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The Open University of Sri Lanka
Faculty of Engineering Technology
The Department of Agricultural and Plantation Engineering
Bachelor of Industrial Studies Honors
Final Examination – 2015/ 2016
AEZ3238 Mathematics for Agriculture

Date : **21-11-2016**
Time : **9.30 a.m. – 12.30 p.m.**
Duration : **Three (03) hours**

General instructions:

- This question paper has eight (08) questions.
- **Answer any six (06) questions.**
- All questions carry equal marks.
- **Write your Index Number clearly on the answer book.**
- Write the number of the question distinctly before each answer.

Question 1

a) Factorize the following expressions.

i) $9x - 15x^2$

ii) $2p^2q - 12q^2p$

iii) $64a^3 - 27b^3$

iv) $2x^3y - 12x^2y^2 + 18xy^3$

v) $a^2 - 2ab + b^2 - c^2$

b) Simplify the following.

i) $\frac{3x}{3x-2} - \frac{6x}{9x^2-4} - 1 + \frac{2}{4-9x^2}$

ii) $\left(\frac{x+4}{2x-1}\right) \div \left(\frac{x^2-16}{12x^2-3}\right) \times \left(\frac{x^2-5x+4}{(2x+1)}\right)$

c) Solve $K = \frac{1}{2}(mv^2)$ for v.

d) Find the quotient and remainder when $(x^2 + 4x + 19)$ is divided by $(x + 6)$.

Question 2

a) Solve the following equations.

i) $x^2 = 5x - 3$ Use completing the square method.

ii) $15x^2 - 4x - 3 = 0$ Use factorize method.

iii) $2x + y = 2;\quad 5y + 3x + 4 = 0$ Use substitution method.

iv) $x - y + z = 2;$
$2x + 3y - z = 3;$
$3x + 2y + 3z = 11$

b) Find the range of the value of k if the equation $x^2 + (k-2)x + 4 = 0$ has real roots.

c) In the above equation if the value of $k = -4$, and the roots are given by α and β, find the values of the following:

i) $\alpha\beta$

ii) $(\alpha + \beta)$

Question 3

a) Covert the following angles given in radians to degrees.

i) $5\pi/2$

ii) $8\pi/3$

iii) $7\pi/6$

b) Convert the following angles given in degrees to radians.

i) 24^0

ii) 160^0

iii) 300^0

c) Prove the following trigonometric relationships.(csc = Cosec)

i) $\tan^2 x - \sin^2 x = \tan^2 x \ \sin^2 x$

ii) $\tan x + \cot x = \sec x \csc x$

iii) $\frac{(\cot x - 1)}{(\cot x + 1)} = \frac{1 - \tan x}{1 + \tan x}$

iv) $\tan x + \frac{(\cos x)}{(1 + \sin x)} = \sec x$

Question 4

a) Evaluate the limits of the following functions.

i) $\lim_{x \to -2} \frac{2x^2 + 7x + 6}{x + 2}$

ii) $\lim_{x \to 0} \frac{(x+2)^2 - 4}{2x}$

iii) $\lim_{x \to 1/3} \frac{3x - 1}{9x^2 - 1}$

iv) $\lim_{x \to -2} \frac{x^2 - x - 6}{x^2 + 3x + 2}$

b) Differentiate following functions.

i) $y = \frac{2}{x^3}$

ii) $y = 4x^4 - 3x^3 + 2x^2 - 5$

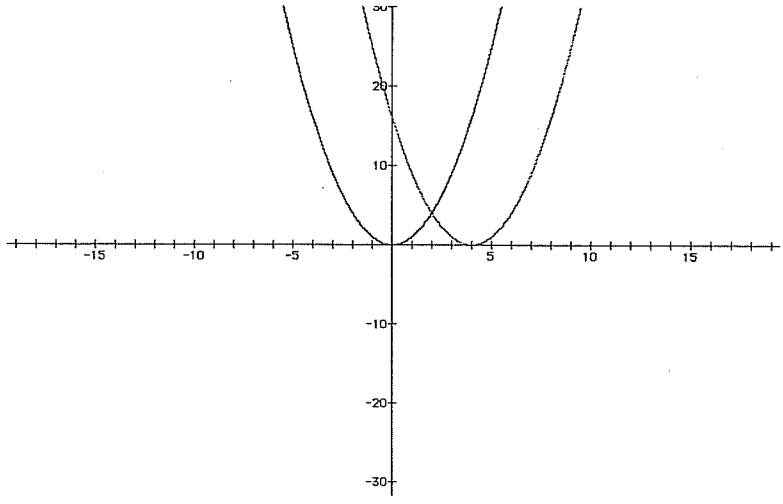
iii) $y = (2x + 3)(x^2 + 4x + 1)$

iv) $y = (2x^2 + 3)^{10}$

v) $y = \frac{x^2 + 2x + 1}{x^3 + 3x}$

Question 5

a) By using the curves of $f(x) = x^2$ and $g(x) = x^2 - 8x + 16$ given below, write your answers to the following questions.



i) Find the minimum values of the functions $f(x)$ and $g(x)$.

ii) Do the functions have real roots? If so, what are they?

iii) About which lines the graphs are symmetrical?

iv) What are the intersect points of these two graph?

v) For all real values of x, what is the value range of $f(x)$and $g(x)$?

b) The function $y = x^3 + x^2 - 5x + 2$ has two turning points.

i) What are the coordinates of these turning points?

ii) Check for maxima and minima and identify the nature of the turning points.

Question 6

a) Find the indefinite integral of the following functions.

i) $\int(4x^3 + 6x^2 - 5)\,dx$

ii) $3\int(x^2 + 3)^2\,dx$

iii) $\int \frac{7x+1}{2x^2-3x-2}\,dx$

iv) $\int x \sin 3x\,dx$

b) Find the finite integral of the following functions.

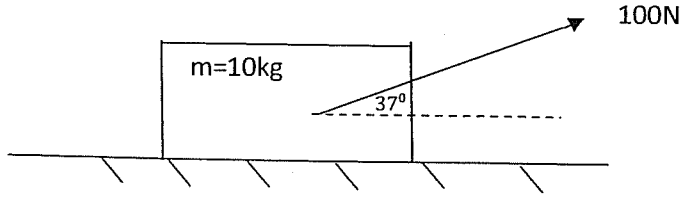
i) $\int_0^2(3x^2 + 1)dx$

ii) $\int_0^1(x + 3)^2\,dx$

iii) $\int_1^2(\frac{2x^2-3x+5}{x^2})\,dx$

Question 7

a) A box is pulled with $100N$ force. Mass of the box is $10kg$ and surface is frictionless. Find the acceleration of the box. ($\sin 37^\circ = 0.6, \cos 37^\circ = 0.8$)



b) An object is thrown straight down from the top of a building at a speed of 20 ms^{-1}. It hits the ground with a speed of 40 ms^{-1}.

i) What is the height of the building?

ii) How long was the object in the air?

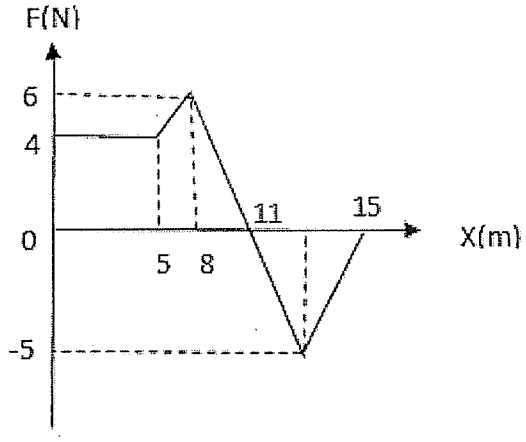
c) A car accelerates uniformly 0 to 72kmh^{-1} in 11.5 seconds.

i) What is the acceleration of the car in ms^{-2}

ii) What is the position of the car by the time it reaches the velocity of 72kmh^{-1}?

Question 8

a) Applied force vs. position graph of an object is given below. Find the work done by the forces on the object.



b) A girl ($m = 56.2\ kg$) is traveling at a speed of 12.8 ms^{-1} at the top of a 19.5 m high roller coaster loop.

i) Determine girl's kinetic energy at the top of the loop.

ii) Determine girl's potential energy at the top of the loop.

iii) Assuming negligible losses of energy due to friction and air resistance, determine girl's total mechanical energy at the bottom of the loop ($h = 0\ m$).

iv) Determine girl's speed at the bottom of the loop.

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