*This midterm has **4 questions** on **7 pages**, for a total of 40 points.*

Duration: 50 minutes

- Read all the questions carefully before starting to work.
- You should give complete arguments and explanations for all your calculations; answers without justifications will not be marked.
- Continue on the back of the previous page if you run out of space.
- Attempt to answer all questions for partial credit.
- This is a closed-book examination. **None of the following are allowed**: documents, cheat sheets or electronic devices of any kind (including calculators, cell phones, etc.)

Full Name (including all middle names): _____

Student-No: _____

Signature: _____

Question:	1	2	3	4	Total
Points:	10	10	10	10	40
Score:					

10 marks

1. At 1:00 p.m. ship A is 25 km due north of ship B. If ship A is sailing west at a rate of 16 km/h and ship B is sailing south at 20 km/h, find the rate at which the distance between the two ships is changing at 1:30 p.m. (Be sure to draw a diagram.)

10 marks

2. In each problem below, assume that interest is compounded continuously. (LEAVE YOUR ANSWERS UNSIMPLIFIED).

(a) You invest \$100 000 now at 3% interest. How much will you have after 5 years?

(b) You invest \$200 000 now at a fixed interest rate. After 10 years your investment doubles. How much longer must you wait till your investment triples?

(c) You invest \$P at the beginning of the year 2000 at an interest rate of 5%. What must P be in order to be able to withdraw \$10000 at the beginning of 2010, then \$20000 at the beginning of 2020?

10 marks

3. Suppose that Lindo Cafe. sells 400 half-kilogram bags of Colombian coffee per week when it is priced at \$10 per 500 grams. For every \$1 per bag increase in price, it sells 10 fewer bags of coffee. Recall that the price elasticity of demand is given by $\epsilon(p) = \frac{p}{q}\frac{dq}{dp}$.

   (a) Find the demand equation for Lindo's Colombian coffee. Use p for price and q for the demand.

   (b) Compute $\epsilon(p)$ for this demand function.

(c) If the price is \$12 and increases by 4%, what is the percentage change in demand? (Hint: Use the price elasticity of demand to answer this question.) You may leave your answer in the simplest calculator-ready form you can find.

(d) Will the Lindo Cafe's revenue increase or decrease as a result of the price change in part (c)? Explain your answer.

10 marks 4. For the function

$$f(x) = \frac{x^2 - 1}{x^2 - 4}$$

determine all of the following if they are present: (i) critical points (where $f'(x) = 0$ or $f'(x)$ does not exist), local maxima and minima, intervals where $f(x)$ is increasing or decreasing; (ii) inflection points and intervals where $f(x)$ is concave upward or downward; (iii) asymptotes (horizontal, vertical). Sketch the graph of $y = f(x)$, giving the (x, y) coordinates for all of the points of interest above. **Please make your sketch big enough to see clearly all features of interest.**

You may use, without demonstrating it, the fact that $f''(x) = \dfrac{6(3x^2 + 4)}{(x^2 - 4)^3}$.

(Question 4 continued)