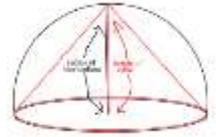


Greatest Teacher: _____

Name: _____

A right circular cone and a hemisphere have the same base, and the cone is inscribed in the hemisphere. The figure is expanding in such a way that the surface area of the hemisphere and its base are increasing at a constant rate of $12 \text{ in}^2/\text{sec}$.



a) Find the rate of change of the volume per second of the hemisphere when the radius of the common base is 4 inches.

b) Find the rate at which volume of the area between the hemisphere and the cone is changing when the radius of the common base is 4 inches.

c) Water is filling up the volume between another hemispheres with a right circular cone inscribed in it and has the same base with a radius of 5 (neither are expanding) from the base to the top. Express the equation for the volume occupied by the water at time equals seconds and find what would be the change in volume occupied by the water when $t=2$ seconds and the water level is rising at a rate of 1.5 inches per second?

Greatest Teacher: _____

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1)	<p>Two trains leave the same station at $t=0$ hours and travel in a straight towards their destinations. The tracks they are traveling on form a 60 degree angle at the train station. Train C's distance from the train station at any time t is $C(t) = .1t^2$ while Train B's distance from the train station at time t is $B(t) = \sin((\pi/4)t) + t$. Find the change of the distance between the trains at $t=10$ hours.</p> <p>a) $47/331^{1/2}$ mph b) $111^{1/2}$ mph c) $50/111^{1/2}$ mph d) $15/111^{1/2}$ mph e) not enough information given</p>
2)	<p>Noah sees a mysterious light that is bubbling up and down in the air 16ft away. Its height equals $y = 2\sin((\pi/2)t) + 10$. Noah is 4ft tall and begins walking towards the light at a rate of 2ft/sec. Find the rate that the length of his shadow changes at $t=2$ seconds.</p> <p>a) 2 cm/sec b) $-8/(\pi+4)$ cm/sec c) -2 cm/sec d) $(5\pi-4)/3$ cm/sec e) not enough information given</p>
3)	<p>A cube is inscribed inside a sphere with its vertices touching the outside of the sphere. The sphere's volume is increasing at a rate of 100π cm^3/sec. How fast is the volume of the cube changing when the radius is 5cm.</p> <p>a) $(200 * 3^{1/2})/3$ cm^3/sec b) $(100 * 3^{1/2})/3$ cm^3/sec c) $1 \text{ cm}^3/\text{sec}$ d) $75 \text{ cm}^3/\text{sec}$ e) not enough information given</p>
4)	<p>An Airplane is taking off and traveling at a 30 degree angle to the horizontal. It will pass directly over a radar antenna. When the plane is 12 miles away horizontally from the radar and at an altitude of 5 miles, the radar detects that the distance from the radar to the plane, s, is changing at a rate of 240 mph. What is the speed of the airplane? (calc active)</p> <p>a) 260 mph b) 242 mph c) 212 mph d) 395 mph</p>
5)	<p>The conical bottom of a large hour glass with a height of 4cm and a radius of 2 cm is being filled with sand at a rate of $2 \text{ cm}^3/\text{sec}$. Find the rate at which the sand levels are rising when $h=2$</p> <p>a) $1/\pi$ cm/sec b) $2/\pi$ cm/sec c) 2 cm/sec d) $1/(3\pi)$ cm/sec</p>

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Hints:

- 1) Law of cos: $A^2 = B^2 + C^2 - 2BC\cos(a)$
- 2) Similar triangles $4/y = z/(z+x)$
- 3) diameter equals square root of 3 times the height of the cube
- 4) horizontal change = speed of plane times $\cos(\pi/3)$
Vertical change = speed of plane times $\sin(\pi/3)$
- 5) $h = 2r$ substitute to get rid of h

Answers:

Free response

- a) 1: dr/dt (3/10 π in/sec)
1: dv/dt (9.6 in³/sec)
- b) 1: finding change of the volume of a cone (dc/dt) when $r=4$ (4.8 in³/sec)
1: Showing change of volume in between is ($dv/dt - dc/dt$) change of hemispheres volume minus change of the volume of a cone.
1: Finding change of volume between hemisphere and cone (4.8 in³/sec)
- d) 2: Express the equation for the volume occupied by the water at time equals seconds. Must have correct limits (0 to 1.5t)
1: find the change in volume occupied by the water at $t=2$ seconds (18 π in³/sec)
1: units
0/9 points if student fails to put Ms. Sammit as best teacher

Multiple choice

1. d
2. d
3. a
4. b
5. b