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

DATE: 13 October 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

Expand completely using the Binomial theorem, i.e.

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

(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 :

$x^2 + 2x + y^2 - 6y = 6$ (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)

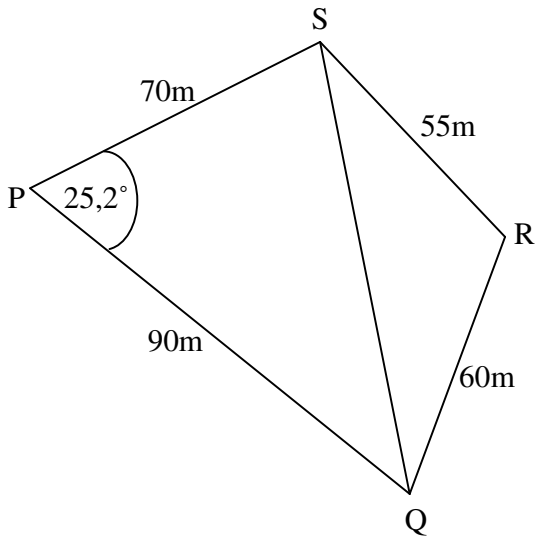
[17 marks]

QUESTION 6

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

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

(b)



In the above diagram, PQRS is a quadrilateral with PS = 70m, PQ = 90m, SR = 55m, QR = 60m and angle P = 25,2°.

Calculate :

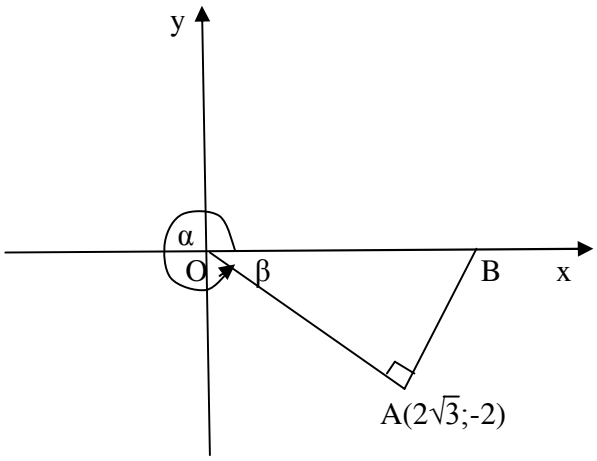
(i) the area of triangle PQS

(ii) the length of QS

(iii) the size of angle R if SQ = 40m (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 = α is a reflex angle, and B is a point on the x-axis so that angle OAB = 90°.

Calculate :

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

[11 marks]

QUESTION 8

(a) Prove that :

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

(b) Simplify :

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

[9 marks]

TOTAL [100 Marks]