

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

DATE: 13 October 2011 (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

Expand completely using the Binomial theorem, i.e.

$$(a + x)^n = a^n + na^{n-1}x + \frac{n(n-1)}{2!} a^{n-2}x^2 + \frac{n(n-1)(n-2)}{3!} a^{n-3}x^3 + \dots + x^n :$$

- (a) $(1 - x)^5$
- (b) $(1 + 2x)^4$

[8 marks]

QUESTION 2

- (a) Determine the equation of a straight line which is perpendicular to line $y = x - 3$, and which passes through point $(1;2)$. (4)
- (b) Determine , algebraically, the co-ordinates of the intersection point of two lines in (a).(4)
- (c) $A(m;4)$ and $B(7;7)$ are two points 5 units apart. Determine the value(s) of m . (8)
- (d) Determine the co-ordinates of the centre and radius of the circle given by :

$$x^2 + 2x + y^2 - 6y = 6 \quad (4)$$

[20 marks]

QUESTION 3

The ballast below a built up railway line on surface 1 100 metres long was surveyed.
The cross-sectional area every 100 metres was calculated and recorded as follows :

1	=	20.20 m ²
2	=	9.50 m ²
3	=	7.00 m ²
4	=	10.24 m ²
5	=	6.84 m ²
6	=	8.94 m ²
7	=	9.24 m ²
8	=	3.80 m ²
9	=	2.44 m ²
10	=	1.02 m ²
11	=	0.40 m ²

Calculate the volume of the ballast using Simpson's rule.

[7 marks]

QUESTION 4

(a) If $\log 72 = a$ and $\log 36 = b$, find $\log 2$ and $\log 3$ in terms of a and b .

(7)

(b) Find without the use of a calculator

(5)

$$\frac{\log 16 - \log 9}{\log 4 - \log 3}$$

[12 marks]

QUESTION 5

Solve for x :

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

(6)

(b) $\sqrt{x + 6} = x$

(5)

(c) $3^x + 3^{x-2} = 90$

(6)

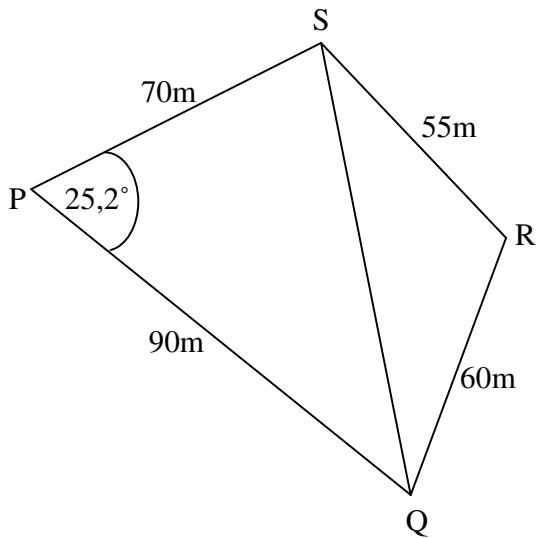
[17 marks]

QUESTION 6

(a) Given triangle ABC, and angle C is obtuse.

Prove that $c^2 = a^2 + b^2 - 2ab \cdot \cos C$ (7)

(b)



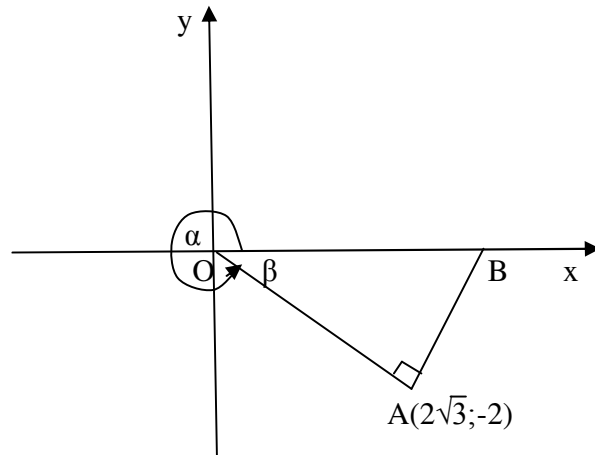
In the above diagram, PQRS is a quadrilateral with $PS = 70\text{m}$, $PQ = 90\text{m}$, $SR = 55\text{m}$, $QR = 60\text{m}$ and angle $P = 25,2^\circ$.

Calculate :

- (i) the area of triangle PQS
- (ii) the length of QS
- (iii) the size of angle R if $SQ = 40\text{m}$ (9)

[16 marks]

QUESTION 7



In the accompanying diagram, which is not drawn to scale, $A(2\sqrt{3}; -2)$ is a point in the Cartesian plane. Angle $BOA = \alpha$ is a reflex angle, and B is a point on the x -axis so that angle $OAB = 90^\circ$.

Calculate :

- (a) α and β
- (b) the length of OA
- (c) the co-ordinates of B

[11 marks]

QUESTION 8

- (a) Prove that :

$$\frac{1}{\operatorname{cosec}^2 160^\circ} + \sin 160^\circ \cdot \cos(-20^\circ) \cdot \tan 250^\circ = 1$$

- (b) Simplify :

$$\frac{\sin(360^\circ - x) \cdot \tan(-x) \cdot \sec(90^\circ - x)}{\cos(360^\circ + x) \cdot \operatorname{cosec}(x - 180^\circ) \cdot \cot^2(90^\circ + x)}$$

[9 marks]

TOTAL [100 Marks]