

**QUEEN'S UNIVERSITY**  
**APSC 171J – Assignment 5**  
**Wesley Burr**  
**Due: February 14, 2013**

**INSTRUCTIONS**

- This assignment is due in-class (4:30-5:20pm) Thursday, February 14, 2013.
- Answer all questions, writing clearly on the sheets provided. **You must print this file and hand in a carefully stapled copy!** Unstapled assignments will not be accepted.
- One mark in each question is for **complete** (and mostly correct) work shown
- The second mark is for a **fully** correct solution, which **must** be placed in the box provided
- If more than two marks are provided for a question, expect the question to require more work and logically divide into sections, each of which will be worth a mark.
- Whenever possible, simplify your solution.
- There are no part marks: you will receive integer marks only for each question.
- **This assignment is out of 26, but has 27 marks. The last mark is bonus.**

FOR INSTRUCTOR'S USE ONLY		
Question	Mark Available	Received
1	4	
2	3	
3	4	
4	4	
5	4	
6	4	
7	4	
TOTAL	26	

1. [4 marks] A pile of gravel in the shape of a cone (with height 3m and base of radius 2m) needs to be lifted over a 4m fence. If the density of gravel is  $\rho = 1600 \text{ kg}/m^3$ , how much work is required to lift this gravel up?

Final Answer:

2. [3 marks] Water is running into a trough whose length is 2m and whose cross-section is an upside-down right-angled isosceles triangle with base 40 cm. If the water enters the trough at a rate of  $0.2\text{m}^3$  per minute, and if the water level is 10 cm from the bottom, how fast is the water level rising?  
*Note: this is not a work problem!*

Final Answer:

3. [4 marks] A conical tank has height 3m and a radius of 1m at the top. If the bottom of the tank is 2m above the ground, find the work done in filling the tank with water that originates at ground level.

Final Answer:

4. [4 marks] Water is to be pumped out of a lake into a triangular prism-shaped trough, whose width at the top is 2m, whose depth at the center is 1m, and whose length is 4m. Suppose the bottom of the trough is 2m above the lake. How much work is required to fill to the trough full of lake water?

Final Answer:

5. [4 marks] An empty spherical tank of radius 2m is constructed by the side of a lake in such a way that the vertical distance between the bottom of the water tank and the surface of the lake is 5m. Find the work required to half-fill the tank with lake water.

Final Answer:

6. [4 marks] Find the points on the ellipse  $2x^2 + y^2 = 1$  with the property that the tangent lines at these points go through the point  $(2, 0)$ .

Final Answer:

7. [4 marks] There are four points  $P$  on the ellipse  $x^2 + 2y^2 = 8$  such that the normal line at  $P$  passes through the point  $(0, 1)$ . Find the four points. Note that the *normal line* is the line that is perpendicular to the tangent line to a curve at a given point.

Final Answer: