Name _____ Calculus Project

This is a take-home project over Thanksgiving break. We will not have class on Monday (11/21) or Tuesday (11/22) so that you have time to work on this project. The project is worth three quiz scores.

Note that some of the problems provide the answer. This is so that you can check your answer and be confident that you're doing the problem correctly.

You may select the level at which you would like to complete this project below. Mark all that apply.

☐ For 70%, complete problems 1-6.

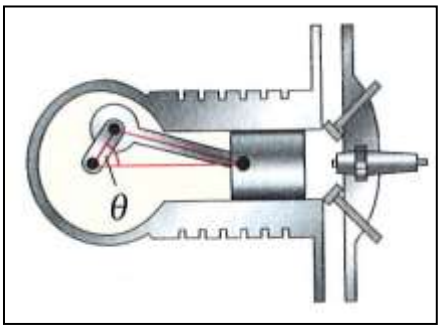
☐ For 80%, complete problems 1-6 and 7-9.

☐ For 90%, complete problems 1-6, 7-9, and 10-11. Note that problems 10-11 will require a partner or group.

☐ For 100%, complete problems 1-6, 7-9, 10,11, and 12. Note that problems 10-12 will require a partner or group.

☐ For 5% bonus, turn in the project by the end of business on Tuesday (11/22).

1) Find the derivative of $\left(x^2 + 3\sqrt{x}\right)^{xe^{-2x}}$



2) A piston is controlled by a rotating arm as shown here. The shaft controlling the arm rotates at 1200rpm. The piston is connected to the shaft by a $\sqrt{17}$ inch rod connected to a $\sqrt{2}$ inch rod.
How fast is the piston moving when $\theta = \frac{\pi}{4}$?

3) Graph the function $f(x) = x^2e^{-x} - xe^{-x}$

4) Find the following limit:

$$\lim_{x\to 0} \frac{x^{x^x}}{(x^x)^x}$$

5) Find $\int \frac{\sin(2x)}{1+\cos^2(x)}\,dx$

6) Suppose a spherical orange with a radius of 2 inches is cut into 4 pieces. Each piece is equally wide. Find the surface area of one of the two smaller pieces. (Set up the integral, and use technology to evaluate it)
(Answer: $\approx 3\pi + 12.56$)

7) Find the area enclosed by the three curves:

- $y = \sqrt{x} + 5$
- $y = x + 3$
- $y = 7 - x$

(Answer: $13/6$)

8) Use a cylindrical shell to find the volume of a cone with radius r and height h.
(Answer: $\frac{1}{3}\pi r^2 h$)

9) Use a circular cross-section to find the volume of a cone with radius r and height h.
(Answer: $\frac{1}{3}\pi r^2 h$)

10) Come up with your own solid of revolution integral problem. It should be solvable by another student in calculus I, but not simple enough that you could solve it without calculus.
(If you're working with a partner or group, do this individually and not with them)

11) With your partner/group, solve their problem from #10.

12) Create a short video (Not longer than 2 minutes) where you explain ONE of the following concepts. Use a whiteboard for any illustrations you want to draw or point to during the video. The library has study rooms with whiteboards available for use that you can use. Upload the video to Blackboard.

- Volume of a solid using cross-sectional areas
- Volume of a solid of revolution
- Arc length of a curve
- Surface area of a solid of revolution

(You should choose a different topic from your partner/group)