BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

MATHEMATICS **0563/03**

Paper 3 **October/November 2018**

2 hours 30 minutes

Additional materials: Answer paper
Electronic calculator
Geometrical instruments
Graph paper (2 sheets)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

510

Write your answers on the separate answer paper provided.

Start each question on a fresh side of the page.

Write your Centre number, candidate number and name on each sheet of answer paper you use.

Answer **all** questions.

All working must be clearly shown. The working should be done on the same sheet as the rest of the answer. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

At the end of the examination, fasten all your work securely together using the string provided.

Do not use staples, paper clips, highlighters, glue or correction fluid.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total of the marks for this paper is 125.

Electronic calculators may be used.

If the degree of accuracy is not specified in the question and if the answer is not exact, the answer should be given to three significant figures. Answers in degrees should be given to one decimal place.

In any question where the value of π is required, use the value from your calculator or take π as 3.142.

A007

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Mathematical formulae for paper 3

Surface area and volume of solids

Name of solid	Total surface area	Volume
cone	$\pi r^2 + \pi rl$	$\frac{1}{3}\pi r^2 h$
pyramid		$\frac{1}{3}$ base area x height
sphere	$4\pi r^2$	$\frac{4}{3}\pi r^3$

Trigonometry

Sine Rule $\quad \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Area of a triangle $\quad = \frac{1}{2}ab\sin C$

Cosine Rule $\quad a^2 = b^2 + c^2 - 2bc\cos A$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

Statistics

$$\text{Variance} = \frac{\Sigma(x-\bar{x})^2}{n}, \quad \frac{\Sigma f(x-\bar{x})^2}{\Sigma f}$$

$$\text{Standard deviation (SD)} = \sqrt{\text{Variance}} = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n}}, \quad \sqrt{\frac{\Sigma f(x-\bar{x})^2}{\Sigma f}}$$

$$\text{or} \quad \sqrt{\frac{\Sigma x^2}{n} - (\bar{x})^2}, \quad \sqrt{\frac{\Sigma fx^2}{\Sigma f} - (\bar{x})^2}$$

1 In an athletics championship, athletes competed in track and field events.

(a) Mike competed in the marathon race which started at 17 05. He took 2 hours 39 minutes to complete the race.

At what time did he complete the race? [2]

(b) The women's high jump championship record is 2.01 m. Jeanine won the women's high jump category by a jump which is 97% of the championship record.

Calculate Jeanine's jump. [2]

(c) Each event has men's and women's categories. In each event, athletes who got positions one, two and three won Gold, Silver and Bronze medals respectively.

(i) Calculate the total number of medals won in the marathon race and high jump events. [2]

(ii) The total number of medals won in the marathon race and the high jump events is 10% of the total number of medals won at the championship.

Calculate the total number of medals won at the championship. [3]

(iii) How many events were there at the athletics championship? [2]

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2 The radius of a sphere is 8.1 cm, correct to 1 decimal place.

(a) Write down the upper bound of the radius of the sphere. [1]

(b) Calculate the maximum possible volume of the sphere. [2]

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3 The first four terms of a sequence are 98, 94, 88 and 80.

(a) What is the

(i) next term, [1]

(ii) expression for the nth term of the sequence? [3]

(b) Calculate the

(i) 50^{th} term, [2]

(ii) value of n for which the nth term is -500. [3]

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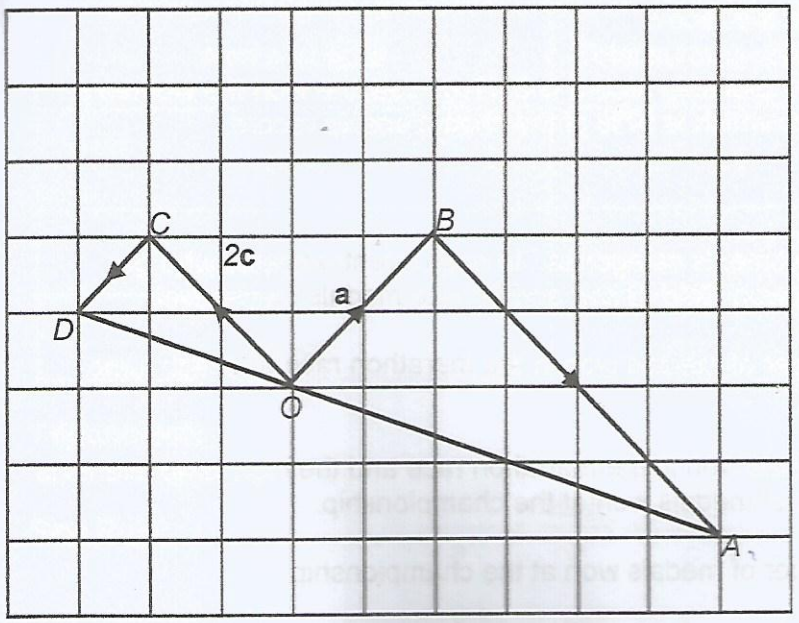
4 The diagram below shows the vectors $\overrightarrow{BA}$, $\overrightarrow{OB}$, $\overrightarrow{OC}$ and $\overrightarrow{CD}$. OC is parallel to BA and OB is parallel to CD. The position vector $\overrightarrow{OB} = \mathbf{a}$ and the position vector $\overrightarrow{OC} = 2\mathbf{c}$.



(a) Express in terms of **a** and/or **c**

(i) $\overrightarrow{CD}$, [1]

(ii) $\overrightarrow{OD}$, [2]

(iii) $\overrightarrow{AO}$. [2]

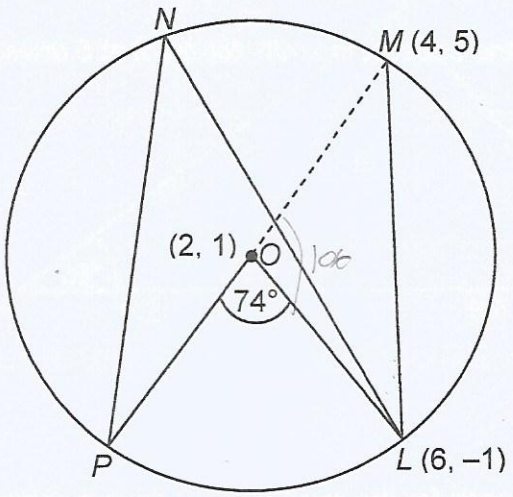
(b) What is the geometrical relationship between triangle ABO and triangle OCD. [1]

(c) State the ratio of $AB : OC$. [1]

(d) The sum of the areas of triangles ABO and OCD is $198\,m^2$.

Calculate the area of triangle ABO. [3]

5 The diagram below shows points L, M, N and P on the circumference of a circle, centre O. The coordinates of points L, M and O are (6, –1), (4, 5) and (2, 1) respectively. The size of angle $LOP = 74°$.



(a) Calculate

(i) the distance LM, [2]

(ii) the coordinates of point P. [2]

(b) State, with a reason, the size of $P\hat{N}L$. [2]

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6 **Answer the whole question on a sheet of graph paper.**

Using a scale of 1 cm to represent 1 unit on each axis, draw a pair of axes from $-7 \leq x \leq 7$ and $-7 \leq y \leq 7$.

(a) Draw and label

(i) triangle L with vertices (–6, 0), (–4, 1) and (–6, 4), [1]

(ii) triangle M with vertices (–2, –6), (–3, –4) and (–6, –6). [1]

(b) Describe fully the single transformation that maps triangle L onto triangle M. [3]

(c) Triangle N is an image of triangle L under an enlargement of scale factor –2, centre (–2, 2).

Draw and label the image N. [2]

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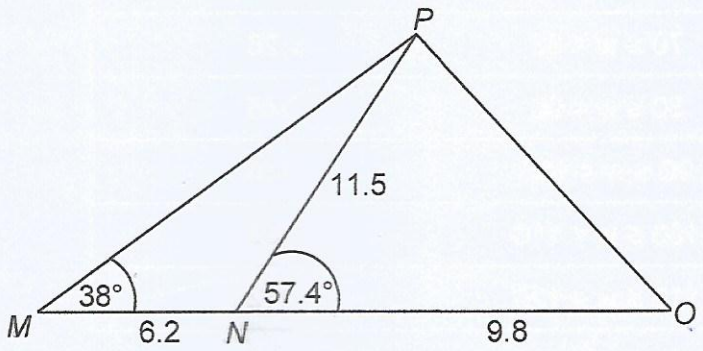
8 The diagram below shows two adjacent triangles MNP and NOP. The length $MN = 6.2$ m, $NO = 9.8$ m and $NP = 11.5$ m. The size of $P\hat{N}O = 57.4°$ and the size of $P\hat{M}N = 38°$.



Calculate

(a) the size of $M\hat{N}P$, [1]

(b) MP, [3]

(c) OP, [4]

(d) the shortest distance of N from MP. [2]

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9 Tawa needs face bricks and stock bricks to build a house.
The cost of a face brick is Px and the cost of a stock brick is Py.

(a) Tawa buys 800 face bricks and 650 stock bricks.

Express, in terms of x and y, the total cost of buying the face bricks and the stock bricks. [2]

(b) Tawa pays a total of P2775 for the 800 face bricks and the 650 stock bricks.

Form an equation, in terms of x and y, to show this information. [1]

(c) Tawa buys more face bricks and stock bricks. He pays a total of P1687.50 for 500 face bricks and 375 stock bricks.

Form an equation, in terms of x and y, to show this information. [2]

(d) Solve the equations in parts **(b)** and **(c)** simultaneously. [3]

(e) Calculate the cost of buying 3500 stock bricks. [2]

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10 The table below shows weights, w kg, of 160 rugby players at a tournament.

Weight, w (kg)	Number of players
$70 \leq w < 80$	28
$80 \leq w < 90$	45
$90 \leq w < 100$	40
$100 \leq w < 110$	35
$110 \leq w < 120$	12

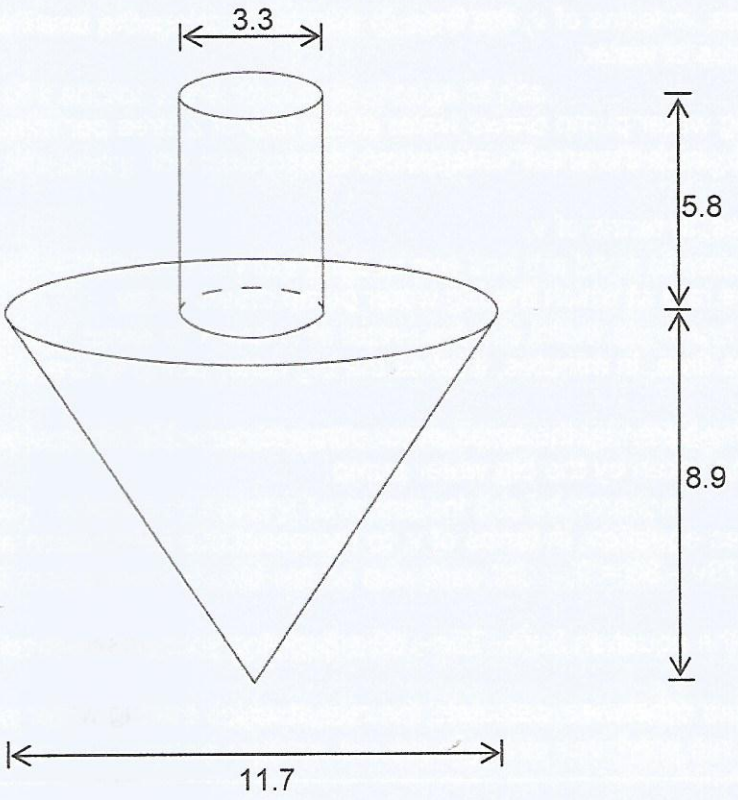
Without drawing the cumulative frequency curve, calculate an estimate of

(a) the lower quartile, [2]

(b) the upper quartile, [2]

(c) the interquartile range. [2]

11 The diagram below represents a wooden toy in the form of a solid cylinder attached to the base of a solid cone. The cylinder is of height 5.8 cm and diameter 3.3 cm. The cone is of height 8.9 cm and diameter 11.7 cm.



(a) The cylindrical part of the toy is painted yellow.

Calculate the area of the part of the toy painted yellow. [3]

(b) The conical part of the toy is painted green.

(i) Show that the base area of the cone painted green is 99.0 cm^2, correct to 3 significant figures. [3]

(ii) Calculate the total area of the part of the toy painted green. [3]

(c) Calculate the volume of wood used to make the toy. [3]

(d) The mass of the toy is 281 g.

Calculate the density of the wooden toy. [2]

12 A small and a big water pump are used to draw water.

(a) The small water pump draws water at the rate of v litres per minute.

Express, in terms of v, the time, in minutes, it takes the small water pump to draw 200 litres of water. [1]

(b) The big water pump draws water at the rate of 2 litres per minute more than 3 times the rate at which the small water pump does.

Express, in terms of v,

(i) the rate at which the big water pump draws water, [1]

(ii) the time, in minutes, it takes the big water pump to draw 200 litres of water. [1]

(c) The time taken by the small water pump to draw 200 litres of water is 5 minutes more than the time taken by the big water pump.

Form an equation, in terms of v, to represent this information and show that it reduces to $3v^2 - 78v - 80 = 0$. [3]

(d) Solve the equation $3v^2 - 78v - 80 = 0$, giving your answers correct to 2 decimal places. [5]

(e) Hence or otherwise, calculate the rate at which the big water pump draws water. [2]

13 Answer the whole question on a sheet of graph paper.

A school bursar has to buy x bags of rice and y bags of maize meal.

(a) A bag of rice costs P105 and a bag of maize meal costs P70.

(i) Express, in terms of x and/or y, the total cost of bags of rice, [1]

(ii) Express, in terms of x and y, the total cost of the bags of rice and the bags of maize meal. [1]

(b) The bursar has a budget of P6300 to buy the bags of rice and the bags of maize meal.

Write down an inequality, in terms of x and y, to represent this information and show that it reduces to $3x + 2y \leq 180$. [2]

(c) She needs at most 10 bags of maize meal less than twice the number of bags of rice.

Write down an inequality, in terms of x and y, to represent this information. [1]

(d) The number of bags of maize meal should not be less than 20.

Form an inequality, in terms of x and/or y, to represent this information. [1]

(e) Using a scale of 2 cm to represent 10 bags of rice and 2 cm to represent 20 bags of maize meal, show, by shading the **unwanted** regions, the set of points satisfying the inequalities in **(b)**, **(c)** and **(d)**. [3]

(f) The school bursar has to buy a total of 50 bags of rice and maize meal.
She can only buy bags of rice in multiples of 5, and bags of maize meal in multiples of 5.

(i) List all the points that show the possible number of ways of buying the bags of rice and maize meal. [2]

(ii) Calculate the minimum amount of money that could be used to buy the 50 bags of rice and maize meal. [2]