

REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF MINERALS AND ENERGY
EXAMINATION FOR THE MINE SURVEYORS CERTIFICATE OF COMPETENCY

DATE: 14 October 2004 (Thursday)
TIME: 8:30 to 11:30 (3 Hours)

TOTAL MARKS: 100
TO PASS: 50

MATHEMATICS

- Note:**
- (1) The make and model number of your calculator must be shown on the front cover of your answer book.
 - (2) All steps must be shown.

QUESTION 1

Find the limits of the following:

(a) $\lim_{x \rightarrow 1} (x^3 + 3x^2 - 2x - 17)$ (2)

(b) $\lim_{x \rightarrow 2} \frac{x+3}{x+6}$ (2)

(c) $\lim_{x \rightarrow -5} \frac{x^2 + 3x - 10}{x + 5}$ (3)

(d) $\lim_{a \rightarrow 2} \frac{a^3 - 8}{a^4 - 16}$ (3)

(e) Let $f(x) = \begin{cases} 3 - x, & x < 2 \\ \frac{x}{2} + 1, & x > 2 \end{cases}$

Find $\lim_{x \rightarrow 2^+} f(x)$ (2)

[12 marks]

QUESTION 2

(a) Find the derivative from first principles if:

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

(b) Find the derivatives of the following:

$$(i) \quad y = \frac{x^4}{2} - \frac{3x^2}{2} - x \quad (3)$$

$$(ii) \quad y = \cos^2 3x \quad (3)$$

$$(iii) \quad y = (x^2 + 2x + 3)^3 \quad (3)$$

[13 marks]

QUESTION 3

Prove that :

$$(a) \quad \log_3 4 = \frac{2}{\log_2 3} \quad (4)$$

$$(b) \quad \log_3 2 + \log_4 3 - \log_5 4 = \frac{1}{\log_2 5} \quad (4)$$

[8 marks]

QUESTION 4

Factorise fully

$$(a) \quad 3ax + bx - 3ax^2 - bx^2 + 3ax^3 + bx^3 \quad (3)$$

$$(b) \quad 2px^2 - 3qx^2 + x^2 - 6p + 9q - 3 \quad (2)$$

$$(c) \quad a^2 + a(3 + b) + 3b \quad (3)$$

[8 marks]

QUESTION 5

Find the Highest Common Factor(HCF) of :

(a) $2x^3 - 18x$,
 $3x^3 - 9x^2$,
 $x(x^3 - 27)$ (5)

(b) $3px^2 + 3px - 18p$,
 $15px^2 - 60px + 60p$,
 $2px - 4p$ (5)

[10 marks]

QUESTION 6

Solve for x, y and z

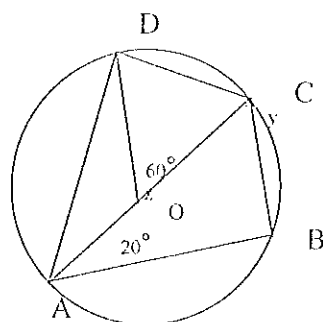
(a) $x + y + z = 6$
 $x - y + 2z = 5$
 $x + y + 3z = 12$ (5)

(b) $x + 2y + 3z = -7$
 $3x - y + 4z = -4$
 $-2x + 2y - z = -2$ (5)

[10 marks]

QUESTION 7

(a) Given a circle with centre point [O] and containing a cyclic quadrilateral ABCD. Find the values of x, y and z.

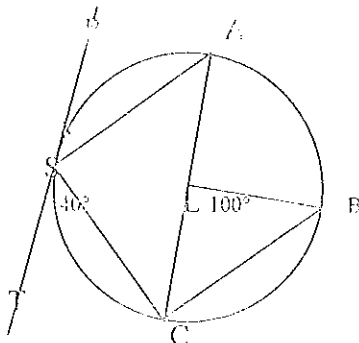


(7)

(b) PT is a tangent (point S) to the circle with centre point [L].

Angle TSC = 40° and angle BLC = 100° .

Prove that SA // CB.



(8)

[15 marks]

QUESTION 8

Use the fundamental identities to prove the following identities:

(a) $\frac{1 - \cos\theta}{\sin\theta} = \frac{\sin\theta}{1 + \cos\theta}$ (5)

(b) $\frac{\tan x \operatorname{cosec} x}{\tan x + \cot x} = \sin x$ (6)

(c) $\frac{1 - 2\sin^2 x}{\sin x \cos x} = \cot x - \tan x$ (6)

[17 marks]

QUESTION 9

Without using a calculator, evaluate

$$\frac{3\sec^2 150^\circ \sec 180^\circ}{1 + \sin 315^\circ - \cos^2 240^\circ}$$

[7 marks]

TOTAL

[100 Marks]

Page 4 of 4