Math 31 - Unit 2 Exam Part A

March 2014 Name _____

[marks]

1. Unbalanced forces act on a particle so that it moves according to the function $s(t)=4t^3-31t^2+70t$ while $0\le t\le 5$. t is measured in seconds and s is measured in cm.

   a) What is the particle's **velocity** after 2.0 s? (give an exact answer)

   b) At what time(s), t , measured in seconds, is the particle at rest? (answers must be exact)

   c) What is the particle's acceleration after 2.0 s?

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   d) When is the particle's **acceleration** equal to $0\ cm/s^2$?

   e) Over what time period is the particle moving backwards (in a negative direction)?

2. Rena, who is 1.65 *m* tall, is walking away from a lamppost at 1.2 *m/*s. The light at the top of the lamppost is 4.95 m above the ground. How fast is Rena's shadow lengthening when she is 12 m from the lamppost?

[6]

3. Grant is using a large conical tank to hold rainwater for his greenhouse. The tank has a diameter of 2.0 *m* at the top and is 2.5 *m* high. During a June shower, rain is flowing into the tank at the rate of 0.5 *l/s* (litres per second). Oh, yes, that's $500\,cm^3/s$ How fast is the rainwater rising in the tank when the water level in the tank has reached a height of $80\,cm$ from the bottom?

   $\left(\text{Note: the volume of a cone is given by } V=\frac{1}{3}\pi r^2 h\right)$

[6]

4. Logan plans to start a business selling subs. After doing his research, he determines that the cost function for *Logan's Subs* is given by $C(n)=8200+1.3n$ Where C is the cost in Canadian Dollars and n is the number of submarine produced. The demand function, in dollars, is $p(n)=5.2-0.0001n$.

a) Determine the **revenue function**. Note: the revenue function is the product of the **demand** (or price) **function** and **quantity** of subs sold.

b) Find the **profit function** (the revenue minus the cost) in simplified form.

c) Determine the **marginal profit** function (the derivative of the profit function).

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d) How many submarines should Logan produce so as to maximize his profit?

e) What will the profit be if the profit is maximized?

5. Delaney has a square piece of cardboard $80\,cm$ by $80\,cm$ that he wishes to make into a box of **maximum volume**. He has plenty of tape, a square a tape measure and a utility knife. He intends to cut out **squares from each of the corner** of the piece of cardboard and fold up the flaps and use tape to keep the box together. He does not need a top to the box. How large should his cut out squares be? (for maximum volume? $V = l\,w\,h$)

[6]

6. At exactly 12:15:00 pm, Deanna is driving her car **west** at exactly **25 *m/s*** (90 *km/h*). She is **approaching** an unmarked intersection which is still exactly **400 *m* in front of** her. Nick, at exactly the same instant, is driving his car **north** and **approaching the same** unmarked intersection. He is still **510 *m*** from the intersection and is travelling at exactly **30 *m/s*** (108 *km/h*). If both Deanna and Nick maintain their speeds exactly, how many seconds after 11:15:00 pm do Deanna and Nick get as close to each other as they get?
Note: your answer must be exact! Clearly show your method (calculus) and reasoning, including a well marked diagram.

[7]

[40] total marks