Friday, May 1, 2026 10:23 AM

Tues 5/5 @ 8am
LD 136

Question 24 of 54

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All the edges of a cube are shrinking at a rate of 4 cm/sec. How fast is the volume shrinking when each edge is 7 cm?

$V = x^3$ $\quad \frac{dx}{dt} = 4$ $\quad x = 7$

- 27 cm^3/sec
- 343 cm^3/sec
- 285 cm^3/sec
- 588 cm^3/sec
- 147 cm^3/sec
- 413 cm^3/sec

$$\frac{dV}{dt} = 3x^2 \frac{dx}{dt}$$

$$\frac{dV}{dt} = 3(7)^2 \cdot 4$$

$$= 588$$

Question 34 of 54

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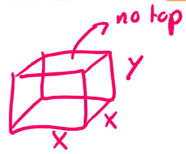
If 1200 cm^2 of material is available to make a box with a square base and an open top, find the dimensions of the box that gives the largest possible volume.

- 20 cm × 20 cm × 20 cm
- ~~10 cm × 10 cm × 100 cm~~
- ~~15 cm × 15 cm × 30 cm~~
- ~~10 cm × 10 cm × 40 cm~~
- 20 cm × 20 cm × 10 cm
- ~~5 cm × 5 cm × 160 cm~~



$$V = x^2 y$$

$$1200 = x^2 + 4xy$$

$$1200 - x^2 = 4xy$$

$$\frac{1200 - x^2}{4x} = y$$

$$V = x^2\left(\frac{1200 - x^2}{4x}\right) = \frac{1}{4}(x)(1200 - x^2)$$

$$= \frac{1}{4}(1200x - x^3)$$

$$V' = \frac{1}{4}(1200 - 3x^2) = 0$$

$$1200 - 3x^2 = 0$$

$$400 = x^2$$

$$x = 20$$

$$y = \frac{1200 - x^2}{4x}$$

$$y(20) = \frac{1200 - 400}{80}$$

$$= \frac{800}{80} = 10$$

Question 24 of 54

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Given $y'' = 4e^x - 3$, $y'(0) = 6$ and $y(0) = 5$, find $y(2)$.

- $4e^2 + 6$
- $4e^2 - 11$
- $4e^2 - 6$
- $4e^2 + 11$
- $4e^2 + 1$
- $4e^2 - 1$

$$\int y''\,dy = \int 4e^x - 3\,dx$$

$$y' = 4e^x - 3x + C$$

When $y'(0) = 6$

$$6 = 4 \cdot e^0 - 3(0) + C$$

$$6 = 4 - 0 + C$$

$$C = 2$$

$$y' = 4e^x - 3x + 2$$

$$\int y'\,dy = \int 4e^x - 3x + 2\,dx$$

$$y = 4e^x - \frac{3x^2}{2} + 2x + C$$

When $y(0) = 5$

$$5 = 4e^0 - \frac{3}{2} \cdot 0^2 + 2 \cdot 0 + C$$

$$5 = 4 + C$$

$$C = 1$$

$$y = 4e^x - \frac{3x^2}{2} + 2x + 1$$

$$y(2) = 4e^2 - 3 \cdot 2 + 4 + 1$$

Question 16 of 54

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A particle moving on a straight line has an acceleration of

$$a(t) = 2t,$$

where t is time in seconds and $a(t)$ is in ft/sec^2. Its initial velocity is 10 ft/sec, and its initial position is 0. What is its position after 3 seconds?

$v(0) = 10$ $\quad p(0) = 0$

- 66 ft
- 19 ft
- 33 ft
- 39 ft

$$v(t) = \int a(t)\,dt = \int 2t\,dt = \frac{2t^2}{2} + C = t^2 + C$$

When $v(0) = 10$,

$$10 = 0^2 + C \iff C = 10$$

$$p(t) = \int v(t)\,dt = \int t^2 + 10\,dt$$

$$= \frac{t^3}{3} + 10t + C$$

When $p(0) = 0$

- ○ 66 ft
- ○ 19 ft
- ○ 33 ft
- ● 39 ft
- ○ 16 ft
- ○ 63 ft

When $v(0)=10$,
$10 = 0^2 + C \Leftrightarrow C = 10$
$v(t) = t^2 + 10$

$= \frac{t^3}{3} + 10t + C$

When $p(0)=0$,
$0 = 0 + C$
$p(t) = \frac{t^3}{3} + 10t$
$p(3) = \frac{3^3}{3} + 10(3) = 39$

Question 6 of 54

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The squirrel population t years after 2010 (i.e., $t = 0$ corresponds to 2010) is given by $P(t)$. The rate of change of the squirrel population is proportional to P. If the population in 2010 was 12000 and the population in 2013 was 15000, find the population in 2015. (Round your answer to the nearest whole number.)

- ○ 16,149
- ○ 10,496
- ○ 8,273
- ○ 21,757
- ○ 23,710
- ● 17,406

$\frac{dP}{dt} = kP \Rightarrow P = Ce^{kt}$

$\boxed{t=0 \quad P=12000}$ $C = P = 12000$
$t=3 \quad P=15000$
$t=5 \quad P=?$

$P = 12000e^{kt}$
$t=3$ & $P=15000$
$15000 = 12000e^{k \cdot 3}$ $\Leftrightarrow \frac{5}{4} = \frac{15}{12} = e^{3k}$
$\ln\left(\frac{5}{4}\right) = 3k$
$k = \frac{1}{3}\ln\left(\frac{5}{4}\right)$

$P = 12000\exp\left[\frac{1}{3}\ln\left(\frac{5}{4}\right)t\right]$

$P(5) = 12000\exp\left[\frac{1}{3}\ln\left(\frac{5}{4}\right) \cdot 5\right]$

Question 15 of 54

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The growth rate of the population of a city is

$$P'(t) = -20(100 - e^t),$$

where t is time in years and $P(t)$ is the population. How does the population change from $t = 1$ to $t = 3$? (Round your answer to the nearest person.)

- ● The population decreases by 3653.
- ○ The population increases by 5912.
- ○ The population decreases by 5912.
- ○ The population increases by 3653.
- ○ The population increases by 8134.
- ○ The population decreases by 8134.

$\int_1^3 -20(100-e^t)\,dt = -20(100t - e^t)\Big]_1^3$
$= -20(100(3) - e^3) - (-20)(100 - e)$
$= -6000 + 20e^3 + 2000 - e$

Question 24 of 54

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The population, P, of a species of wolves in a forest is decreasing at a rate proportional to the population itself. If $P = 3000$ when $t = 1$ and $P = 2500$ when $t = 2$, what is the population when $t = 5$? Round your answer to the nearest whole number.

- ○ 1651
- ● 1447
- ○ 1522
- ○ 1480
- ○ 1689
- ○ 1563

$\frac{dP}{dt} = kP \Rightarrow P = Ce^{kt}$

When $P = 3000, t = 1$
$3000 = Ce^k$ ①

When $P = 2500, t = 2$
$2500 = Ce^{2k}$ ②

Solve ① for C.
$3000e^{-k} = C$

Plug this in ②.
$25\cancel{00} = 30\cancel{00}e^{-k}e^{2k}$
$\frac{25}{30} = e^k$

Plug $k = \ln\left(\frac{5}{6}\right)$ into ①
$3000 = Ce^{\ln(5/6)}$
$3000 = C \cdot \frac{5}{6}$
$C = 3000 \cdot \frac{6}{5}$
$C = 3600$

So $P = 3600\exp\left[\ln\left(\frac{5}{6}\right) \cdot t\right]$
$P(5) = 3600\exp\left[\ln\left(\frac{5}{6}\right) \cdot 5\right]$
≈ 1447

$$\frac{25}{30} = e^{k}$$

$$\ln\left(\frac{5}{6}\right) = k$$

$$\approx 1447$$

Question 25 of 54

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Radioactive radium-226 has a half-life of approximately 1600 years. What percent of a given amount remains after 360 years? (Round your answer to two decimal places.)

$360 \to t$

- 90.17 %
- 92.46 %
- 57.33 %
- 85.56 %
- 73.69 %
- 69.82 %

$$y = Ce^{kt}$$

$$k = \frac{-\ln(2)}{\text{half-life}} = \frac{-\ln(2)}{1600}$$

$$y = C\exp\left[\frac{-\ln(2)}{1600}t\right]$$

$$y = C\exp\left[\frac{-\ln(2)}{1600}\cdot 360\right]$$

Answer

Question 33 of 54

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The radioactive isotope ^{14}C has a half-life of approximately 5715 years. Now there are 40g of ^{14}C. How much of it remains after 16000 years? (Round your answer to four decimal places.)

$40g = C$, $16000 = t$

- 5.7449 grams
- 3.7823 grams
- 4.4562 grams
- 6.1327 grams
- 2.6870 grams
- 9.2816 grams

$$y = Ce^{kt}$$

$$k = -\frac{\ln(2)}{5715}$$

$$y = C\exp\left[-\frac{\ln(2)}{5715}t\right]$$

$$y = 40\exp\left[\frac{-\ln(2)}{5715}\cdot 16000\right]$$

Question 5 of 54

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A certain radioactive isotope has a half life of 24110 years. Suppose 10 grams of the radioactive element are released during a nuclear accident. Approximately how many years will it take for the 10 grams to decay to 1 gram?

$10 = C$

- 68,428 years
- 90,520 years
- 70,150 years
- 80,092 years
- 66,325 years
- 96,400 years

$$y = Ce^{kt}$$

$$k = \frac{-\ln(2)}{24110}$$

$$y = C\exp\left[\frac{-\ln(2)}{24110}t\right]$$

$$y = 10\exp\left[\frac{-\ln(2)}{24110}t\right]$$

With $y = 1$ solve for t.

$$1 = 10\exp\left[\frac{-\ln(2)}{24110}t\right]$$

$$\frac{1}{10} = \exp\left[\frac{-\ln(2)}{24110}t\right]$$

$$\ln\left(\frac{1}{10}\right) = \frac{-\ln(2)}{24110}t$$

$$\frac{\ln(1/10)}{1}\cdot\frac{24110}{-\ln(2)} = t$$

	0	$\pi/6$	$\pi/4$	$\pi/3$	$\pi/2$
sin	0	$1/2$	$\sqrt{2}/2$	$\sqrt{3}/2$	1
cos	1	$\sqrt{3}/2$	$\sqrt{2}/2$	$1/2$	0

Question 45 of 54

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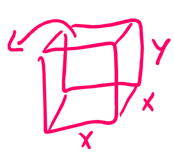
An open-top box with a square base is made using 48 ft^2 of material. Find the maximum possible volume of this box.

- 32 ft^3
- 48 ft^3
- 16 ft^3
- 96 ft^3
- 64 ft^3
- 80 ft^3

no top



$$V = x^2 y$$

$$SA = x^2 + 4xy = 48$$

$$4xy = 48 - x^2$$

$$y = \frac{48 - x^2}{4x}$$

$$V' = \frac{1}{4}(48 - 3x^2) = 0$$

$$48 - 3x^2 = 0$$

$$48 = 3x^2$$

$$16 = x^2$$

$$x = 4$$

- 64 ft^3
- 80 ft^3

$4xy = 48 - x$

$y = \frac{48 - x^2}{4x}$

$V = x^2\left(\frac{48 - x^2}{4x}\right)$

$= \frac{1}{4}x(48 - x^2)$

$= \frac{1}{4}(48x - x^3)$

$16 = x^2$

$x = 4$

$y = \frac{48 - x^2}{4x}$ @ $x = 4$

$= \frac{48 - 4^2}{4 \cdot 4}$

$= \frac{48 - 16}{16} = \frac{32}{16} = 2$

$V = 4 \cdot 4 \cdot 2 = 32$

Question 52 of 54

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$v(0) = 6$

A particle is moving on a straight line with an initial velocity of 6 ft/sec and an acceleration of

$$a(t) = 4t - 3,$$

where t is time in seconds and $a(t)$ is in ft/sec^2. What is its velocity after 3 seconds?

- −3 ft/sec
- 9 ft/sec
- 21 ft/sec
- 3 ft/sec
- −6 ft/sec
- 15 ft/sec

$v(t) = \int a(t)\,dt = \int 4t - 3\,dt$

$= \frac{4t^2}{2} - 3t + C$

$= 2t^2 - 3t + C$

when $v(0) = 6$

$6 = 2(0)^2 - 3(0) + C$

$6 = C$

$v(t) = 2t^2 - 3t + 6$

So $v(3) = 2(3)^2 - 3(3) + 6$

$= 18 - 9 + 6$

$= 15$