Topic: Radius of the balloon

Question: Air is being pumped into a spherical ball at a rate of 2 cm^3/s. How fast is the length of the radius increasing when $r = 10$ cm?

Answer choices:

A $\frac{1}{200\pi}$ cm/s

B 400π cm/s

C 200π cm/s

D $\frac{1}{400\pi}$ cm/s

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Solution: A

The formula for the volume of a sphere is

$$V = \frac{4}{3}\pi r^3$$

Use implicit differentiation to take the derivative of both sides.

$$(1)\frac{dV}{dt} = \frac{4}{3}\pi 3r^2\frac{dr}{dt}$$

$$\frac{dV}{dt} = 4\pi r^2\frac{dr}{dt}$$

From the question, we know that $dV/dt = 2$ and that $r = 10$, so we'll plug those in.

$$2 = 4\pi(10)^2\frac{dr}{dt}$$

$$2 = 400\pi\frac{dr}{dt}$$

Solve for dr/dt, which is the rate we were asked to find.

$$\frac{dr}{dt} = \frac{2}{400\pi}$$

$$\frac{dr}{dt} = \frac{1}{200\pi}$$

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Topic: Radius of the balloon

Question: Air is being pumped into a spherical balloon at a rate of 100 cm^3/s. How fast is the radius increasing when $r = 10$ cm?

Answer choices:

A $\frac{1}{4}$ cm/s

B 4 cm/s

C $\frac{1}{4\pi}$ cm/s

D 4π cm/s

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Solution: C

The formula for the volume of a sphere is

$$V = \frac{4}{3}\pi r^3$$

Use implicit differentiation to take the derivative of both sides.

$$(1)\frac{dV}{dt} = \frac{4}{3}\pi 3r^2\frac{dr}{dt}$$

$$\frac{dV}{dt} = 4\pi r^2\frac{dr}{dt}$$

From the question, we know that $dV/dt = 100$ and that $r = 10$, so we'll plug those in.

$$100 = 4\pi(10)^2\frac{dr}{dt}$$

$$100 = 400\pi\frac{dr}{dt}$$

Solve for dr/dt, which is the rate we were asked to find.

$$\frac{dr}{dt} = \frac{100}{400\pi}$$

$$\frac{dr}{dt} = \frac{1}{4\pi}$$

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Topic: Radius of the balloon

Question: Air is being sucked out of a spherical balloon so that its volume is decreasing by 250 cm^3/s. How fast is the radius decreasing when the radius is 5 cm?

Answer choices:

A $\frac{5}{2\pi}$ cm/s

B $-\frac{5}{2\pi}$ cm/s

C $\frac{2}{5\pi}$ cm/s

D $-\frac{2}{5\pi}$ cm/s

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Solution: B

The formula for the volume of a sphere is

$$V = \frac{4}{3}\pi r^3$$

Use implicit differentiation to take the derivative of both sides.

$$(1)\frac{dV}{dt} = \frac{4}{3}\pi 3r^2\frac{dr}{dt}$$

$$\frac{dV}{dt} = 4\pi r^2\frac{dr}{dt}$$

From the question, we know that $dV/dt = -250$ and that $r = 5$, so we'll plug those in.

$$-250 = 4\pi(5)^2\frac{dr}{dt}$$

$$-250 = 100\pi\frac{dr}{dt}$$

Solve for dr/dt, which is the rate we were asked to find.

$$\frac{dr}{dt} = -\frac{250}{100\pi}$$

$$\frac{dr}{dt} = -\frac{5}{2\pi}$$

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