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

DATE: 14 April 2011 (Thursday) TOTAL MARKS: 100
TIME: 8:30 to 11:30 (3 Hours) 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

(a) Is the following sequence arithmetic ? (3)
1/2 ; 5/6 ; 7/6; 3/2; . . .

(b) Is the following sequence geometric ? (3)
8; 4; 2; 1; …

(c) Determine the value of x if the sequence $2x - 1; 3x + 1; 7x - 1; \ldots$ is geometric . (6)

(d) How many terms of the series $5 + 10 + 20 + \ldots$ must be added to give a sum of 315? (6)

[18 marks]

QUESTION 2

Simplify :

(a) $\dfrac{2.2^{x+3}}{(2^{x})^{x-1}} \div \dfrac{4^{x+1}}{(2^{x+1})^{x-1}}$ (4)

(b) $\dfrac{6^{6x} \cdot 9^{3x}}{54^{4x} \cdot (¼)^{2-x}}$ (5)

(c) $3^{x+1} - 3.3^{3x-1} + 3^{x}$ (3)

[12 marks]

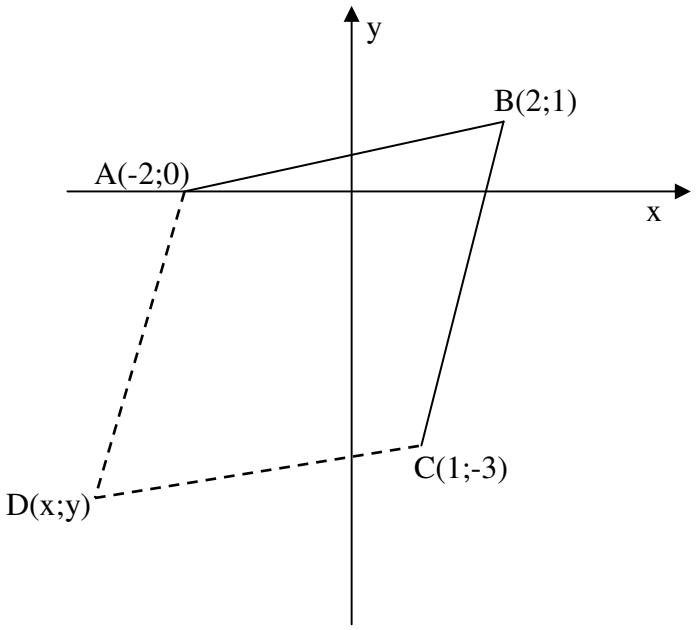
QUESTION 3

The distance between two towns P and Q is 300 km. R is a third town exactly half-way between P and Q.
At 6H00 a cyclist travelling at a uniform speed of x kilometres per hour leaves Q for R and at 7H 00 a second cyclist travelling 5km/h faster than the first leaves P for R.
The two cyclists reach R at the same time.

(a) Write down, in terms of x, the time taken by each cyclist. (3)
(b) Find the speed of each cyclist. (7)

[10 marks]

QUESTION 4



(a) Find the fourth vertex of the parallelogram ABCD in which the vertices A, B and C are (-2;0) , (2;1) and (1;-3) respectively. (10)

(b) Show that the diagonals of this parallelogram bisect each other at right angles. (5)

[15 marks]

QUESTION 5

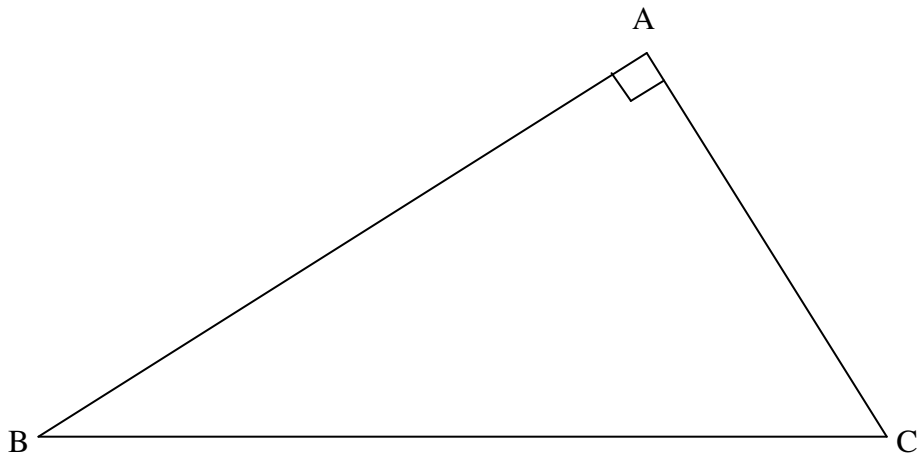
Solve for x, y and z :

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

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

[10 marks]

QUESTION 6



Prove that in a right-angled triangle ABC, the square on the hypotenuse is equal to the sum of the squares on the other two sides, that is, $BC^2 = AB^2 + AC^2$.

[17 marks]

QUESTION 7

Prove the following:

(a) $\tan(A + B) = \dfrac{\tan A + \tan B}{1 - \tan A \tan B}$ (6)

(b) $\dfrac{\sin(4x + \Theta) + \sin(4x - \Theta)}{\cos(2x + \Theta) + \cos(2x - \Theta)} = 2\sin 2x$ (6)

[12 marks]

QUESTION 8

If $f(x) = 2x - 1/x$, determine $f'(x)$ using first principles

[6 marks]

TOTAL [100 Marks]