

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

DATE: **10 APRIL 2003** (Thursday)
TIME: **8:30 to 11:30** (3 Hours)

TOTAL MARKS: **100**
TO PASS: **50**

MATHEMATICS

- NOTES:**
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) Prove that $\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \cdot \tan B}$. (6)
- (b) Show that $\frac{1 + \tan^2 \theta}{1 - \tan^2 \theta} = \frac{1}{2 \cos^2 \theta - 1}$. (5)

[11 marks]

QUESTION 2

If $\operatorname{cosec} \theta = \frac{13}{5}$, find the value of $\frac{\cot^2 \theta - \operatorname{cosec}^2 \theta}{\operatorname{cosec}^2 \theta + 3}$.

[5 marks]

QUESTION 3

Solve for x

- (a) $2^{2x+4} - 5 \cdot 2^{x+1} + 1 = 0$ (5)
- (b) $\frac{8}{x^6} - \frac{217}{x^3} + 27 = 0$ (5)
- (c) $4^{(x+1)(x-3)} = 8^{-x}$ (5)

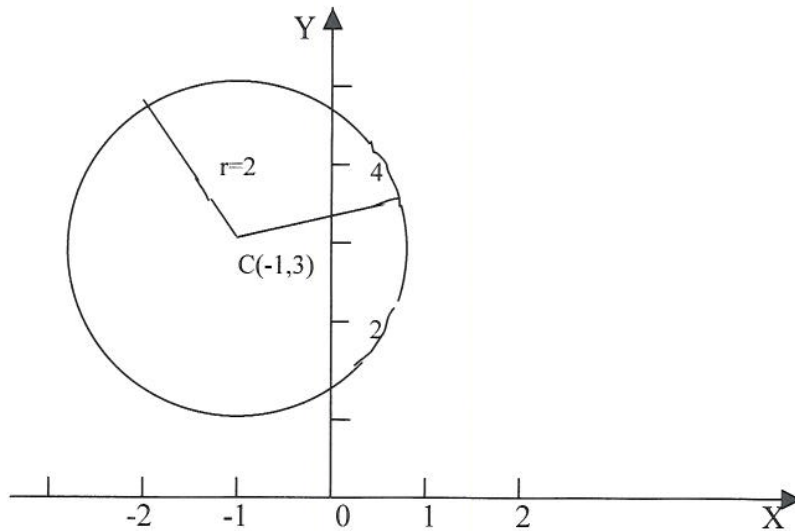
[15 marks]

QUESTION 4

- (a) Determine the equation of the line perpendicular to line $y = 4x - 3$, and passing through point (1;2). (4)
- (b) Determine the co-ordinates of the intersection point of the two lines in (a) above. (4)

[8 marks]

QUESTION 5



The graph shows a circle with centre c and radius of 2 units.

- (a) Determine the equation of the circle. (2)
- (b) If the centre of the circle shifts by 1 unit to the right and 1 unit down, what will the new equation of the circle be? (3)

[5 marks]

QUESTION 6

The first term of the geometric progression is 3 and the sixth term is 96. Find:

- (a) the common ratio (3)
- (b) the tenth term (3)
- (c) the sum of the first ten terms. (4)

[10 marks]

QUESTION 7

Solve for x, y and z

$$\begin{aligned} \text{(a)} \quad x + y + z &= 6 \\ x - y + 2z &= 5 \\ x + y + 3z &= 12 \end{aligned} \qquad (5)$$

$$\begin{aligned} \text{(b)} \quad x + 2y + 3z &= -7 \\ 3x - y + 4z &= -4 \\ -2x + 2y - z &= -2 \end{aligned} \qquad (5)$$

[10 marks]

QUESTION 8

If $\tan \frac{\theta}{2} = t$, express $\tan \theta$, $\cos \theta$ and $\sin \theta$ in terms of t.

[6 marks]

QUESTION 9

Simplify:

$$\text{(a)} \quad \frac{n + 9n^{1/2}}{n + 7n^{1/2} - 18} + \left[1 - \frac{2}{n^{1/2}} \right]^{-1} \qquad (3)$$

$$\text{(b)} \quad \frac{x^{-1} + y^{-1}}{x^{-2} - y^{-2}} \qquad (4)$$

[7 marks]

QUESTION 10

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 travelling at a uniform speed of x kilometres per hour leaves B for C, and at 8H00 a second cyclist travelling 5 km/h faster than the first leaves A for C. The two cyclists reach C at the same time.

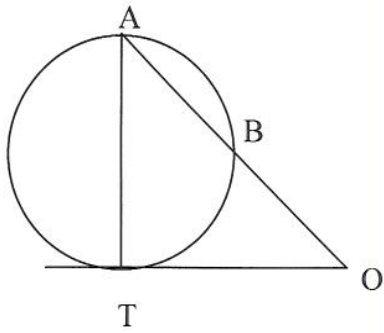
- (a) Write down, in terms of x, the time taken by each cyclist. (2)
(b) Find the speed of each cyclist. (7)

[9 marks]

QUESTION 11

The sketch shows the circle with the tangent and the secant meeting at point O.
Prove that :

$$OA \cdot OB = OT^2$$



[6 marks]

QUESTION 12

Express $\frac{2x + 5}{(x + 2)(x + 3)}$ in partial fractions.

[8 marks]

TOTAL [100 Marks]