



## AP<sup>®</sup> Calculus AB 2002 Sample Student Responses

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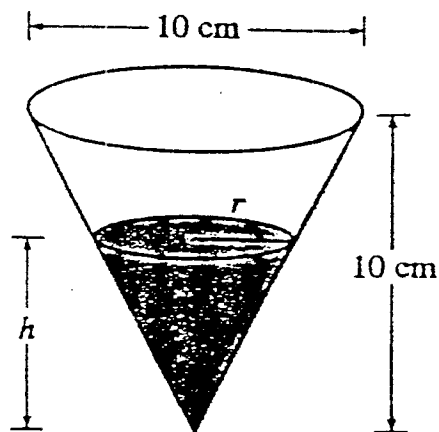


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NO CALCULATOR ALLOWED

A,



$$\frac{dh}{dt} = -\frac{3}{10} \text{ cm/hr}$$

$$V = \frac{1}{3} \pi r^2 h$$

Work for problem 5(a)

$$V = \frac{1}{3} \pi r^2 h$$

$$V = \frac{1}{3} \pi (2.5)^2 (5)$$

$$V = \frac{5}{3} \pi (2.5)^2 \text{ cm}^3$$

$$\frac{10}{5} = \frac{5}{r} \quad r = 2.5 \text{ cm}$$

$$\frac{10}{5} = 2$$

$$2 = r$$

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NO CALCULATOR ALLOWED

A<sub>2</sub>

Work for problem 5(b)

$$V = \frac{\pi}{3} \cdot r^2 h$$

$$= \frac{\pi}{3} \left(\frac{h}{2}\right)^2 h$$

$$V = \frac{\pi}{3} \cdot \frac{h^3}{4}$$

$$\frac{dV}{dt} = 3 \frac{\pi}{12} \cdot h^2 \frac{dh}{dt}$$

$$= \frac{\pi}{4} (5)^2 \left(-\frac{3}{10}\right)$$

$$= \frac{8(-15\pi)}{10 \cdot 4} =$$

$$\boxed{-\frac{15\pi}{8} \text{ cm}^3/\text{hr}}$$

Work for problem 5(c)

$$S = \pi r^2$$

$$r = \frac{h}{2}$$

$$= \pi \left(\frac{h}{2}\right)^2$$

$$\frac{dS}{dt} = \frac{\pi}{4} h^2$$

$$\frac{dV}{dt} = \frac{\pi}{4} h^2 \frac{dh}{dt}$$

$$\frac{dV}{dt} \propto SA$$

$$\frac{dV}{dt} = k \cdot SA$$

$$\frac{\pi}{4} h^2 \cdot \frac{dh}{dt} = \frac{\pi}{4} h^2 \cdot k$$

$$\frac{dh}{dt} = k$$

The constant of proportionality =  $\frac{dh}{dt}$

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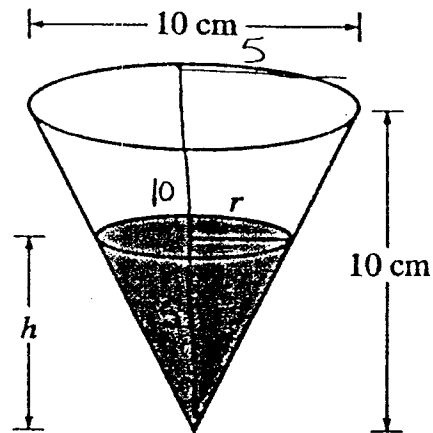
NO CALCULATOR ALLOWED

D,

$$\frac{r}{h} = \frac{5}{10}$$

$$5h = 10r$$

$$\frac{h}{2} = r$$



$$\frac{r}{5} = \frac{5}{10}$$

$$10r = 25$$

$$r = \frac{25}{10}$$

$$r = \frac{5}{2}$$

Work for problem 5(a)

$$\frac{dh}{dt} = -\frac{3}{10} \text{ cm/hr.}$$

find:  $V$  when  $h = 5 \text{ cm}$ 

$$V = \frac{1}{3} \pi \left(\frac{5}{2}\right)^2 (5)$$

$$V = \frac{1}{3} \pi \frac{125}{4}$$

$$V = \frac{125\pi}{12} \text{ cm}^3$$

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NO CALCULATOR ALLOWED

D<sub>2</sub>

Work for problem 5(b)

find:  $\frac{dV}{dt}$  when  $h=5$  cmgiven:  $\frac{dh}{dt} = -\frac{3}{10}$  cm/hr.

$$V = \frac{1}{3} \pi \left(\frac{h}{2}\right)^2 h$$

$$\frac{d}{dt} \left[ V = \frac{1}{3} \pi \frac{h^3}{4} \right]$$

$$\frac{dV}{dt} = \frac{\pi}{4} h^2 \frac{dh}{dt}$$

$$\frac{dV}{dt} = \frac{\pi}{4} \left(\frac{5}{2}\right)^2 \left(-\frac{3}{10}\right)$$

$$\frac{dV}{dt} = -\frac{15\pi}{8} \text{ cm}^3/\text{hr.}$$

Work for problem 5(c)

$$\frac{dA}{dt} \left[ A = \pi \frac{h^2}{4} \right]$$

$$\frac{dA}{dt} = \pi \frac{h}{2} \frac{dh}{dt}$$

$$\frac{dA}{dt} = \pi \left(\frac{5}{2}\right) \left(-\frac{3}{10}\right)$$

$$\frac{dA}{dt} = -\frac{15\pi}{20}$$

$$\frac{dA}{dt} = -\frac{3\pi}{4} \text{ cm}^2/\text{hr.}$$