What month is your birthday ?   ___ ___
What are the first 2 digits of your address ?   ___ ___
What are the last 2 digits of your zip code ?   ___ ___

SCORE: ___ / 20 POINTS

NO CALCULATORS ALLOWED

Give the complete definition of the definite integral. **NO PARTIAL CREDIT.**   **SCORE: ___ / 2 POINTS**

SEE OTHER KEY QUESTION #5

A spherical tank of radius 10 feet is filled with water (density = 62.4 lb/ft^3). Write an integral for the work done   **SCORE: ___ / 4 POINTS**
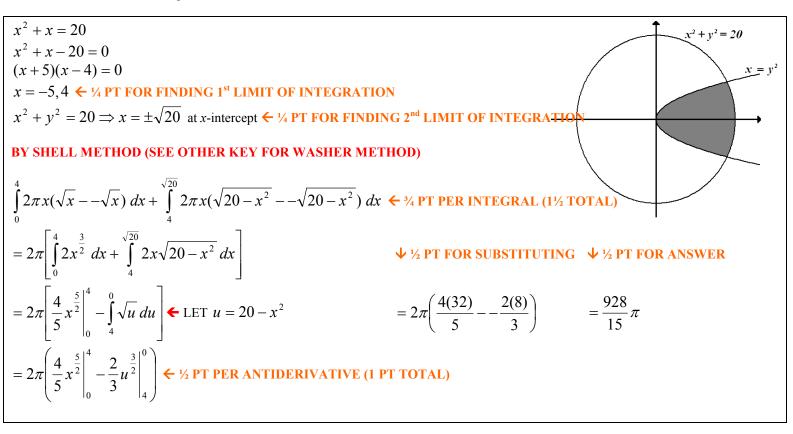in pumping half the water out of the top of the tank. **DO NOT EVALUATE THE INTEGRAL.**

SEE OTHER KEY QUESTION #6

Find the length of the curve $y = x^{\frac{1}{2}} - \frac{1}{3}x^{\frac{3}{2}}$ on $[1, 4]$.   **SCORE: ___ / 4 POINTS**

SEE OTHER KEY QUESTION #2

The shaded area bounded by $x^2 + y^2 = 20$ and $x = y^2$ is revolved around $x = 0$. Find the volume of the resulting solid.   **SCORE: ___ / 4 POINTS**

$x^2 + x = 20$

$x^2 + x - 20 = 0$

$(x + 5)(x - 4) = 0$

$x = -5, 4$ ← **¼ PT FOR FINDING 1ˢᵗ LIMIT OF INTEGRATION**

$x^2 + y^2 = 20 \Rightarrow x = \pm\sqrt{20}$ at x-intercept ← **¼ PT FOR FINDING 2ⁿᵈ LIMIT OF INTEGRATION**

BY SHELL METHOD (SEE OTHER KEY FOR WASHER METHOD)

$$\int_0^4 2\pi x(\sqrt{x} - -\sqrt{x})\, dx + \int_4^{\sqrt{20}} 2\pi x(\sqrt{20 - x^2} - -\sqrt{20 - x^2})\, dx$$ ← **¾ PT PER INTEGRAL (1½ TOTAL)**

$$= 2\pi\left[\int_0^4 2x^{\frac{3}{2}}\, dx + \int_4^{\sqrt{20}} 2x\sqrt{20 - x^2}\, dx\right]$$ **↓ ½ PT FOR SUBSTITUTING   ↓ ½ PT FOR ANSWER**

$$= 2\pi\left[\frac{4}{5}x^{\frac{5}{2}}\Big|_0^4 - \int_4^0 \sqrt{u}\, du\right]$$ ← **LET** $u = 20 - x^2$ $$= 2\pi\left(\frac{4(32)}{5} - -\frac{2(8)}{3}\right)$$ $$= \frac{928}{15}\pi$$

$$= 2\pi\left(\frac{4}{5}x^{\frac{5}{2}}\Big|_0^4 - \frac{2}{3}u^{\frac{3}{2}}\Big|_4^0\right)$$ ← **½ PT PER ANTIDERIVATIVE (1 PT TOTAL)**

Diagram labels: $x^2 + y^2 = 20$, $x = y^2$

The area under $y = x^2 + 1$ on $[-1, 2]$ is revolved around $x = 2$. Find the volume of the resulting solid.   **SCORE: ___ / 4 POINTS**

SEE OTHER KEY QUESTION #4

State the Integral Mean Value Theorem. **<u>NO PARTIAL CREDIT.</u>**   **SCORE: ___ / 2 POINTS**

SEE OTHER KEY QUESTION #1