REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF MINERAL RESOURCES
EXAMINATION FOR THE MINE SURVEYOR'S CERTIFICATE OF COMPETENCY

DATE: 14th October 2010 (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) $\lim_{x \to 1} (x^3 + 3x^2 - 2x - 17)$

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

(c) $\lim_{h \to 0} \frac{(3+h)^2 - 9}{h}$

(d) $\lim_{x \to 2} \frac{2x - 4}{x^3 - 2x^2}$

[11 marks]

QUESTION 2

(a) Given the series $2 + 5 + 8 + \ldots + 62$, determine

(i) the number of terms in the series using the relevant formula.
(ii) the sum of the series.

(b) The first three terms of an arithmetic sequence are $t-2$, $2t-6$, and $4t - 8$. Find

(i) t.
(ii) the common difference.
(iii) the sum of the first ten terms.

[14 marks]

QUESTION 3

Solve for x:

(a) $3^{x+1} - 3^{x-2} = 26$

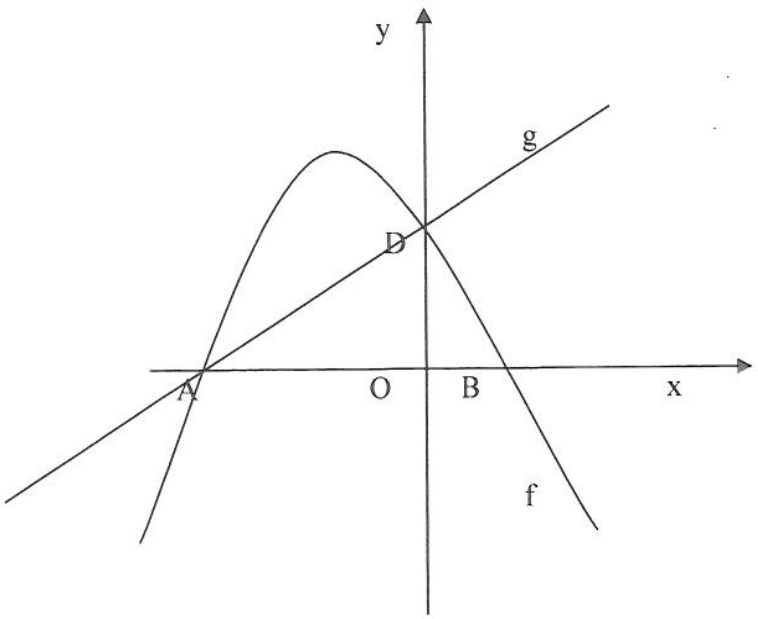
(b) $2\log_3 x + 3\log_3 2 = \log_3(24-16x)$

(c) $\frac{x-3}{x^2+3x+2} - \frac{5}{x^2-4} = \frac{4}{-x-1}$

(d) $\sqrt{x+2} + 4 = x$

[24 marks]

QUESTION 4



Given $f(x) = -2(x+7)(x-1)$ and $g(x) = mx + c$.

(a) Write down the co-ordinates of D, the y-intercept of f and g.
(b) Write down the co-ordinates of A, a common x-intercept of f and g.
(c) Determine the values of m and c.
(d) A circle passes through the point A. Determine the value of r and hence write down the equation of this circle.

[12 marks]

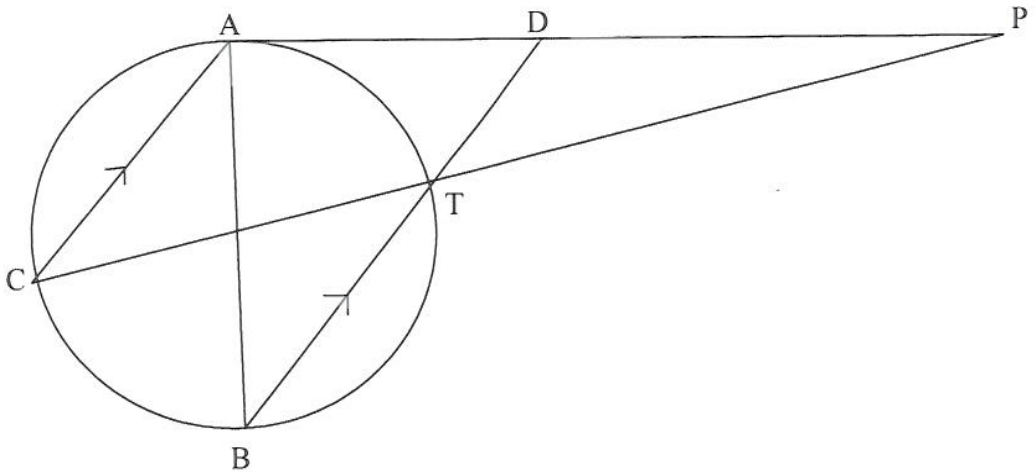
QUESTION 5

If $f(x) = x^3 - 3x^2 - 9x + 12$, determine :

(a) the derivative $f'(x)$ using differentiation rules.
(b) the co-ordinates of all stationary points of f, and clearly indicate local minima and maxima.
(c) the average gradient between points (1;1) and (2;-10).
(d) the gradient of the tangent to the curve at point (1;1).
(e) the second derivative $f''(x)$ using differentiation rules.

[15 marks]

QUESTION 6



In the figure above, PA is a tangent and CA // BT.
Prove that :

(a) Δ ABC /// Δ ADT

(b) PT is a tangent to circle ADT.

[10 marks]

QUESTION 7

Prove the following identities:

(a) $\sec 2A + \tan 2A = \dfrac{\cos A + \sin A}{\cos A - \sin A}$

(b) $\cot x = \dfrac{2 \sin^2 x}{2 \tan x - \sin 2x}$

(c) $\dfrac{\cos p}{1 - \sin p} - \dfrac{\cos p}{1 + \sin p} = 2 \tan p$

[14 marks]

TOTAL [100 Marks]