–2 Topic: Projectile Motion Type: Conceptual

72 A projectile was fired at 35º above the horizontal. At the highest point in its trajectory its speed was 200 m/s. If air resistance is ignored, the initial velocity had a horizontal component of

A) zero
B) 200 cos (35º) m/s
C) 200 sin (35º) m/s
D) 200/cos (35º) m/s
E) 200 m/s

Ans: E

Use the following to answer questions 73-75:



Section: 3–2 Topic: Projectile Motion Type: Conceptual

73 The figure represents the parabolic trajectory of a ball going from A to E in Earth gravity but without air resistance. What is the direction of the acceleration at point B?

A) it is up and to the right
B) it is down and to the left
C) it is straight up
D) it is straight down
E) The acceleration of the ball is zero

Ans: D

Section: 3–2 Topic: Projectile Motion Type: Conceptual

74 The figure represents the parabolic trajectory of a ball going from A to E in Earth gravity but without air resistance. What is the direction of the acceleration at point C?

A) it is to the right
B) it is to the left
C) it is straight up
D) it is straight down
E) The acceleration of the ball is zero

Ans: D

Section: 3–2 Topic: Projectile Motion Type: Conceptual

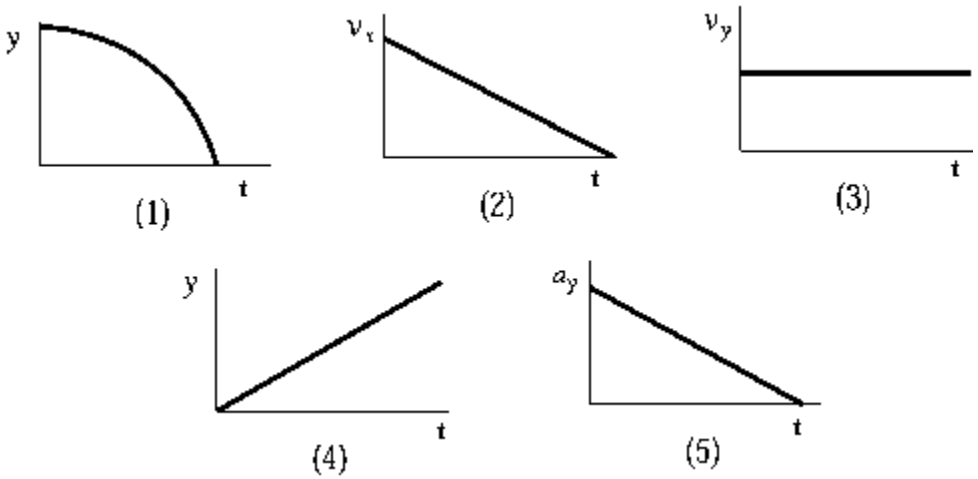
75 The figure represents the parabolic trajectory of a ball going from A to E in Earth gravity but without air resistance. At point C the velocity of the ball is

A) a maximum and is directed to the right
B) directed to the left
C) a maximum
D) a minimum and is directed to the right
E) zero

Ans: D

Section: 3–2 Topic: Projectile Motion Type: Conceptual

76

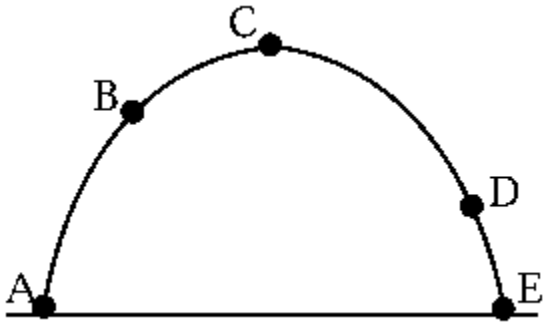


A projectile is fired horizontally in Earth gravity with an initial speed v_0. In the absence of air resistance, which of the following graphs is representative of the projectile's motion?

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

Ans: A

Use the following to answer question 77:



Section: 3–2 Topic: Projectile Motion Type: Conceptual

77 The figure represents the parabolic trajectory of a ball going from A to E. What is the speed at point C compared with that at point A?

A) It is greater at C than at A
B) It is less at C than at A
C) The speeds are identical
D) The speeds are both zero
E) It is not possible to answer this question without more information.

Ans: B

Section: 3–2 Topic: Projectile Motion Type: Numerical

78 A naughty squirrel jumps from a tree limb onto a birdfeeder. The tree limb is 4.5 m above the ground and the top of the birdfeeder is 1.5 m above the ground. If the squirrel jumps horizontally with a velocity of 2.5 m/s then how far away in the horizontal direction can the bird feeder be for the squirrel to just make it onto the top of the feeder.

A) 3.6 m B) 2.0 m C) 2.4 m D) 1.5 m E) 1.4 m

Ans: B

Section: 3–2 Topic: Projectile Motion Type: Numerical

79 Mark throws a ball to Daniel with an initial speed of 20 m/s at an angle of 45 degrees. If they are initially 55 m apart, calculate the average speed Daniel has to run to catch the ball. (Assume the ball is thrown and caught at the same height. Also assume that Daniel starts to run when the ball is thrown.)

A) 19 m/s B) 14 m/s C) 4.9 m/s D) 9.1 m/s E) 2.9 m/s

Ans: C

Section: 3–2 Topic: Projectile Motion Type: Numerical

80 A roofing tile slides down a roof and falls off the roof edge 10 m above the ground at a speed of 6 m/s. The roof makes an angle of 30 degrees to the horizontal. How far *from the exit point* on the roof does the tile land?

A) 6.00 m B) 16.0 m C) 11.7 m D) 13.6 m E) 19.2 m

Ans: C

Section: 3–2 Topic: Projectile Motion Type: Numerical

81 A projectile is ejected from a 25-m high tower with a velocity of 40 m/s at an angle of 30 degrees to the horizontal first on Earth and then on Mars. What is the ratio of the time taken to hit the ground on Mars compared to Earth? (Assume $g_{\text{Mars}} = 0.38 g_{\text{Earth}}$)

A) 2.4 B) 2.6 C) 0.38 D) 6.9 E) 1.0

Ans: A

Section: 3–3 Topic: Circular Motion Type: Numerical

82 A merry-go-round completes one revolution in 30 s. What is the speed of a rider located at a distance 3 m from the center of the merry go-round?

A) 0.1 m/s
B) 0.2π m/s
C) 2π m/s
D) 6π m/s
E) 30 m/s

Ans: B

Section: 3–3 Topic: Circular Motion Type: Numerical

83 A merry-go-round completes one revolution in 40 s. What is the centripetal acceleration of a rider located at a distance 2 m from the center of the merry go-round?

A) $\frac{1}{4}$ m/s^2
B) $\frac{1}{4}\pi$ m/s^2
C) $\pi^2/200$ m/s^2
D) $\pi^2/100$ m/s^2
E) π^2 m/s^2

Ans: C

Section: 3–3 Topic: Circular Motion Type: Conceptual

84 A ball is whirled in a horizontal circle of radius r and speed v. The radius is increased to 2r keeping the speed of the ball constant. The period of the ball changes by a factor of

A) half
B) one
C) two
D) three
E) four

Ans: C