

MCV4U – Grade 12 Calculus & Vectors, University Preparation.

1. Evaluate

a) [2]  $\lim_{x \rightarrow 3} \frac{x^2 - 7x + 12}{5x - 15}$

b) [3]  $\lim_{x \rightarrow 10} \frac{\sqrt{x-1} - 3}{x-10}$

c) [3]  $\lim_{x \rightarrow -2} \frac{\frac{1}{x+1} + 1}{x+2}$

2. Find  $\frac{dy}{dx}$ .

a) [1]  $y = \sqrt[4]{x^3}$

b) [3]  $y = (5 - 2x)^2(x - 1)^3$

c) [3]  $y = \frac{2x^2 + x - 5}{x + 2}$

3. [4] Find the equation of the tangent at the given point:  $y = 3x^3 + 4x^2 - 15x - 7$ ; (2,3)

4. Analyze the following functions and sketch the graph:

a) [9]  $y = -x^3 + 3x^2 + 45x + 27, -5 \leq x \leq 5$

MAX/MIN POINTS

b) [7]  $y = \frac{x^2}{x^2 - 4}$

ASYMPTOTES

INFLECTION POINT

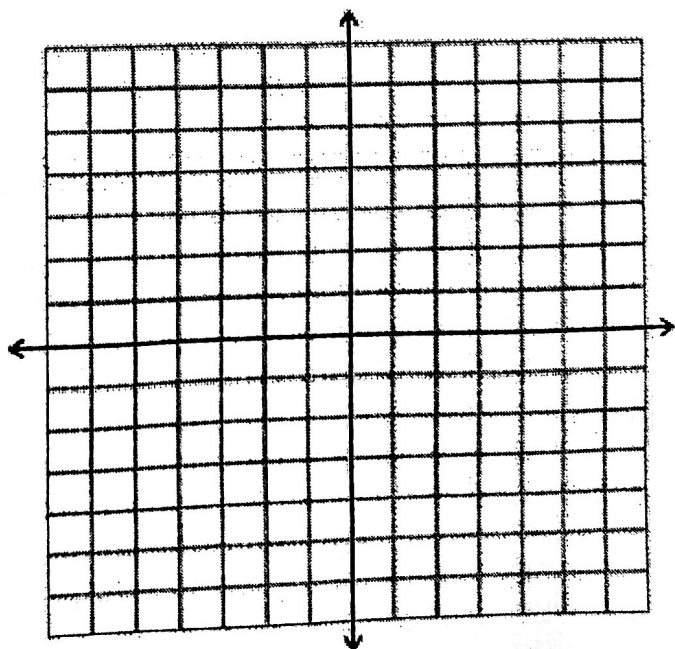
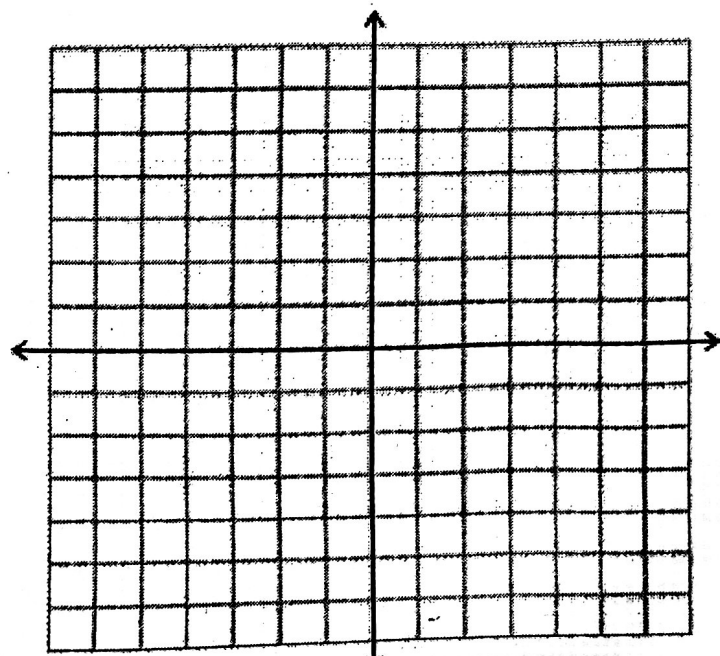
INTERCEPTS

INTERVALS OF INCREASE/DECREASE

INTERVALS OF CONCAVITY

RANGE

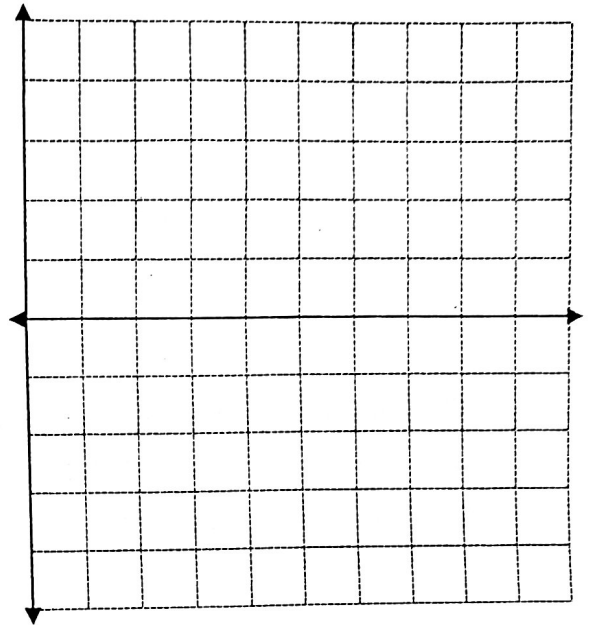
DOMAIN



c) [5]  $y = \sin x - \frac{1}{\sqrt{2}}x, 0 \leq x \leq 2\pi$

RELATIVE MAX/MIN

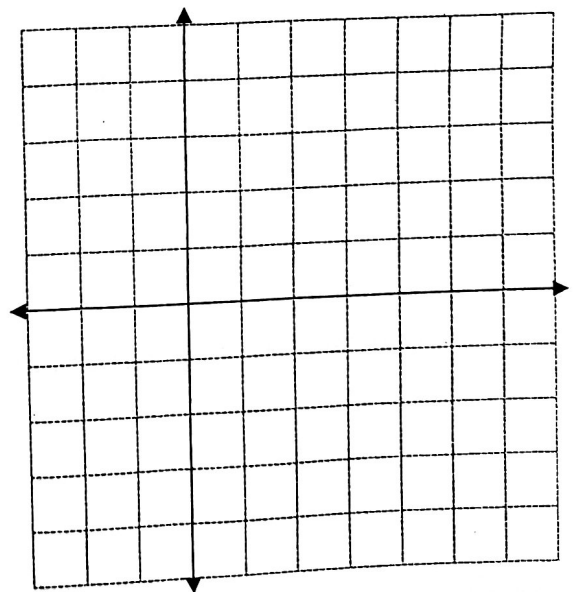
ABSOLUTE MAX/MIN



d) [5]  $y = \frac{x^2}{2^x}, -1 \leq x \leq 5$

RELATIVE MAX/MIN

ABSOLUTE MAX/MIN



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5. [6] Kathleen's rectangular yard is enclosed on three sides with 400 m of fencing. Find the dimensions of the yard so its area will be maximized.

6. The position of a particle in  $s(t)$  metres after  $t$  seconds is given by the formula

$$s(t) = \frac{1}{3}t^3 - 4t^2 - 20t + 3. \text{ Determine the following.}$$

a) [1] displacement at 3 seconds.

b) [3] acceleration when the velocity is zero

c) [3] Interval(s) where the particle speeds up.

7. [4] Determine all possible angles of  $\theta$ ,  $0^\circ \leq \theta \leq 180^\circ$ , between  $\vec{u}$  and  $\vec{v}$  such that  $|\vec{u} \times \vec{v}| < |\vec{u} \cdot \vec{v}|$ .

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8. Given  $A(-1,3,-1)$ ,  $B(2,4,1)$  and  $D(3,3,1)$ , find:

a) [1]  $\overrightarrow{AB}$ ,  $\overrightarrow{AD}$ ,  $\overrightarrow{BD}$

b) [1]  $\overrightarrow{AB} \cdot \overrightarrow{AD}$

c) [2]  $\overrightarrow{AB} \times \overrightarrow{AD}$

d) [3]  $|\overrightarrow{AB}|$

$|\overrightarrow{AD}|$

$|\overrightarrow{BD}|$

e) [2] area of  $\triangle ABD$ .

f) [5] angles in  $\triangle ABD$ .

9. [6] Find the resultant velocity of a boat heading 16 km/h  $[N15^\circ W]$  if there is a 6 km/h current from  $[S35^\circ W]$ . Include a diagram with appropriate labels.