

Name: \_\_\_\_\_

Section: \_\_\_\_\_

R.I.T SCHOOL OF MATHEMATICAL SCIENCES

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## Practice Final Exam

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MATH 211

1. The body mass index (BMI) of an adult human is given by the function  $B = w/h^2$  where  $w$  is the mass measured in kilograms and  $h$  is height measured in meters. Find the total differential that approximates the BMI when weight increases from 50 to 52 kilograms and the height increases from 1 to 1.25 meters.
2. Find the volume of the solid below the plane  $z = 4x + 3y + 1$  and above the  $xy$ -plane over the region bounded by  $y = x$ ,  $y = x^2$ . You MUST sketch the region (shaded and labeled) with its typical rectangle and element of integration.
3. An 1kg object is dropped from the top of a building and experiences air resistance numerically equal to twice the velocity. Find the velocity of the object as a function of time. You MUST solve this equation using separation of variables.

$$m \frac{dv}{dt} = mg - kv$$

4. A simple  $RL$ -circuit has inductance of  $2H$ , resistance  $4\Omega$  and a battery source of  $E(t) = e^{-t}V$ . Find the current as a function of time. You MUST solve this equation using the first order linear integrating factor.

$$L \frac{di}{dt} + Ri = E$$

5. A mass of  $\frac{1}{2}kg$  is attached to a spring, stretched 1 meter past equilibrium and then released. The strength of the spring is  $2N/m$ . No external force is applied to the spring until 4 seconds later when an electromagnet is switched on and applies a continual force of  $5N$ . Find the equation of motion of the spring, assuming no damping.

$$mx'' + bx' + kx = f(t)$$

6. A 10m long beam is embedded at  $x = 0$  and free at the other end. Find the equation of the deflection of the beam if a load of  $w(x) = 24EI$  is uniformly distributed along its length. You MUST solve this equation using the Method of Undetermined Coefficients.

$$EIy^{(4)} = w(x)$$

7. A simple pendulum rotates around a point,  $Q$ . The pendulum rod is  $l = 2$  feet long and is released from rest at  $\theta(0) = \pi/2$  radians. Find the equation of angular motion of the pendulum.

$$\theta''(t) + \frac{g}{l}\theta(t) = 0$$

8. Find any relative extrema or saddle points for the following function.

$$f(x, y) = x^2 + 2y^2 - 6x + 8y + 4$$