I am sorry that this appears so late. I had a kitchen emergency this weekend that took longer than I anticipated. This study guide represents my memory of the review from last Thursday. If my memory is faulty it is because now I am anticipating, in earnest, writing the exam.

1. State the fundamental theorem of calculus.

2. Compute the following definite and indefinite integrals

   (a) \[ \int_{0}^{20} (20 - 4h/5) \, dh \]

   (b) \[ \int (3x^2 + 2x - 5) \, dx \]

   (c) \[ \int_{0}^{\pi/2} \sin (2x) \, dx \]

   (d) \[ \int (3x^2 - 2)\sqrt{x^3 - 2x} \, dx \]

   (e) \[ \int_{0}^{5} \frac{-x \, dx}{\sqrt{25 - x^2}} \]

   (f) \[ \int \cos (x) e^{\sin (x)} \, dx \]

   (g) \[ \int \tan (x) \, dx \]

   (h) \[ \int \cos (3x) \sin^5 (3x) \, dx \]

3. Determine the volume that is obtained by revolving the region that lies above the curve \( x = y^2 \), below the line \( y = 3 \), and to the right of the \( y \)-axis, around the \( x \)-axis.

4. Determine the volume that is obtained by revolving the region that is bounded by \( y = \sqrt{x} \), the \( x \)-axis, and the line \( y = 4 \) about the \( x \)-axis.
5. Use the formula

\[ SA = \int_{a}^{b} 2\pi f(x) \sqrt{1 + (f'(x))^2} \, dx \]

that is used to compute the surface area of the result of rotating a curve \( y = f(x) \) about the \( x \)-axis to demonstrate that this surface area only depends on the distance \( b - a \) when the represented surface is a sphere that is obtained by rotating the curve \( y = \sqrt{R^2 - x^2} \) about the \( x \)-axis, and \(-R \leq a \leq b \leq R\).

6. Compute the volume of the solid generated by rotating region that is bounded by the curve \( y = \sin(x) \cos(x) \) and the line \( y = 0 \) about the \( x \)-axis.

7. Compute the volume of the region that is bounded by the curves \( y = x^3 \), \( y = 8 \), and \( x = 0 \) about the line \( x = 3 \).

8. A storage tank in the shape of a right rectangular parallelepiped (box shape) length 10 meters, width 12 meters, and depth 20 meters. It is filled with water which has a density of 1000 kilograms per meter. How much work does it take to pump out all the water?

9. It took 5000 Joules of work to stretch a spring from its natural length of 3 meters to a length of 8 meters. What is the spring’s force constant, \( k \), from Hooke’s law \( F = kx \)?

10. A bag of sand, initially weighing 144 lbs was lifted at a constant rate. As it rose sand leaked out also at a constant rate. The bag was half-full by the time the bag had been lifted to 18 feet. How much work was done in lifting the the sand?