

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

DATE: 16 April 2009 (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

The distance between two towns A and B is 300 km. C is a third town exactly half-way between A and B.

At 7H00 a cyclist traveling at a uniform speed of x kilometres per hour leaves B for C, and at 8H00 a second cyclist traveling 5km/h faster than the first leaves A for C.

The two cyclists reach C 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 2

Find the Highest Common Factor (HCF) of the following:

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

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

[10 marks]

QUESTION 3

The equation of a straight line is given by $y = 3x + 4$.

Determine :

- (a) the equation of a line (L_1) parallel to y and passing through the point (2;2). (4)
- (b) the equation of a line (L_2) perpendicular to y and passing through the point (2;2). (4)
- (c) the x-intercept for the line (L_1) in (a) above. (2)
- (d) show that the two lines(L_1 & L_2) in (a) and (b) above, are perpendicular to each other. (2)

[12 marks]

QUESTION 4

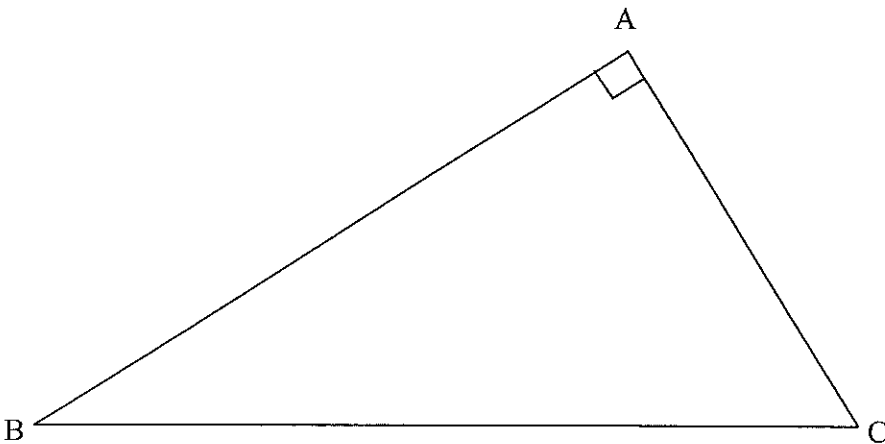
- (a) Insert four terms between 1 and $\frac{32}{243}$ such that the six terms form a geometric sequence. (6)
- (b) Find the 1st and 8th terms of the geometric sequence whose 4th and 5th terms are 4 and 6 respectively. (7)

[13 marks]

QUESTION 5

In the figure below, ΔABC is given with angle $BAC = 90^\circ$.

Prove that $BC^2 = AB^2 + AC^2$



[17 marks]

QUESTION 6

Prove the following identities:

(a) $\frac{1 - \sin A}{1 + \sin A} = (\sec A - \tan A)^2$ (7)

(b) $\cot x = \frac{2 \sin^2 x}{2 \tan x - 2 \sin x \cdot \cos x}$ (7)

[14 marks]

QUESTION 7

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

(a) the derivative $f'(x)$ using differentiation rules. (3)

(b) the co-ordinates of all stationary points of f , and clearly indicate local minima and maxima. (6)

(c) the average gradient between points (1;1) and (2;-10). (3)

(d) the gradient of the tangent to the curve at point (1;1). (1)

(e) the second derivative $f''(x)$ using differentiation rules. (2)

[15 marks]

QUESTION 8

Determine the following integrals :

(a) $\int (x^2 + 3x + 4) dx$ (2)

(b) $\int x^{-3} dx$ (2)

(c) $\int -\frac{1}{3} x^5 dx$ (2)

(d) $\int (x - 3)(x + 3) dx$ (3)

[9 marks]

TOTAL [100 Marks]