student BGCSE exam Past Paper Booklet Mathematics

THE STUDENT SHED
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BGCSE Mathematics
Year 2016
Papers 1, 2, & 3
MATHEMATICS

PAPER 1 (CORE/EXTENDED) 3815/1

Tuesday 17 MAY 2016 1:00 P.M.–2:30 P.M.

Additional materials:
Calculator (not graphing)
Geometrical instruments

MINISTRY OF EDUCATION
NATIONAL EXAMINATIONS
BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

INSTRUCTIONS TO CANDIDATES

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Answer ALL questions in the spaces provided for each question.

ALL working must be shown.

ALL working must be done in blue or black ink, except for drawings, lines and constructions which may be done in pencil.

INFORMATION FOR CANDIDATES

Calculators [NOT GRAPHING CALCULATORS] may be used.

Tracing paper may be used.

Geometrical instruments are required.

The mark for each question, or part question, is shown in brackets [ ].

The total number of marks for this paper is 100.

This question paper consists of 13 printed pages and 3 blank pages.
INFORMATION AND FORMULAE

Angle sum of triangle \[ a + b + c = 180^\circ \]

Area of rectangle = base \times height

Angle sum of quadrilateral \[ a + b + c + d = 360^\circ \]

Area of triangle = \[ \frac{\text{base} \times \text{height}}{2} \]

Volume of cuboid = length \times width \times height

Circumference of circle = \( 2\pi r \) or \( \pi d \)

Area of circle = \( \pi r^2 \)
1. At a weather station, a balloon is released every 6 hours, day and night. Calculate the number of balloons that are released in one week.

Answer: ___________________________ [2]

2. Given that $x = 7$ and $y = -4$, calculate the value of $x^2 + 3y$.

Answer: ___________________________ [3]

3. Calculate the remainder when the sum of 486 and 985 is divided by 83.

Answer: ___________________________ [3]

4. Simplify

$19 - 2(3 + 9) ÷ 4$

Answer: ___________________________ [3]
5. On the diagram below, draw in all the lines of symmetry.

6. *Coffee Break* prepares a blend of coffee containing Arabica beans and Brazil beans in the ratio 4 : 3.

(a) Calculate the weight of Arabica beans in a blend of 455 g.

Answer: ____________________________ g [2]

*Coffee Break* has placed an order of 150 kg of Brazil beans.

(b) Calculate the weight of Arabica beans to be ordered to make their blend.

Answer: ____________________________ kg [2]
9. Mr. Rolle attended a tourist conference session beginning at 8:45 a.m. and ending at 11:05 a.m.
(a) How long was the session?

Answer: ______________________________ hr [2]

Mr. Rolle then had a 55 minute lunch break.
(b) At what time did the lunch break end?

Answer: ______________________________ [2]

10. A power boat in a *Formula 2* race has an average speed of 165 km per hour.

Calculate
(a) the distance, in km, that the boat travelled in a race of $1 \frac{2}{3}$ hours,

Answer: ______________________________ km [2]

(b) the time, in minutes, to travel a lap of 5.5 km.

Answer: ______________________________ mins [3]
Cassandra needs to determine the weight of her two dogs, Mimi and Mitzi. However, neither dog will sit on the scale by herself. Cassandra, Mimi and Mitzi altogether weigh 175 pounds. Cassandra and Mimi together weigh 143 pounds. Cassandra and Mitzi together weigh 139 pounds.

Calculate:

(a) the weight of Mitzi,

Answer: ______________ lbs [2]

(b) the weight of Mimi,

Answer: ______________ lbs [2]

(c) the weight of Cassandra.

Answer: ______________ lbs [2]
13. (a) Complete the following conversions:

(i) \( 5400 \text{ ml} = \quad \) \( \text{l} \) \[1\]

(ii) \( 0.35 \text{ g} = \quad \) \( \text{mg} \) \[1\]

(iii) \( 685 \text{ cm} = \quad \) \( \text{m} \) \[1\]

(b) \text{Java Coffee Shop} purchases coffee beans in bags of 13.2 kg. The shop then sells this coffee in packages of 220 g. Calculate the number of packages that can be filled from one bag of coffee beans.

Answer: \[3\]

14. The diagram shows a sector of a circle with an angle of 90° and radius of 10 cm. A segment of the circle is shaded.

Calculate

(a) the area of the triangle,

Answer: \( \quad \) \( \text{cm}^2 \) \[2\]

(b) the area of the sector of the circle (use \( \pi = 3.14 \)),

Answer: \( \quad \) \( \text{cm}^2 \) \[3\]

(c) the area of the shaded segment.

Answer: \( \quad \) \( \text{cm}^2 \) \[2\]
15. In a survey, people were asked which of three newspapers they read. The incomplete table below shows the results of this survey.

<table>
<thead>
<tr>
<th>Newspaper</th>
<th>Number of People</th>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Daily</td>
<td>60</td>
<td>120°</td>
</tr>
<tr>
<td>The Sun</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>The Press</td>
<td></td>
<td>140°</td>
</tr>
</tbody>
</table>

(a) Calculate

(i) the angle representing The Sun.

Answer: ______________________ ° [2]

(ii) the number of people who read The Press.

Answer: ______________________ [3]

(b) With a protractor and ruler, use the information from (a) to complete the pie chart below.
The shoe store for men sold 8 pairs of shoes. The shoe sizes sold were:

\[ 8\frac{1}{2}, 10\frac{1}{2}, 9, 10\frac{1}{2}, 7, 6, 10, 10\frac{1}{2} \]

(a) Calculate

(i) the mean of the shoe sizes,

Answer: \[ \text{[2]} \]

(ii) the median shoe size.

Answer: \[ \text{[3]} \]

(b) Write down the modal shoe size.

Answer: \[ \text{[1]} \]

(c) Write down the measurement that is most useful to the store manager.

Answer: \[ \text{[1]} \]
17. Simplify
   (a) \( \frac{1}{2}(3 - 2x) \)
   Answer: ___________________________ [2]
   (b) \( 19s - 6t - s + 5t \)
   Answer: ___________________________ [2]
   (c) \( 5w \times w^3 \times 3 \)
   Answer: ___________________________ [2]
   (d) \( 24p^7 \div 3p^2 \)
   Answer: ___________________________ [2]

18. (a) Restaurants add a gratuity of 15% to the diner’s bill. Calculate the gratuity for a bill of $67.50, giving your answer to the nearest cent.

   Answer: $_________________________ [3]

   (b) The regular price of a purse is $159. The sale price is $106. Calculate the percentage saving.

   Answer: ___________________________ % [3]

   (c) A savings account earns interest of 2.5% per year. Calculate the interest earned on $840 in 6 months.

   Answer: $_________________________ [3]
19. Linda is paid $12.40 per hour for the first 36 hours of a regular work week. Overtime is paid at time and a half. This week she worked 42 hours.

(a) Calculate her earnings for

(i) the regular 36 hours worked,

Answer: $ ___________________________ [1]

(ii) one hour overtime,

Answer: $ ___________________________ [2]

(iii) her total earnings for this week.

Answer: $ ___________________________ [3]

Last week Linda’s total earnings were $465. The employee National Insurance contribution was 3.4% of the total earnings.

(b) Calculate

(i) her National Insurance contribution for last week,

Answer: $ ___________________________ [2]

(ii) her net earnings.

Answer: $ ___________________________ [1]
MATHEMATICS
PAPER 2 (CORE/EXTENDED) 3815/2

Wednesday 18 MAY 2016 9:00 A.M.–11:00 A.M.

Additional materials:
Calculator (not graphing)
Geometrical instruments
Answer booklet
Graph paper

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INFORMATION AND FORMULAE

MENSURATION

Parallelogram

Triangle

Trapezium

Area = bh

Area = \( \frac{1}{2}bh \)

Area = \( \frac{1}{2}(a + b)h \)

Circle (radius \( r \), diameter \( d \))

Circumference = \( 2\pi r \) or \( \pi d \)

Area = \( \pi r^2 \)

Cylinder (radius \( r \), height \( h \))

Volume = \( \pi r^2 h \)

Prism

e.g. triangular prism

Volume = area of cross-section \( \times \) length

TRIGONOMETRY

Right-angled triangle

\( r^2 = x^2 + y^2 \), (result of Pythagoras)

\( \sin A = \frac{\text{opposite}}{\text{hypotenuse}} \), \( \cos A = \frac{\text{adjacent}}{\text{hypotenuse}} \), \( \tan A = \frac{\text{opposite}}{\text{adjacent}} \)

NUMBER

Standard form is \( a \times 10^n \) where \( 1 \leq a < 10 \) and \( n \) is an integer.
1. Express this ratio in its simplest form.

\[
\frac{96 \text{ cm}}{2.4 \text{ m}}
\]

[2]

2. Light travels at \(1.86 \times 10^5\) miles per second. Calculate how far it travels in a minute, giving your answer in scientific notation (standard form).

[2]

3. Solve \(\frac{x}{3} - \frac{7}{12} = \frac{x}{4}\)

[4]

4. (a) Solve the inequality \(9 + 11x < 42\)

[2]

(b) Write down the solution set of natural numbers that satisfy the inequality in (a).

[2]

5. Evaluate

   (a) \(5^3\)

   [1]

   (b) \(9^0\)

   [1]

   (c) \((2^3)^2\)

   [1]

   (d) \(4^{-2}\)

   [1]

6. Jerry had $100. He went to a Computer Store, a Book Store and a Music Store. He spent three times as much money in the Computer Store as he did at the Music Store. He spent $12 less at the Book Store than at the Music Store. He then had $37 left.

   (a) Using \(x\) to represent the amount he spent at the Music Store, express in terms of \(x\),

      (i) the amount spent at the Computer Store,

      [1]

      (ii) the amount spent at the Book Store.

      [1]

   (b) Form an equation in terms of \(x\) for the total amount of money spent.

      [1]

   (c) Solve the equation formed in (b) to determine the amount of money spent at the Music Store.

      [2]
7. Solve the following pair of simultaneous equations

\[ y = \frac{3}{2}x \]
\[ 3x + 2y + 4 = 0 \]

8. (a) Using a ruler, compass and pencil only, construct and label \( \triangle ABC \) such that \( AB = 11.2 \text{ cm}, AC = 9 \text{ cm} \) and \( \angle CAB = 60^\circ \).

(b) Measure and write down the size of \( \angle ABC \).

9. (a) \( AB \) is a diameter of the circle \( ABC \) with centre \( O \). \( AD \) is a tangent to the circle at \( A \). \( \angle ADC = 56^\circ \).

\[ \begin{array}{c}
\text{NOT TO SCALE} \\
\end{array} \]

Calculate

(i) \( \angle BCA \),

(ii) \( \angle ABD \),

(iii) \( \angle CAD \).

(b) Each interior angle of a regular polygon is \( 165^\circ \).

Calculate

(i) the size of each exterior angle,

(ii) the number of sides of the polygon.
10. Use the formula $Q = 3t^2 - 5th$ to
(a) calculate the value of
   (i) $Q$ when $t = 7$ and $h = 6$, [2]
   (ii) $h$ when $Q = 332$ and $t = 16$, [3]
(b) make $h$ the subject of the formula. [2]

11. The diagram represents a triangular prism of length 19 cm. The triangular cross-section has sides of length 10 cm, 11.3 cm and 14 cm, and a height of 8 cm.

   Calculate
(a) the area of the cross-section, [2]
(b) the volume of the prism, [2]
(c) the total surface area of the prism. [3]
12. \( \mathcal{E} = \{\text{positive numbers less than 30}\} \)
\( L = \{\text{positive multiples of 2 less than 30}\} \)
\( M = \{\text{positive multiples of 3 less than 30}\} \)
\( N = \{\text{positive multiples of 5 less than 30}\} \)

(a) List the elements of

(i) \( L \), 
(ii) \( M \), 
(iii) \( N \), 
(iv) \( L \cap N \), 
(v) \( M' \cap N \).

(b) Determine \( n(L \cup N) \).

(c) Describe the set \( L \cap M \) in a similar manner as the descriptions given for the sets \( L, M \) and \( N \).

13. (a) Factorise completely

\[ 12pq^2 + 3p - 6p^2q \]

(b) Simplify

(i) \( \left(\frac{5m}{n^3}\right)^2 \)

(ii) \( 13 - 3(t + 5) + 4t \)
14. The diagram shows transmission tower $TB$ of height $25.2\, \text{m}$ topped with an antenna $AT$. The point $C$ is $18.9\, \text{m}$ from $B$ and the angle of elevation at $C$ to the top of the antenna is $56^\circ$.

Calculate, giving your answer correct to one decimal place,

(a) the length of $TC$, [3]

(b) the angle, $BTC$, [3]

(c) the height of the antenna, $AT$. [4]
15. **ANSWER THIS ENTIRE QUESTION ON THE GRAPH PAPER PROVIDED.**

(a) Copy and complete the following table for the graph of \( y = \frac{2x-1}{3} \).

<table>
<thead>
<tr>
<th>( x )</th>
<th>-7</th>
<th>-2.5</th>
<th>-1</th>
<th>2</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>-5</td>
<td>-1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Using a scale of 1 cm to 1 unit for each axis, and values \(-8 \leq x \leq 10\) and \(-8 \leq y \leq 10\), draw the graph of the line \( y = \frac{2x-1}{3} \).

(c) Calculate the gradient (slope) of your graph in (b).

(d) Another graph has the equation \( y = 3 \). Draw this graph on the same coordinate plane.

(e) Write down the gradient (slope) of the graph in (d).

(f) Write down the coordinates of the point where the graphs intersect.
16. **ANSWER THIS ENTIRE QUESTION ON THE GRAPH PAPER PROVIDED.**

(a) Using a scale of 1 cm to represent 1 unit on each axis, taking values of $x$ from $-8 \leq x \leq 10$ and values of $y$ from $-8 \leq y \leq 10$, copy and draw the above quadrilateral $A$. [3]

(b) Draw the image of quadrilateral $A$ after a rotation of $180^\circ$ about the origin. Label it $B$. [2]

(c) Translate quadrilateral $A$ by $\left(\frac{1}{-5}\right)$. Label the image $C$. [2]

(d) Reflect quadrilateral $A$ in the line $x = -1$. Label the image $D$. [2]

(e) Enlarge quadrilateral $A$ by a scale factor of 2 through the origin. Label the image $E$. [2]
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<th>Candidate No.</th>
<th>Level:</th>
<th>For Examiner’s Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Paper:</td>
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</tr>
<tr>
<td>Subject Number &amp; Title:</td>
<td></td>
<td>Section:</td>
<td></td>
</tr>
<tr>
<td>Surname &amp; Initials:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signature:</td>
<td>Date:</td>
<td>Qu. No.</td>
<td></td>
</tr>
</tbody>
</table>
**INFORMATION AND FORMULAE**

**MENSURATION**

<table>
<thead>
<tr>
<th>Shape</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallelogram</td>
<td>Area = $bh$</td>
</tr>
<tr>
<td>Circle (radius $r$, diameter $d$)</td>
<td>Circumference = $2\pi r$ or $\pi d$</td>
</tr>
<tr>
<td>Cylinder (radius $r$, height $h$)</td>
<td>Volume = $\pi r^2 h$</td>
</tr>
<tr>
<td>Sphere (radius $r$)</td>
<td>Area of curved surface = $4\pi r^2$</td>
</tr>
<tr>
<td>Prism</td>
<td>Volume = area of cross-section $\times$ length</td>
</tr>
<tr>
<td>Pyramid</td>
<td>Volume = $\frac{1}{3}$ area of base $\times$ height</td>
</tr>
<tr>
<td>Cone (radius $r$, height $h$)</td>
<td>Area of curved surface = $\pi r s$ where $s$ = slant height $\sqrt{h^2 + r^2}$</td>
</tr>
</tbody>
</table>

**TRIGONOMETRY**

Right-angled triangle

\[ r^2 = x^2 + y^2 \] (result of Pythagoras)

\[ \sin A = \frac{\text{opposite}}{\text{hypotenuse}}, \cos A = \frac{\text{adjacent}}{\text{hypotenuse}}, \tan A = \frac{\text{opposite}}{\text{adjacent}} \]

Any triangle

In any triangle $ABC$:

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

\[ a^2 = b^2 + c^2 - 2bc \cos A \]

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

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

**NUMBER**

Standard form is $a \times 10^n$ where $1 \leq a < 10$ and $n$ is an integer.

**ALGEBRA**

The quadratic equation $ax^2 + bx + c = 0$ has solutions

\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

The determinant of matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ is $ad - bc$.

The inverse of $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ is $\frac{1}{ad - bc} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

If $y = ax^n$, then $\frac{dy}{dx} = anx^{n-1}$
1. In the diagram, the line $DE$ is tangent to the circle $ABC$ at the point $B$.

$AC = BC$ and $\angle ABD = 62^\circ$.

Calculate the value of

(a) $\angle ACB$. [1]  
(b) $\angle BAC$. [1]  
(c) $\angle CBE$. [1]

2. In the formula $\frac{k}{x^3}$, $k$ is a constant. If $y = 4$ when $x = 6$, calculate

(a) the value of $k$, [2]  
(b) the value of $y$ when $x = 4$. [2]

3. (a) Simplify $(16b^8)^{\frac{3}{4}}$. [2]  
(b) Solve for $x$ $9^{2x} = 27$. [3]
4. The estimated number of tourist arrivals for this year is 5.355 million. This is an increase of 5\% from last year.

(a) Calculate the number of tourist arrivals for last year. \[\text{[2]}\]

The projected number of tourist arrivals for next year is 5.5692 million.

(b) Calculate the projected percentage increase for tourist arrivals. \[\text{[3]}\]

5. (a) For the following matrix equation, solve for \(k, m\) and \(n\).
\[
\begin{pmatrix} m & 0 \\ 1 & 4 \end{pmatrix} + k \begin{pmatrix} 0 & 3 \\ -2 & 1 \end{pmatrix} = \begin{pmatrix} 3 & 12 \\ n & 8 \end{pmatrix}
\]
\[\text{[3]}\]

(b) Given that the matrix \(\begin{pmatrix} x & 1 \\ 2 & 3 \end{pmatrix}\) does not have an inverse, calculate the value of \(x\). \[\text{[3]}\]

6. \(\overrightarrow{OA}\) and \(\overrightarrow{OB}\) are position vectors relative to the origin \(O\). Given the points \(A(7, -15)\) and \(B(-2, 3)\),

(a) write down the column vectors \(\overrightarrow{OA}\) and \(\overrightarrow{OB}\), \[\text{[2]}\]

(b) express \(\overrightarrow{AB}\) as a column vector, \[\text{[2]}\]

(c) calculate \(|\overrightarrow{AB}|\), the magnitude of \(\overrightarrow{AB}\). \[\text{[2]}\]

7. Given that \(h(t) = 7 - 5t\) and \(k(t) = \frac{4 + t}{3}\), calculate

(a) the value of \(h(3)\), \[\text{[1]}\]

(b) \(t\) where \(k(t) = 9\), \[\text{[2]}\]

(c) a simplified expression for \(kh(t)\), \[\text{[2]}\]

(d) \(k^{-1}(t)\). \[\text{[2]}\]
8. (a) Express as a fraction in simplest form.

\[
\frac{3}{x-1} - \frac{2}{3-x}
\]

(b) Solve for \(x\).

\[
\frac{1}{x} - \frac{1}{2x} + \frac{1}{3x} = \frac{2}{3}
\]

9. For the quadrilateral \(ABCD\), \(AB = 51\) cm, \(AD = 102\) cm and \(AC = 93\) cm. \(\angle ABC = 114^\circ\) and \(\angle CAD = 36^\circ\).

Calculate, giving your answer to the nearest whole number,

(a) the length of \(CD\).

(b) the angle \(\angle ACB\).
10. In a club with 30 members, 18 are girls, 6 are left-handed and 3 are left-handed boys. The table is to show the number of members in each category.

<table>
<thead>
<tr>
<th></th>
<th>Left-handed</th>
<th>Right-handed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Boys</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

(a) Copy and complete the table. [2]

(b) A member is chosen at random. Use your table to calculate the probability that the member is

(i) left-handed, [1]
(ii) a boy, [1]
(iii) a girl and right-handed. [1]

(c) The president of the club is right-handed. Calculate the probability that the president is a boy. [2]

(d) Two members are chosen, one after the other, to represent the club. Calculate the probability that they are

(i) both right-handed, [2]
(ii) a boy and a girl, in any order. [3]
11. **ANSWER THIS ENTIRE QUESTION ON THE GRAPH PAPER PROVIDED.**

The following is an incomplete table of values for the graph of $y = 3 + \frac{2}{x}$.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0.4</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>4.5</td>
<td>4</td>
<td>3.7</td>
<td>3.4</td>
<td>3.3</td>
</tr>
</tbody>
</table>

(a) Calculate

(i) the missing $y$ value. 

(ii) the missing $x$ value. 

(b) Using a scale of 2 cm to 1 unit on each axis for $0 \leq x \leq 7$ and $0 \leq y \leq 9$, draw the graph of $y = 3 + \frac{2}{x}$. 

(c) Using the same scale and axes, draw the graph of $y = 7 - x$. 

(d) From your graph, estimate the values of $x$ where the curve and line intersect.
A manufacturing company ships material in quantities of 8000 cm³ by volume. The material is shipped in cubic packaging as shown.

(a) For this cube, calculate

(i) the length of a side, [2]

(ii) the surface area. [2]

In the interests of economy, it was found that it would be cheaper to use cylindrical packaging as shown.

(b) For this cylinder, calculate, using \( \pi = 3.14 \) where necessary,

(i) the radius (to 1 decimal place), [3]

(ii) the surface area. [4]

(c) Calculate the amount of packaging saved by using the cylindrical form. [1]
13. The general expression for a trinomial is $ax^2 + bx + c$.

(a) Substitute each set of values into the expression, and factorise.

(i) $a = 1, \ b = -5, \ c = 0$ [2]

(ii) $a = 1, \ b = 7, \ c = 10$ [2]

(iii) $a = 2, \ b = 5, \ c = -3$ [2]

(b) When $a = 1$ and $c = -9$, determine the value of $b$ so that the product of the factors of the expression is the difference of squares.
Show your working. [3]

(c) When $a = 1$ and $b = 8$, determine the value of $c$ so that the expression factorises into a perfect square.
Show your working. [3]