This Examination paper consists of 7 pages (including this one). Make sure you have all 7.

INSTRUCTIONS:
No memory aids allowed. No calculators allowed. No communication devices allowed.

MARKING:

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Q1  [10 marks]

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.)
Q2  [10 marks]

A used Cesna 172 Skyhawk aircraft is purchased for $56,000. The buyer predicts it will decline continuously in value at a rate of 4% per year.

(a) Write down a function to model the value of the aircraft $t$ years from now.

(b) What is the predicted value of the plane 5 years from now?

(c) In 5 years time, the buyer is forced to sell the plane for $30,000. What constant annual rate of depreciation would have the buyer’s $56,000 aircraft worth only $30,000 after 5 years?
Q3 [10 marks]

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 \( \epsilon(p) = \frac{p dq}{q dp} \).

(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.
Q4  [10 marks]

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 \( f''(x) = \frac{6(3x^2 + 4)}{(x^2 - 4)^3} \).
(Question 4 continued)