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04/15/2020 • Mathematics • College

answered • expert verified

A horizontal trough is 16 m long, and its end are isosceles trapezoids with an altitude of 4 m, a lower base of 4 m, and an upper base of 6 m. If the water level is decreasing at a rate of 25 cm/min when the water is 3 m deep, at what rate is the water being drawn from the trough?

## This is an Expert-Verified Answer

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The rate at which the water **level** (the depth) is **decreasing**, increases as more **water** is drawn from the trough.

The rate at which water is being drawn from the through is 22 m³/min.

**Reasons**:

The given parameter are;

Length of the through, L = **16 m**

Height of the through = **4 m**

**Lower base** of the trapezoidal cross section, $a$ = 4 m

**Upper** base of the trapezoidal cross section, $b$ = 6 m

Rate at which the water is decreasing at the depth of 3 m, $\frac{dh}{dt}$ = **25 cm/min**

**Required**:

Rate at which water is being drawn from the through

**Solution**:

Let the length of the **upper base** at height $h$ = **4 + 2·x**

Volume of the through = **Trapezoidal cross sectional area** × **Length**

$$Area\ of\ trapezoid = \frac{a+b}{2} \times h$$

$$Trapezoidal\ cross\ sectional\ area,\ A = \frac{4+(4+2\cdot x)}{2} \times h$$

$$Volume\ of\ water\ in\ the\ through,\ V = \frac{4+(4+2\cdot x)}{2} \times h \times L$$

Therefore;

$$V = \frac{4+(4+2\cdot x)}{2} \times h \times 16$$

By similar triangles, we have;

$$\frac{1}{x} = \frac{4}{h}$$

h = 4·x

Which gives;

$$V = \frac{4+(4+2\cdot \frac{h}{4})}{2} \times 4 \cdot \frac{h}{4} \times 16 = 64\cdot h + 4\cdot h^2$$

$$\frac{dV}{dh} = \frac{dV}{dt} \times \frac{dt}{dh}$$

$$\frac{dV}{dh} = 64 + 8\cdot h$$

$\frac{dh}{dt}$ = 25 cm/min = **0.25 m/min**

$$\frac{dV}{dt} = \frac{\frac{dV}{dh}}{\frac{dt}{dh}} = \frac{dV}{dh} \times \frac{dh}{dt}$$

$$\frac{dV}{dt} = (64 + 8\times 3)\times(0.25) = 22$$

The **rate** at which **water** is being **drawn** from the through, $\frac{dV}{dt}$ = 22 m³/min.

Learn more here:

brainly.com/question/13806595

THANKS 1 1.0 (1 vote)

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## Answer

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**Answer:**

0.28cm/min

**Step-by-step explanation:**

Given the horizontal trough whose ends are isosceles trapezoid

Volume of the Trough =Base Area X Height

=Area of the Trapezoid X Height of the Trough (H)

The length of the base of the trough is constant but as water leaves the trough, the length of the top of the trough at any height h is 4+2x **(See the Diagram)**

The Volume of water in the trough at any time

$Volume = \frac{1}{2}(b_1+4+2x)hXH$

$Volume = \frac{1}{2}(4+4+2x)hX16$

=8h(8+2x)

V=64h+16hx

We are not given a value for x, however we can express x in terms of h from **Figure 3** using **Similar Triangles**

x/h=1/4

4x=h

x=h/4

Substituting x=h/4 into the Volume, V

$V = 64h + 16h(\frac{h}{4})$

$V = 64h + 4h^2$
$\frac{dV}{dt} = 64\frac{dh}{dt} + 8h\frac{dh}{dt}$

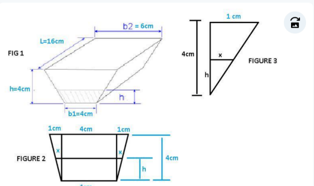
h=3m,

dV/dt=25cm/min=0.25 m/min

$0.25 = (64+8*3)\frac{dh}{dt}$
$0.25 = 88\frac{dh}{dt}$
$\frac{dh}{dt} = \frac{0.25}{88}$

=0.002841m/min =0.28cm/min

The rate is the water being drawn from the trough is 0.28cm/min.



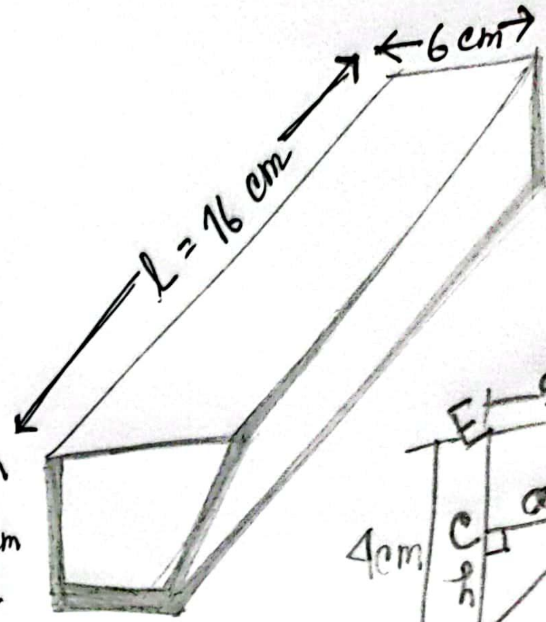

THANKS 4 0.0 (0 votes)

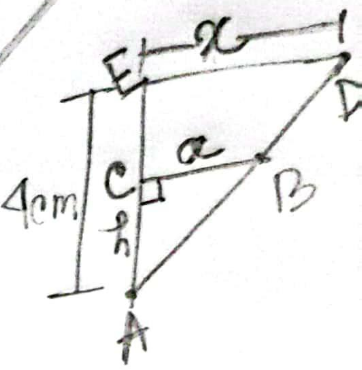
Ans: to the Question no: 01

Let,

$l$ = length of the trough = 16m

$h$ = height of water level




Given that,

altitude of trough = 4m

lower base = 4m

upper base = 6m

We have to find,

$$\left.\frac{dh}{dt}\right|_{h=2}$$

Now, from question we get that,

$$\frac{dV}{dt} = 10\ m^3/min \ldots\ldots (1)$$

P.T.O

Here,
$V$ = volume of trough = Area of trapezoid $\times l$

Now,
Area of trapezoid is $= h(4+a)$

whereas,
$\frac{h}{4} = \frac{a}{x}$ [$\because \Delta ABC$ and $\Delta ADE$ is isosceles triangle]

$\Rightarrow \frac{h}{4} = \frac{a}{1}$

$\therefore a = \frac{h}{4}$

$\therefore V = h\left(4+\frac{h}{4}\right) \cdot 16$

$= \left(4h + \frac{h^2}{4}\right) 16$

$= 64h + 4h^2$

Now again,

$$\frac{dV}{dt} = \frac{d}{dt}(64h + h^2)$$

$$\Rightarrow \frac{dV}{dt} = 64\frac{dh}{dt} + 8h\frac{dh}{dt}$$

$$\Rightarrow \frac{dV}{dt} = \frac{dh}{dt}(64 + 8h)$$

$$\Rightarrow \frac{dh}{dt} = \frac{dV/dt}{64 + 8h}$$

$$\therefore \frac{dh}{dt}\Big|_{h=2} = \frac{10}{64 + (8\cdot 2)} = \frac{10}{80}$$

$$= 0.125 \text{ m/min.}$$

(Ans.)

## Best Answer

A) g'(x) = f'( sec(x) ) tan(x) sec(x) = f'(2) * sec(pi/3) tan(pi/3) = 4*2*2*sec(pi/3)*tan(pi/3)=32*sqrt(3)

B) h' = 4* ( 9 f(x)/(x-1))^3 * 9 ( f'(x)/(x-1) - f(x)/(x-1)^2)

h'(2) = 4*(9*2)^3 *9 (4*2*2 - 2)=2939328

**Likes: 1** **Dislikes: 0**

---

## Answer 1

g(x)=f(secx)

g'(x) = sec x tan x

g'(pi/3)

= sec pi/3 *tan pi/3

=

2 sqrt(3)

**Likes: 0** **Dislikes: 0**

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## Answer 2

f(x) = sec(x),
f'(x) = secx tan x
f''(x) = secx tan^2x + sec^3x
f'(x) = secx (tan ^2 x+ sec ^2 x)
f''(pi/3) = ?2 (1+2) =3?2

**Likes: 0** **Dislikes: 0**

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## Answer 3

g(x)=f(secx)

g'(x) = f'(secx). secx tanx

g'(pi/3) = f'(secpi/3). secpi/3 tanpi/3 = f'(2). 2/root3

**Likes: 0** **Dislikes: 0**

---

## Answer 4

$g'(x) = f'(\sec x)\sec x \tan x$

$g'(\pi/3) = 2 \sqrt{3} f'(2)$

$h'(x) = d/dx [9 f(x)/(x-1)]^4$

$= 9^4 \cdot 4 \cdot f(x)^3 f'(x) \cdot (x-1)^4 - 9^4 \cdot f(x)^4 4(x-1)^3 / (x-1)^8$

$h'(2) = 9^4 \cdot 4 \cdot f(2)^3 f'(2) - 9^4 \cdot f(2)^4 \cdot 4$

**Likes: 0** **Dislikes: 0**

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## Answer 5

$g'x = d/dx ( f(\sec x)$;

$= f'x \cdot d/dx \sec x$;

$= f'x (-\sec x \cdot \tan x)$;

$= f' (\pi/3) \cdot (-2/\sqrt{3} \cdot 1/1.732)$;

$h x = 9 f 9x / (x-1)^4$;

$h' x = 9 \cdot f'x \cdot d/dx(9x / (x-1)^4)$;

$= 9 \cdot f'2 \cdot [(x-1)^4 \cdot 9 - 9x \cdot 4 (x-1)^3]/ (x-1)^8$;

$h'2 = 9 f'2 \cdot [ 9 - 72]/1$;

$h'2 = 549 f'2$

**Likes: 0** **Dislikes: 0**

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## Answer 6

***A. g'(pi/3) if g(x)=f(secx)***

***since g(x) = f(secx)***

***therefore***

***g'(x) = f'(secx)* secx tanx***

***= f'(sec pi/3)* sec(pi/3)* tan(pi/3)***

***B:find h'(2) IF H(X)=[9F9X)/(X-1)]^4***

***h'(x) = 81f'(9x)/(x-1)^4 + 36 f(9x)/(x-1)^5***

***putting the value we ve***

***h'(2) = 81f'(18)/(1)^4 + 36 f(18)/(1)^5***

***= 81f'(18) + 36 f(18)***

**Likes: 0** **Dislikes: 0**

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## Answer 7

f'(x) = 4x f(x)

f'(x)/f(x) = 4x

integratng

ln f(x) = 2x^2 + c

f(2) = 2

so ln 2 = 8 + c

c = ln2 - 8

f(x) = e^(2x^2 + ln2 - 8)

f'(x) = e^(2x^2 + ln2 - 8). 4x

now

g(x)=f(secx)

g'(x) = f'(secx). secx tanx

g'(pi/3) = f'(secpi/3). secpi/3 tanpi/3 = f'(2). 2root3

f'(2) = 2.4.2 = 16

so g'(pi/3) = 16.2root3 = 32root3

**Likes: 0** **Dislikes: 0**

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## Answer 8

**Likes: 0** **Dislikes: 0**

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Ans: to the Ques: no 2

ⓐ Given That,

$f'(x) = 2x f(x)$

$f(2) = 5$

$f'(2) = 4 f(2)$ [considering $x = 2$]

$= 4 \times 5 = 20$

if, $g(x) = f(\sec x)$

while,

$y = \sec x$, and, $x = \pi/3$

$f'(y) = 2y . f(y)$

$\Rightarrow f'(\sec x) = 2 \sec x . f(\sec x)$

$\Rightarrow f'(2) = 2 \times \sec x \, f(\sec x)$

$\Rightarrow f'(\sec x) = \frac{f'(\sec x)}{2} \times \cos x$

$g(x) = f(\sec x)$

$= \dfrac{\cos x \, f'(\sec x)}{2}$

$\Rightarrow g'(x) = -\dfrac{\sin x}{2} f'(\sec x) + \dfrac{\cos x}{2} f''(\sec x)$

Here,

$f'(2) = 20$

$\therefore f''(2) = 0$

$\Rightarrow g'\left(\frac{\pi}{3}\right) = \dfrac{-\sqrt{3}}{2 \times 2} \times f'(2) + 0$

$= -\dfrac{\sqrt{3}}{\cancel{4}} \times \cancel{20}^{5}$

$= -5\sqrt{3}$

(Ans.)

(b) Given that,

$f'(x) = 2x f(x)$

$f(2) = 5$

since, $h(x) = \left[\frac{f(x)}{x-1}\right]^4 = \frac{(f(x))^4}{(x-1)^4}$

$\therefore h'(x) = \frac{(x-1)^4 \times \frac{d}{dx}(f(x))^4 - (f(x))^4 \frac{d}{dx}(x-1)^4}{\{(x-1)^4\}^2}$

$\left[\because \frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{d}{dx}u - u\frac{d}{dx}v}{v^2}\right]$

$= \frac{(x-1)^4 \times 4(f(x))^3 \times f'(x) - (f(x))^4 \cdot 4(x-1)^3 \cdot 1}{(x-1)^8}$

$[\because f(x) = 2x f(x)]$

$\therefore h(2) = \frac{(2-1)^4 \times 4(f(2))^3 \times 2\times 2 \times f(2) - f(2)^4 \cdot 4(2-1)^3}{(2-1)^8}$

$= \frac{\{(1)^4 \times 4 \times (5)^3 \times 2 \times 2 \times 5\} - \{(5)^4 \times 4 \times (1)^3\}}{1^8}$

$= 10000 - 2500 = 7500$

$\therefore h'(2) = 7500$ (Ans)