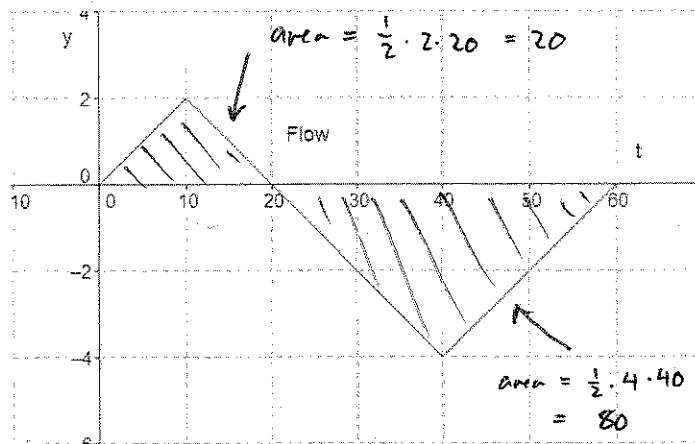


MTH 124 - Quiz 9  
1 November 2013

Please answer the questions in the space provided. If you run out of room, use the back of the page. Show all your work to receive credit. No books or note sheets are allowed for this quiz.

Name: Solutions

1. (4 points) Water flows through a valve into and out of a tank at a rate  $f(t)$ , where time  $t$  is given in minutes, and flow is measured in cubic meters per minute. Suppose that the graph of  $f$  is given below:



- (a) When does the tank have the most water?  
(b) If the tank originally contains 100 cubic meters of water, how much water is in the tank after 60 minutes?

a) Water is flowing in for 20 minutes

b) Change =  $\int_0^{60} f(t) dt = 20 \text{ m}^3 - 80 \text{ m}^3 = -60 \text{ m}^3$

Final =  $100 \text{ m}^3 + \text{change} = \span style="border: 1px solid black; padding: 2px;">40 \text{ m}^3$

2. (2 points) Set up, but do not evaluate, an integral to find the area below  $y = e^x$  and above  $y = x^2$ , between  $x = 1$  and  $x = 3$ .

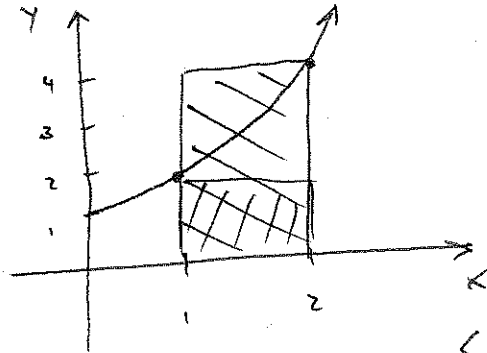
area =  $\int \text{top} - \text{bottom}$

$$\int_1^3 (e^x - x^2) dx$$

3. (2 points) Two people calculated the integral

$$\int_1^2 2^x dx$$

on a calculator and got values 1.8 and 5. Without computing the integral, explain why neither of these values is correct.



Lower estimate:

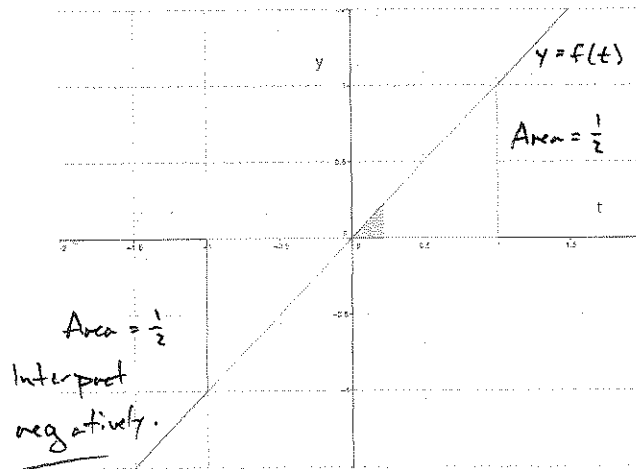
$$1 \cdot 2^1 = 2 > 1.8$$

Upper estimate:

$$1 \cdot 2^2 = 4 < 5$$

So  $2 \leq \int_1^2 2^x dx \leq 4$   
and 1.8, 5 are wrong.

4. (2 points) Consider the function graphed below.



(a) Find the area of the shaded region.

(b) Evaluate the integral  $\int_{-1}^1 f(t) dt$ .

a) Add areas:  $\frac{1}{2} + \frac{1}{2} = \boxed{1 \text{ sq. unit}}$

b)  $\int_{-1}^1 f(t) dt = -\frac{1}{2} + \frac{1}{2} = \boxed{0}$