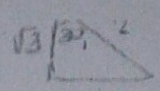
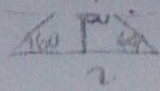


$$t^2 - 4t + 3$$

$$-3 - 1$$



$$t^2 - 3t - t + 3$$

$$t(t-3) - 1(t-3)$$

Multi Ques

$$t = 1$$

$$t = 3$$



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$$\sqrt{2^2 - 1^2}$$

$$\sqrt{3}$$

$$1/2$$

$$\sqrt{3}/2$$

30

SECOND SEMESTER EXAMINATIONS 2010/2011

FIRST YEAR EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN ENVIRONMENTAL AND BIOSYSTEMS ENGINEERING, BACHELOR OF SCIENCE IN CIVIL AND CONSTRUCTION ENGINEERING, BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING, BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING AND BACHELOR OF SCIENCE IN GEOSPATIAL AND SPACE ENGINEERING

FEB 112, FCE 162, FEE 122, FME 172, FSP 182; PURE MATHEMATICS B

DATE: JUNE 9, 2011

TIME: 8.30, A.M. - 10.30 A.M.

INSTRUCTIONS: ATTEMPT QUESTION ONE AND ANY OTHER TWO QUESTIONS OF YOUR CHOICE IN TWO HOURS.

Question One (30 Marks)

(a) The position at time t of an object moving along a line is given by

$$s(t) = t^3 - 6t^2 + 9t + 5$$

(i) Find the velocity of the object and discuss its motion between times $t = 0$ and $t = 4$. (5 marks)

(ii) Find the total distance travelled by the object between times $t = 0$ and $t = 4$.

(iii) Find the acceleration of the object and determine when the object is accelerating and decelerating between times $t = 0$ and $t = 4$.

(b) Find all critical numbers of the function $f(x) = 2x^4 - 4x^2 + 3$ and classify each critical point as relative maximum, a relative minimum or neither, (5 marks)

(c) Correct each of the following polar coordinates to rectangular coordinates.

(i) $(r, \theta) = (2, \pi)$ (2 marks)

(ii) $(r, \theta) = (\sqrt{3}, \pi/6)$ (2 marks)

(d) Find the area under the graph of

$$f(x) = \frac{1}{\sqrt{5x+1}} \text{ between } x = 0 \text{ and } x = 3$$

(e) Evaluate the volume, if the area bounded by the curve $y = x^3 + 1$, the x -axis and the limits of $x = 0$ and $x = 3$ is rotated about the x -axis. (6 marks)

Handwritten notes: $6t - 12$, -12 , -2

Handwritten notes: $dy/dx = 3x^2$, $0 = 3x^2$, $x = 0$

Question Two (20 Marks)

- (a) Determine where the function $f(x) = 3x^4 - 2x^3 - 12x^2 + 18x + 15$ is increasing and decreasing, and where its graph is concave up and concave down. Find all relative extrema and points of inflection, and sketch the graph. (12 marks)
- (b) Find the length of the arc from $\theta = 2\pi$ for the cardioid
 $r = f(\theta) = 2 - 2\cos\theta$ (8 marks)

Question Three (20 marks)

- (a) Evaluate the integral $\int_0^3 |3t - 5| dt$ (6 marks)
- (b) Evaluate the area of the region enclosed by the line $y = 4x$ and the curve $y = x^3 + 3x^2$ (6 marks)
- (c) Find the interval of increase or decrease for the function $f(x) = \frac{x^2}{x-2}$ (4 marks)

Question Four (20 marks)

- (a) The revenue desired from the sale of a new kind of motorized skateboard t weeks after its introduction is given by:

$R(t) = \frac{63t - t^2}{t^2 + 63}$ million shillings. When does the maximum revenue occur? What is the maximum revenue? (8 marks)

- (b) A cup is made by rotating the area between $y = 2x^2$ and $y = x + 1$ with $x \geq 0$ around the x -axis. Find the volume of the material needed to make the cup. (units in cm). (12 marks)

Question Five (20 marks)

- (a) Determine the area of the region bounded by $y = 2x^2 + 10$, $y = 4x + 16$, $x = -2$, and $x = 5$
- (b) Find the intervals of concavity for the function $f(x) = 2x^6 - 5x^4 + 7x - 3$

$y = x^3 + 1$
 $x \quad | \quad -5 \quad -4 \quad -3 \quad -2 \quad -1 \quad 0$
 $y \quad | \quad -124 \quad -63 \quad -2 \quad 1 \quad 0$

$\frac{dy}{dx} = 3x^2$
 $0 = 3x^2$
 $x = 0$