Velocity and acceleration as a function of x

Solutions Main Menu

28 A particle is moving along the x-axis. Its velocity v at position x is given by $v=\sqrt{8x-x^2}$. What is the acceleration when $x=3$?

(A) 1
(B) 2
(C) 3
(D) 4

29 The velocity of a particle moving in a straight line is given by $v=2x+3$ where x metres is the distance from fixed point O and v is the velocity in metres per second. What is the acceleration of the particle when it is 4 metres from O?

(A) $a=11$ ms^{-2}
(B) $a=19$ ms^{-2}
(C) $a=23.5$ ms^{-2}
(D) $a=72$ ms^{-2}

30 The velocity of a particle moving along the x axis is given by $v^2=24+2x-x^2$. Which of the following expressions is the correct equation for the acceleration of the particle in terms of x?

(A) $1-x$
(B) $1-2x$
(C) $12x+\frac{x^2}{2}-\frac{x^3}{6}$
(D) $24x+x^2-\frac{x^3}{3}$

31 The acceleration of a particle is defined in terms of its position by the equation $a=2x+4$. If $v=5$ when $x=2$, what is the velocity when $x=4$?

(A) 5 ms^{-1}
(B) 7 ms^{-1}
(C) $\sqrt{65}$ ms^{-1}
(D) $\sqrt{95}$ ms^{-1}

32 A particle moves in a straight line so that at time t its displacement from a fixed origin is x and its velocity is v. The acceleration is $3-2x$. Which of the following is the correct equation for velocity given that $v=2$ when $x=1$?

(A) $v=3x-x^2$
(B) $v=\sqrt{3x-x^2}$
(C) $v=\sqrt{6x-2x^2}$
(D) $v=\sqrt{12x-4x^2}$

33 A particle moves such that when it is x metres from the origin its acceleration is given by $a=-\frac{1}{2}e^{-x}$. What is its velocity when $x=3$, given that $v=1$ when $x=0$?

(A) 0.050 ms^{-1}
(B) 0.070 ms^{-1}
(C) 0.158 ms^{-1}
(D) 0.223 ms^{-1}

34 The acceleration of a particle is given by $a=6x^2-4x-3$ where x is the displacement. The particle is initial at the origin and has a velocity of 3 cm/s. What is the velocity when the particle is 3 cm from the origin?

(A) $v=2\sqrt{7}$ cm/s
(B) $v=3\sqrt{7}$ cm/s
(C) $v=\sqrt{41}$ cm/s
(D) $v=\sqrt{57}$ cm/s

35 A particle moves in a straight line so that at any time t its displacement from a fixed point origin is x and its velocity is v. When $t=0$ the acceleration is $3x^2$, velocity $-\sqrt{2}$ and displacement is 1. Which of the following is the correct equation for x as a function of t?

(A) $x=\frac{-2}{(t+\sqrt{2})^2}$
(B) $x=\frac{-2}{(t-\sqrt{2})^2}$
(C) $x=\frac{2}{(t+\sqrt{2})^2}$
(D) $x=\frac{2}{(t-\sqrt{2})^2}$

Velocity and acceleration as a function of x		Main Menu
	Solution	**Criteria**
28	$v=\sqrt{8x-x^2}$ $v^2=8x-x^2$ $\frac{1}{2}v^2=4x-\frac{x^2}{2}$ $a=\frac{d}{dx}\left(4x-\frac{x^2}{2}\right)$ $=4-x$ When $x=3$ then $a=1$	1 Mark: A
29	$v=2x+3$ $v^2=4x^2+6x+9$ $\frac{1}{2}v^2=2x^2+3x+\frac{9}{2}$ $a=\frac{d}{dx}\left(2x^2+3x+\frac{9}{2}\right)$ $=4x+3$ When $x=4$ then $a=19$	1 Mark: B
30	$v^2=24+2x-x^2$ $\frac{1}{2}v^2=\frac{24+2x-x^2}{2}$ $a=\frac{d}{dx}(12+x-\frac{x^2}{2})$ $=1-x$	1 Mark: A
31	$a=2x+4$ $v^2=2\int(2x+4)\,dx$ $=2x^2+8x+c$ When $x=2$, $v=5$ then $c=1$ $v^2=2x^2+8x+1$ $v=\sqrt{2x^2+8x+1}$ (conditions indicate positive solution) When $x=4$ $v=\sqrt{2\times4^2+8\times4+1}=\sqrt{65}$	1 Mark: C
32	$a=3-2x$ $v^2=2\int(3-2x)\,dx$ $=6x-2x^2+c$ When $x=1$, $v=2$ then $c=0$ $v^2=6x-2x^2$ $v=\sqrt{6x-2x^2}$ (conditions indicate positive solution)	1 Mark: C

33	$a=-\frac{1}{2}e^{-x}$ $v^2=2\int-\frac{1}{2}e^{-x}dx$ $=e^{-x}+c$ When $x=0$, $v=1$ then $c=0$ $v^2=e^{-x}$ $v=\sqrt{e^{-x}}$ (conditions indicate positive solution) When $x=4$ $v=\sqrt{e^{-3}}=0.223$ ms^{-1}	1 Mark: D
34	$a=6x^2-4x-3$ $v^2=2\int(6x^2-4x-3)\,dx$ $=2(2x^3-2x^2-3x)+c$ When $x=0$, $v=3$ then $c=9$ $v^2=2(2x^3-2x^2-3x)+9$ $v=\sqrt{2(2x^3-2x^2-3x)+9}$ ($v>0$ when $x=1$) When $x=3$ then $v=\sqrt{2(2\times3^3-2\times3^2-3\times3)+9}$ $=\sqrt{63}=3\sqrt{7}$ cm/s	1 Mark: B
35	$a=3x^2$ $v^2=2\int(3x^2)\,dx$ $=2x^3+c$ When $x=1$, $v=-\sqrt{2}$ then $c=0$ $v=-\sqrt{2x^3}$ ($v<0$ when $x=1$) $\frac{dx}{dt}=-\sqrt{2x^3}$ $\frac{dt}{dx}=-\frac{1}{\sqrt{2}}x^{-\frac{3}{2}}$ $t=\frac{2}{\sqrt{2}}x^{-\frac{1}{2}}+c$ When $t=0$, $x=1$ then $c=-\sqrt{2}$ $t=\sqrt{2}x^{-\frac{1}{2}}-\sqrt{2}$ $x^{-\frac{1}{2}}=\frac{t+\sqrt{2}}{\sqrt{2}}$ $x=\frac{2}{(t+\sqrt{2})^2}$	1 Mark: C