

**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

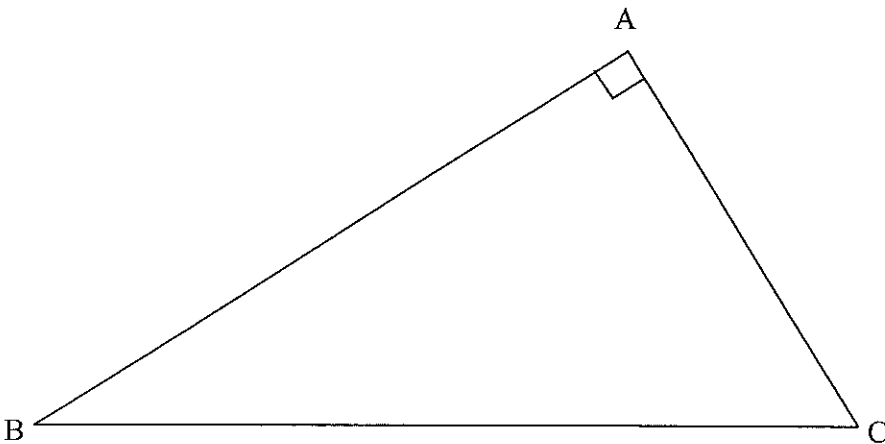
- (a) Insert four terms between 1 and  $\frac{32}{243}$  such that the six terms form a geometric sequence. (6)
- (b) Find the 1<sup>st</sup> and 8<sup>th</sup> terms of the geometric sequence whose 4<sup>th</sup> and 5<sup>th</sup> terms are 4 and 6 respectively. (7)

[13 marks]

### QUESTION 5

In the figure below,  $\Delta ABC$  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]