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GN (DI) STRATEGY FOR LEARNERS ATTAINMENT

PREP 2020_FREE STATE

QUESTION 7

7.1 Given $f(x) = -x^2 - 2$, determine $f'(x)$ using FIRST PRINCIPLES. (5)

7.2 Determine:

7.2.1 $\frac{dy}{dx}$ if $y = \frac{x}{3} + \sqrt[4]{x^3} - 5p^2$ (3)

7.2.2 $D_x \left[(2x^{-1} - \sqrt{5})^2 \right]$ (3)

[11]

QUESTION 8

Given $f(x) = 2x^3 + ax^2 + bx + 3$. The point $(2; -9)$ is a turning point of the function.

8.1 Determine the values of a and b . Show ALL your calculations clearly. (6)

8.2 If it is given that $f(x) = 2x^3 - 5x^2 - 4x + 3$, prove that $(x+1)$ is a factor of f . (2)

8.3 HENCE draw a sketch graph of f , clearly indicating ALL intercepts and coordinates of turning points. (5)

8.4 For which value(s) of x will the graph be concave down? (2)
[15]

QUESTION 9

A dairy company wishes to market its milk in rectangular carton containers. The volume of the container must be exactly $1l$, and the length of the base must be twice the breadth of the base. [$1l = 1000cm^3$]

9.1 Show that the height (h) of the container can be written as $\frac{500}{x^2}$, where x is the breadth of the base. (2)

9.2 Determine the dimensions of the container if the surface area must be a minimum. Ignore the thickness of the carton. (4)
[6]

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PREP 2020_LIMPOPO

QUESTION 8

8.1 Differentiate $f(x) = -x^2 - 3x$ from first principles. (4)

8.2 Calculate $D_x \left[x + \frac{1}{x} \right]^2$ (4)

8.3 Determine $\frac{dy}{dx}$ if $y = -3x^2 - \frac{3}{\sqrt{x}} + 3^{-1}$ (4)

The tangent to the curve of $y = -2x^2 - x$ is perpendicular to the line

8.4 $y = -2x + 1$. Determine the x -coordinate of the point of tangency (the point where the tangent touches the curve). (4)

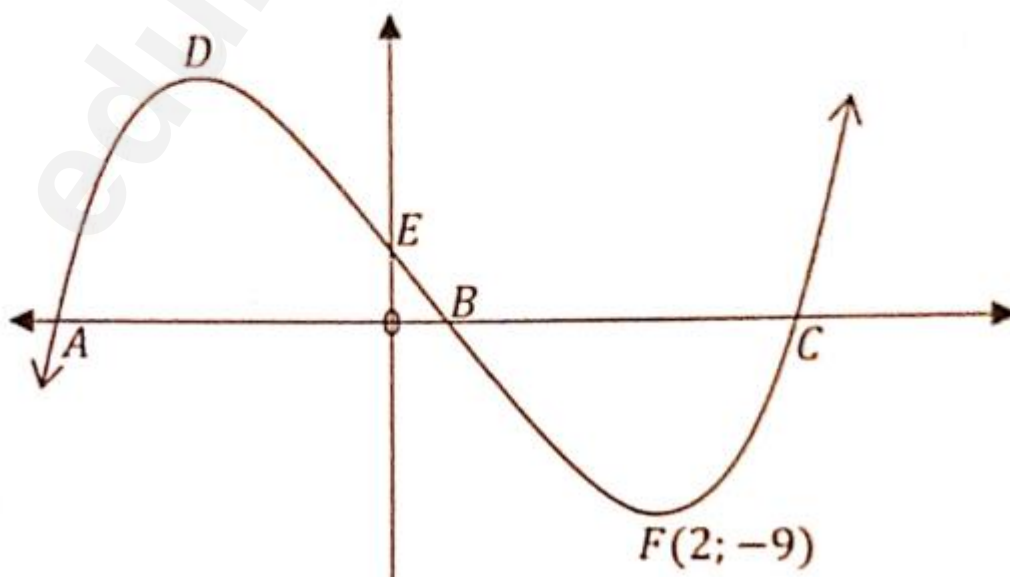
8.5 Given the functions $f(x) = 2x^3 - 16$ and $g(x) = x^2 + 2x + 4$

If $p(x) = \frac{f(x)}{g(x)}$ determine $p'(3)$ (4)

[20]

QUESTION 9

The figure represents the graph of $y = 2x^3 + px^2 + qx + 3$. D and F (2; -9) are the turning points. A, B and C are the x -intercepts and E is the y -intercept.



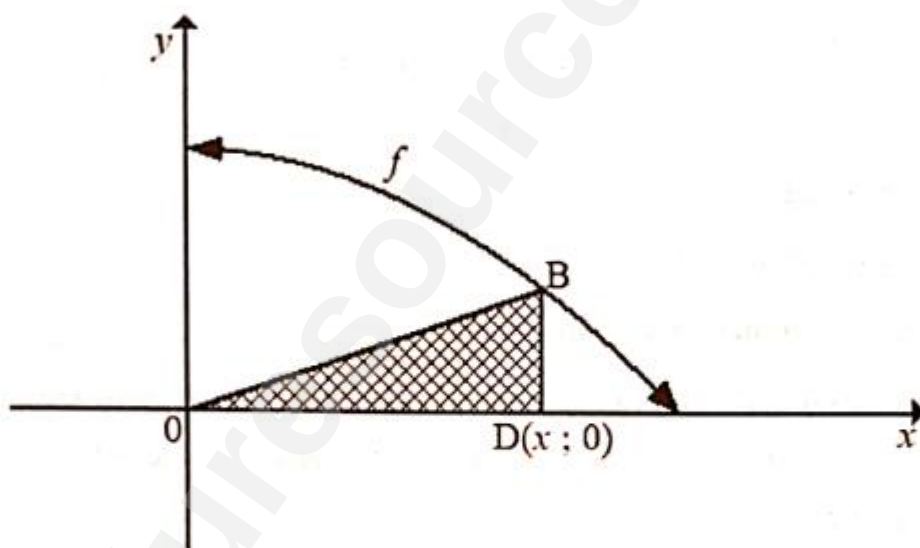
GN (DI) STRATEGY FOR LEARNERS ATTAINMENT

- 9.1 Show that $p = -5$ and $q = -4$ (5)
- 9.2 If A is the point $(-1;0)$. Calculate the co-ordinates of B and C,
the x -intercepts of the graph. (3)
- 9.3 Determine the co-ordinates of D, the local maximum point. (3)

[11]

QUESTION 10

Refer to the figure showing the parabola given by $f(x) = 4 - \frac{x^2}{4}$ with $0 \leq x \leq 4$. D is the point $(x;0)$ and DB is parallel to the y -axis, with B on the graph of f .



- 10.1 Write down the coordinates of B in terms of x . (1)
- 10.2 Show that area A of $\triangle OBD$ is given by: $A = 2x - \frac{x^3}{8}$ (2)
- 10.3 Determine how far D should be from O to give the maximum area of $\triangle OBD$. (4)

[7]

PREP 2020_KZN

QUESTION 9

9.1 Determine $f'(x)$ from first principles given $f(x) = x^2 - bx$, where b is a constant. (5)

9.2 Determine:

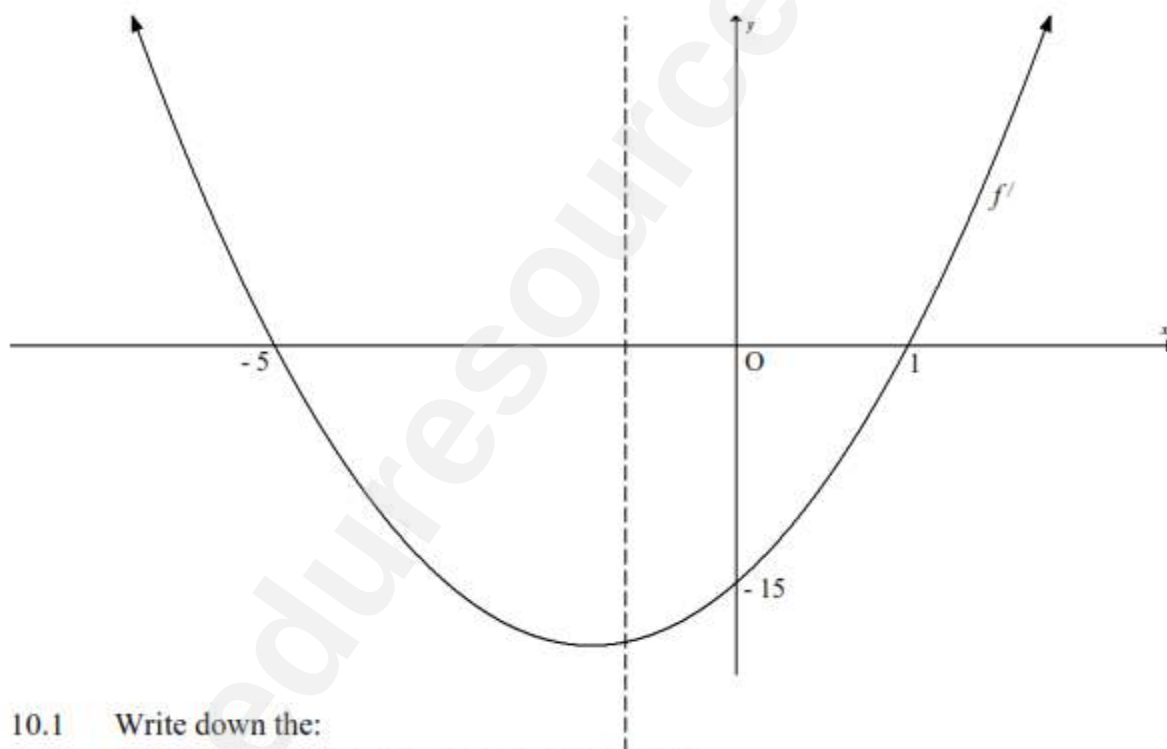
9.2.1 $\frac{d}{dx} \left[\frac{x^4}{4} - 3\sqrt[3]{x} + 7 \right]$ (3)

9.2.2 $\frac{dy}{dx}$ if $y = (x^{\frac{1}{3}} - 2x^{\frac{2}{3}})^2$ (4)

[12]

QUESTION 10

The graph of f' , the derivative of f , is drawn below. $f(x) = ax^3 + bx^2 + cx + d$; $a \neq 0$. f' intersects the x -axis at -5 and 1 and the y -axis at -15 .



10.1 Write down the:

10.1.1 x -values of the turning points of f . (2)

10.1.2 x -value(s) where the gradient of f is equal to -15 . (2)

10.2 Show that the equation of f' is given by $y = 3x^2 + 12x - 15$. (3)

10.3 If $f(-3) = 0$, calculate the value of d . (4)

10.4 Determine the coordinates of the turning points of the graph of f and state whether they are maximum or minimum turning points. (4)

10.5 $y = tx + 4$ is a tangent to f . Calculate the value of t . (5)

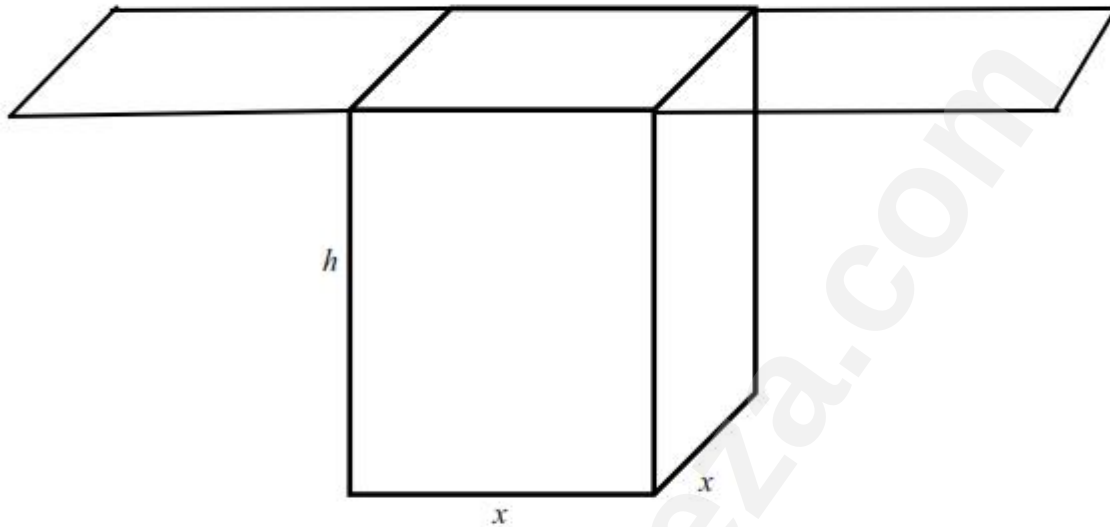
[20]

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QUESTION 11

The rectangular milk carton has a square base which holds 1 litre of milk. It has a specially designed fold-in top. The area of the cardboard used for the top is three times the area of the base.



- 11.1 Show that the Total Surface Area of the carton is given by (3)

$$A(x) = 4x^2 + \frac{4000}{x}$$

- 11.2 Determine the dimensions of the carton so that minimum amount of cardboard is used. (6)

[9]

PREP 2020_MPUMALANGA

QUESTION 6

- 6.1 Given: $f(x) = \frac{x^2}{3} + 1$

Determine $f'(x)$ from FIRST PRINCIPLES. (5)

- 6.2 Determine:

6.2.1 $D_x \left[\left(x - \frac{3}{\sqrt{x}} \right) \left(x + \frac{3}{\sqrt{x}} \right) \right]$ (4)

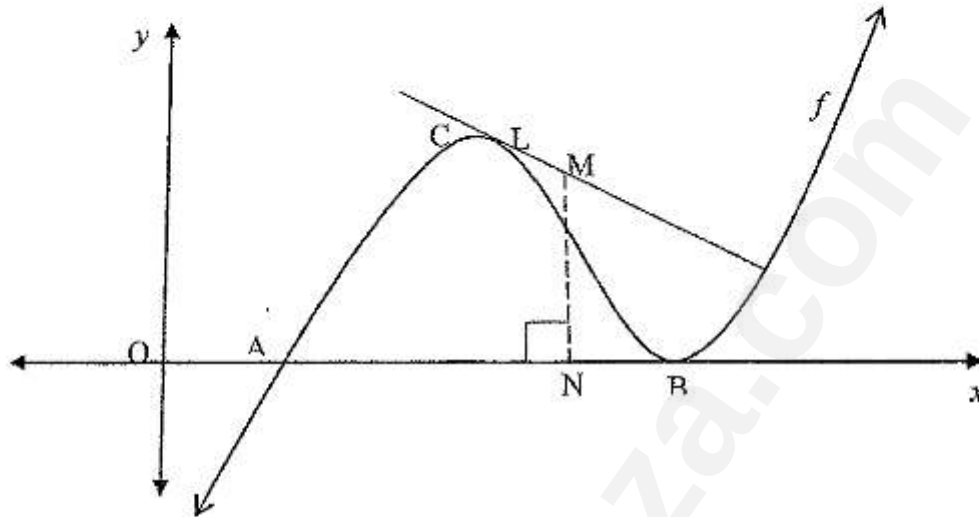
6.2.2 $\frac{dy}{dx}$ if $xy - 5 = \sqrt{x^3}$ (4)

[13]

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QUESTION 7

In the diagram, the graph of $f(x) = 3x^3 + bx^2 + cx - 27$ are drawn. A and B are points on the x -axis and B and C are turning points of f . $f'(1) = 12$ and $f''(1) = -24$.



- 7.1 Show that the equation of f is $f(x) = 3x^3 - 21x^2 + 45x - 27$. (4)
- 7.2 Calculate the coordinates of A and B. (4)
- 7.3 Determine the x -value of C (3)
- 7.4 For which value(s) of x will f be concave down? (2)
- 7.5 If LM is a tangent to the curve at $L(2; 3)$, determine the length of MN in terms of p if N is point $(p; 0)$ and MN is perpendicular to the x -axis. (4)
- 7.6 Use the graph to solve for x if $\frac{f'(x)}{f(x)} \leq 0$ (2)

[19]

PREP 2020_GAUTENG

QUESTION 8

- 8.1 Determine $f'(x)$ from FIRST principles if

$$f(x) = -2x^2 + 6x \quad (4)$$

- 8.2 Evaluate:

8.2.1 $\frac{dy}{dx}$ if $y = 2x^2 + \frac{1}{2}x^4 - 3$ (2)

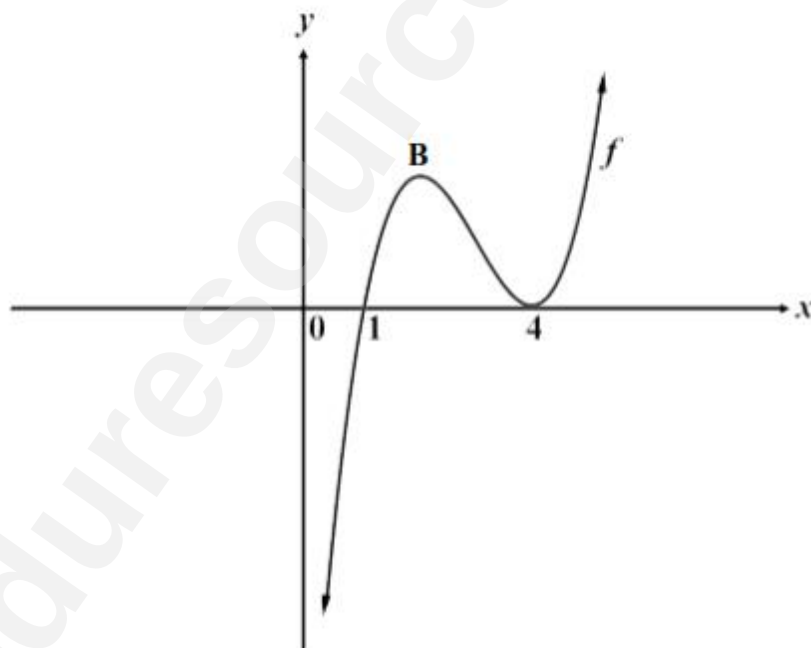
8.2.2 $f'(x)$ if $f(x) = \frac{x^3 - 5x^2 + 4x}{x - 4}$ (4)

- 8.3 The tangent to the curve of $y = 2x^2 - 3x - 5$ is drawn at the point $(2; -3)$.
A straight line parallel to the tangent passing through the y -intercept of the curve is then drawn. Determine the equation of the straight line. (4)
[14]

QUESTION 9

- 9.1 Determine the points on the curve of $y = \frac{4}{x}$ where the gradient of the tangent to the curve is -1 . (5)

- 9.2 The graph of the cubic function with equation $y = x^3 + ax^2 + bx + c$ is drawn below.
- $f(1) = f(4) = 0$
 - f has a local maximum at point B and a local minimum at $x = 4$.



- 9.2.1 Show that $a = -9$, $b = 24$ and $c = -16$. (2)
- 9.2.2 Calculate the coordinates of point B. (4)
- 9.2.3 Determine the value(s) of k for which $f(x) = k$ has ONLY negative roots. (2)
- 9.2.4 Determine the value(s) of x for which f is concave up. (2)
[15]

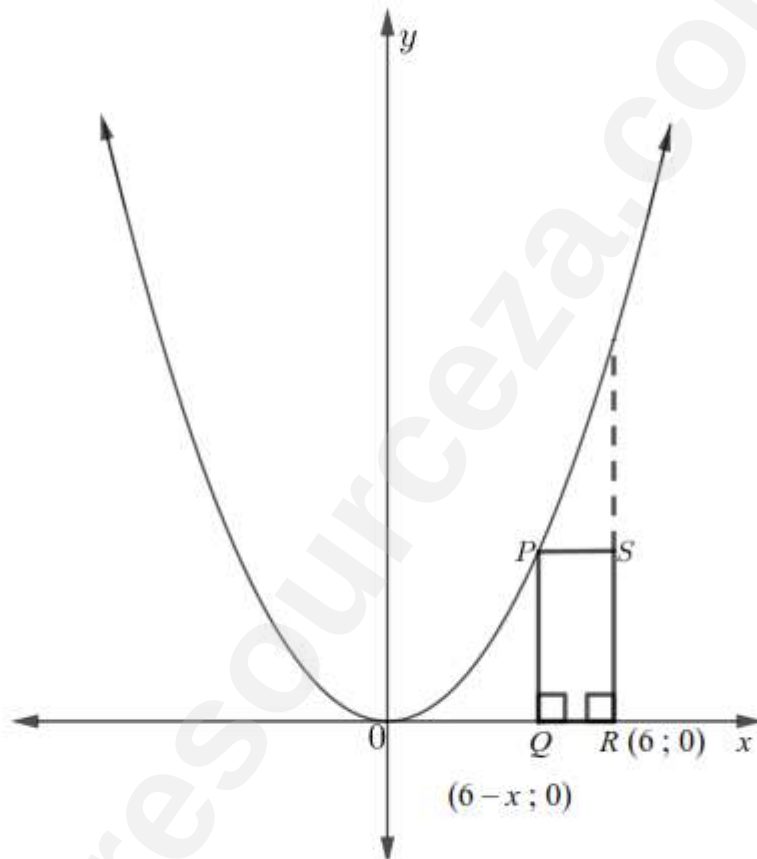
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QUESTION 10

The diagram below represents the graph of $y = x^2$ and rectangle PQRS.

- Point P is a common point on both the graph and the rectangle.
- The graphs of $x = 6$ and $y = 0$ represent TWO adjacent infinite lines of rectangle PQRS.
- The coordinates of point R(6 ; 0) and point Q(6 - x ; 0) are given.



- 10.1 Write down the coordinates of point P in terms of x . (1)
- 10.2 Determine the maximum area of rectangle PQRS. (5)
- [6]