BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

MATHEMATICS **0563/03**

Paper 3 **October/November 2017**

2 hours 30 minutes

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

READ THESE INSTRUCTIONS FIRST

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.

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

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

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

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

1 During a festival, a total of 4580 tickets were sold to adults and children. The percentage of tickets sold to children was 15%. Tickets for adults were sold for P175 each and tickets for children were sold for P110 each.

(a) What percentage of tickets were sold to adults? [1]

(b) Calculate

(i) the number of tickets that were sold to adults, [2]

(ii) the total amount of money made from the sale of the tickets. [3]

(c) An amount of P454 107 from the sale of the tickets was shared amongst three charity organisations in the ratio 6 : 3 : 2.

(i) How much money did the charity organisation with the smallest share receive? [2]

(ii) The amount of money received by the charity organisation with the smallest share represents an increase of $17\frac{1}{4}$ % of what they received in the previous festival.

Calculate the amount of money that the organisation received in the previous festival. [3]

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2 The diagrams below show a pattern of squares.

Diagram 1

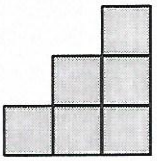

Diagram 2

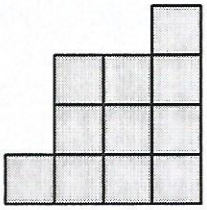

Diagram 3

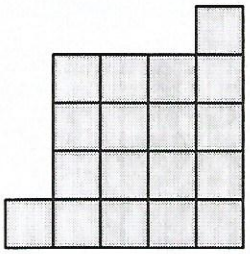

Diagram 4

The table below shows the number of squares in each diagram.

Diagram	1	2	3	4	5	...	...	*n*
Number of squares	3	6	11	18		...	...	

(a) Write down the number of squares in Diagram 5. [1]

(b) Express, in terms of *n*, the total number of squares in Diagram *n*. [3]

(c) Hence or otherwise calculate the number of squares in Diagram 39. [2]

(d) The total number of squares in a diagram is 5331.

What is the diagram number? [3]

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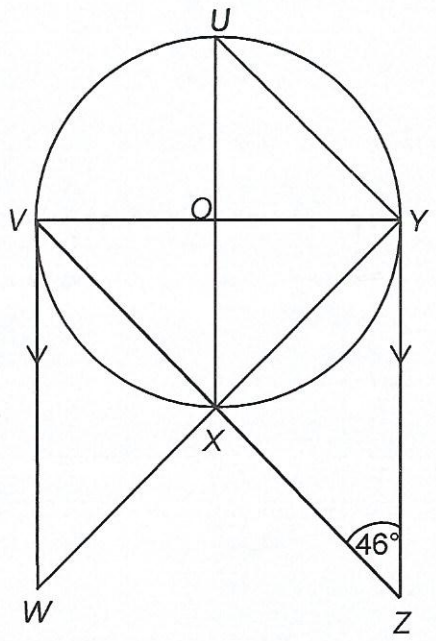
3 The diagram below shows a circle with centre O. The points U, V, X and Y are on the circumference of the circle. The lines VW and YZ are parallel and are tangents to the circle at V and Y respectively. The size of $X\hat{Z}Y = 46°$.



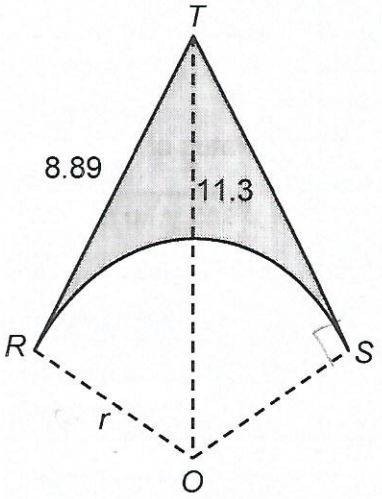
State, with a reason, the size of

(a) $X\hat{V}W$, [2]

(b) $X\hat{V}Y$, [2]

(c) $Y\hat{U}X$. [2]

4 In the diagram below, the shaded region RST is a design of a logo. RS is an arc of a circle with radius $OR = OS = r$ cm. The length of OT is 11.3 cm. TR and TS are tangents of length 8.89 cm.



(a) Write down the size of angle ORT. [1]

(b) Show that the radius, r, is 6.98 cm correct to 3 significant figures. [3]

(c) Calculate the

(i) size of angle ROS, [3]

(ii) area of sector ROS, [2]

(iii) area of the design of a logo. [3]

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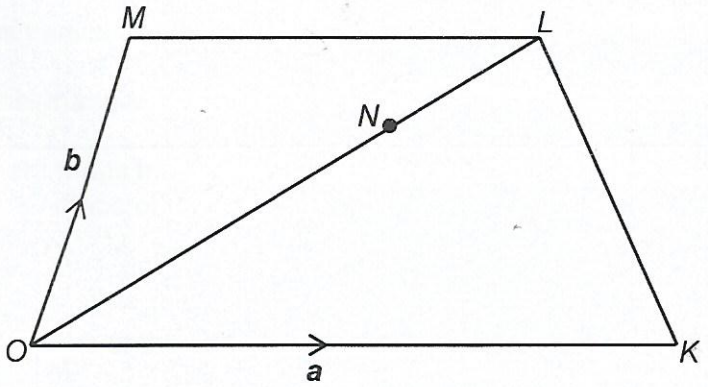
5 The diagram below shows a trapezium $OKLM$. $\overrightarrow{OK} = \mathbf{a}$ and $\overrightarrow{OM} = \mathbf{b}$. $\overrightarrow{OK}$ is twice $\overrightarrow{ML}$. N is a point on OL such that $ON : NL = 5 : 2$.



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

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

(ii) $\overrightarrow{OL}$. [2]

(b) Show that $\overrightarrow{KN} = \frac{5}{7}\boldsymbol{b} - \frac{9}{14}\mathbf{a}$ [3]

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6 A plate of rice costs P15 and a plate of samp costs P19.

(a) Tadwa bought x plates of rice and y plates of samp.

(i) Express, in terms of x and y, the total cost that Tadwa paid for the x plates of rice and the y plates of samp. [2]

(ii) Tadwa paid a total of P930 for the x plates of rice and the y plates of samp.

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

(b) Cain paid a total of P1320 for buying half as many plates of rice and twice as many plates of samp as Tadwa.

Write down an equation, in terms of x and y, to represent this information. [2]

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

(d) How many plates of rice did Cain buy? [1]

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7 A box contains 15 packets of potato chips. 6 packets are of vinegar flavour and 9 packets are of onion flavour.

(a) A packet of potato chips is randomly taken out from the box.

What is the probability, in its simplest terms, that the packet is of onion flavour? [2]

(b) A second packet of potato chips is then randomly taken out from the box.

What is the probability that the packet is of vinegar flavour? [1]

(c) Calculate the probability that the two packets taken out from the box were

(i) both of vinegar flavour, [2]

(ii) of different flavours. [3]

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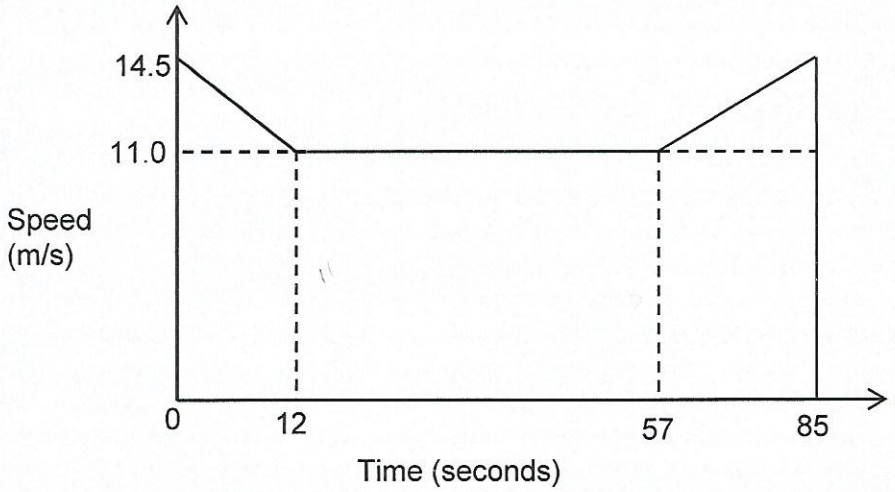
8 The diagram below shows the speed–time graph of a motorbike. The motorbike reduces speed from 14.5 m/s to 11.0 m/s in 12 seconds. It then travels at 11.0 m/s for 45 seconds and accelerates for 28 seconds to regain the speed of 14.5 m/s.



(a) Calculate the acceleration of the motorbike during the first 12 seconds. [2]

(b) Show that the total distance travelled during the 85 seconds is 1005 m. [3]

(c) Calculate the average speed of the motorbike during the 85 seconds. [2]

(d) How many seconds less would the motorbike have taken by travelling the 1005 m at a constant speed of 14.5 m/s? [3]

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

Using a scale of 1 cm to represent 1 unit on each axis, draw the x-axis for $-6 \leq x \leq 10$ and the y-axis for $-6 \leq y \leq 8$.

Triangle PQR has vertices P (−4, 6), Q (−6, 4) and R (−4, 1).

(a) Draw and label triangle PQR. [1]

(b) An enlargement maps triangle PQR onto triangle $P_1Q_1R_1$ such that P maps onto P_1(5, −3) and Q maps onto Q_1 (9, 1).

Write down

(i) the coordinates of the centre of enlargement, [1]

(ii) the scale factor of the enlargement, [1]

(iii) the coordinates of point R_1. [1]

(c) Triangle $P_2Q_2R_2$ is the image of triangle PQR after a rotation of 90° clockwise with centre (−5, −1).

Draw and label triangle $P_2Q_2R_2$. [2]

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10 Peo participated in a 42 km road race in the month of July. He took x hours to complete the race.

(a) Express, in terms of x, Peo's average speed, in km/h, in the road race. [1]

(b) In October, he participated in another 42 km road race. He took 0.18 hrs more than the time taken in July to complete the road race.

Express, in terms of x,

(i) the time, in hours, taken by Peo to complete the race, [1]

(ii) Peo's average speed, in km/h, in October. [1]

(c) Peo's average speed in October was 1 km/h less than his average speed in July.

Form an equation, in x, for this information and show that it reduces to $50x^2 + 9x - 378 = 0$. [3]

(d) Solve the equation $50x^2 + 9x - 378 = 0$, giving the answers correct to 2 decimal places. [5]

(e) How long did Peo take to complete the race in October? [2]

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11 The table below shows the distribution of height, h mm, of 123 seedlings in a garden.

Height, h (mm)	Frequency
$0 < h \leq 5$	9
$5 < h \leq 10$	6
$10 < h \leq 20$	48
$20 < h \leq 35$	60

(a) **(i)** Write down the mid-value of the class $0 < h \leq 5$. [1]

(ii) Calculate an estimate of the mean height of the seedlings. [3]

(b) Without drawing a cumulative frequency curve, calculate an estimate of the

(i) lower quartile, [2]

(ii) upper quartile, [2]

(iii) interquartile range of the height of the seedlings. [2]

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12 Answer the whole of this question on a sheet of graph paper.

In a term, a school collects P2800 from each pre-school pupil and P4900 from each lower primary school pupil as tuition fee.

(a) There are x pre-school pupils and y lower primary school pupils in the term.

Express, in terms of x and/or y, the

(i) amount of money the school collects from pre-school pupils, [1]

(ii) amount of money the school collects from lower primary school pupils, [1]

(iii) total amount of money the school collects from pre-school pupils and lower primary school pupils in the term. [1]

(b) The total amount of money that the school collects from pre-school pupils and lower primary school pupils is at least P1 372 000 in the term.

Write down an inequality, in terms of x and/or y, to represent this information and show that it reduces to $4x + 7y \geq 1960$. [2]

(c) The total number of pre-school pupils and lower primary school pupils that the school collects tuition fee from is not more than 410.

Write down an inequality, in terms of x and y, to represent this information. [2]

(d) The school collects tuition fee from at most 240 lower primary school pupils.

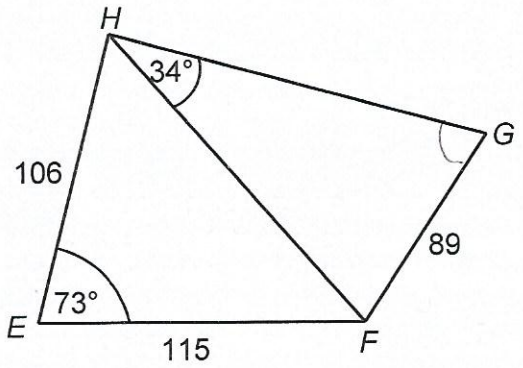
Write down an inequality to represent this information. [1]

(e) Using a scale of 2 cm to represent 100 units on each axis, show, by shading the unwanted regions, the set of points that satisfy the three inequalities in **(b)**, **(c)** and **(d)**. [3]

(f) **(i)** Determine the number of pre-school pupils and lower primary school pupils for which the school would collect the maximum amount of money. [2]

(ii) Calculate the maximum amount of money the school collects. [2]

13 The diagram below represents a farm *EFGH* in the form of a quadrilateral. The farm is partitioned into two triangular paddocks, *EFH* and *FGH*, through diagonal *FH*. *EF* = 115 m, *EH* = 106 m and *FG* = 89 m. The size of angle *FEH* = 73° and the size of angle *FHG* = 34°.



(a) Show that the length of the diagonal *FH* = 132 m. [4]

(b) Calculate the size of the acute angle *FGH*. [3]

(c) An area of 245 m^2 in the triangular paddock *EFH* is to be used for gardening.

Calculate the area of the paddock *EFH* that will not be used for gardening. [3]