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|                  |                |                |                         |                   |
|------------------|----------------|----------------|-------------------------|-------------------|
| Name :           |                | Index No :     | Class :                 | Calculator Model: |
| Expected Grade : | Actual Grade : | Marks Awarded: | /50 Parent's Signature: |                   |



**NORTHLAND SECONDARY SCHOOL**  
*Motivated Learners, Assets to Community*  
*Nurturing Minds, Shaping Character, Strengthening Vigour*

| MID YEAR EXAMINATION 2014           |                        |
|-------------------------------------|------------------------|
| Subject : MATHEMATICS               | Paper: 1               |
| Level : Secondary 2 Normal Academic | Date: 14 May 2014      |
| Setter : Mr. Wong Foh Peng          | Duration : 1 hr 15 min |
| Vetter: Mrs. Chang Ying Ying        | Time: 0900-1015        |

**READ THESE INSTRUCTIONS FIRST**

Write your name, index number, class and calculator model at the top of the page.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

Answer **all** questions.

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

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

The total marks for this paper is 50.

You are expected to use a scientific calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For  $\pi$ , use either your calculator value or 3.142.

**For Examiner's Use**

|  |  |
|--|--|
|  |  |
|--|--|

This paper consists of **12** printed pages including the cover page

1 (a) Evaluate  $10 + 2(10 - \frac{10}{3})$ .

Answer (a) \_\_\_\_\_ [1]

(b) Evaluate  $\frac{7 - \sqrt{41}}{(3.142)^2}$ , leaving your answer correct to 2 significant figures.

Answer (b) \_\_\_\_\_ [1]

- 2  $\frac{2}{5}$  of the children in class walk to school,  $\frac{1}{3}$  of the remaining children travel by bus and the rest travel by car. What fraction travel by car?

Answer \_\_\_\_\_ [2]

3 Express

- (a)  $127\frac{1}{2}\%$  as a fraction in its lowest term.

Answer (a) \_\_\_\_\_ [1]

- (b)  $\frac{7}{17}$  as a decimal.

Answer (b) \_\_\_\_\_ [1]

- 4 (a) The temperature outside a building is  $-17^{\circ}\text{C}$ . The temperature inside the building is  $27^{\circ}\text{C}$  higher. What is the temperature inside the building?

Answer (a) \_\_\_\_\_  $^{\circ}\text{C}$  [1]

- (b) By rounding each number to 1 significant figure, estimate the value of

$$\frac{64.93 \times 8.65}{2.98}$$

2.98

You must show your working.

Answer (b) \_\_\_\_\_ [2]

- 5 (a) A sum of money is divided in the ratio 7 : 5.  
The larger part is \$19.60.  
Find the smaller part.

Answer (a) \$ \_\_\_\_\_ [2]

- (b) Express the ratio 600 ml to 1.85 l in its lowest terms.  
Give your answers in the form  $m : n$ , where  $m$  and  $n$  are integers.

Answer (b) \_\_\_\_\_ [2]

6 60 expressed as a product of its prime factors is  $2^2 \times 3 \times 5$ .

(a) Express 90 as a product of its prime factors.

Answer (a) \_\_\_\_\_ [2]

(b) Find

(i) the highest common factor of 60 and 90,

Answer b(i) \_\_\_\_\_ [1]

(ii) the smallest number that is divisible by both 60 and 90.

Answer b(ii) \_\_\_\_\_ [1]

(iii) the smallest positive integer,  $k$ , such that  $60k$  is a perfect square.

Answer b(iii) \_\_\_\_\_ [1]

7 (a) Simplify  $x^2 + \frac{1}{3}x^2 - \frac{3}{5}x^2$ .

Answer (a) \_\_\_\_\_ [1]

(b) (i) Simplify  $3(y - 2) - (y + 3)$ ,

Answer b(i) \_\_\_\_\_ [2]

(ii) Hence, or otherwise, find the value of  $3(y - 2) - (y + 3)$  when  $y = -4$ .

Answer b(ii) \_\_\_\_\_ [1]

8 (a) Simplify  $\frac{3a}{4} \div \frac{9a^2}{10}$ .

Answer (a) \_\_\_\_\_ [2]

(b) (i) Factorise  $y^2 - 4$ ,

Answer b(i) \_\_\_\_\_ [1]

(ii) Factorise  $y^2 + y - 2$ ,

Answer b(ii) \_\_\_\_\_ [1]

(iii) Hence, simplify  $\frac{3xy}{y^2 - 4} \times \frac{y^2 + y - 2}{6y}$ .

Answer b(iii) \_\_\_\_\_ [1]

- 9 (a) A painting was bought at \$150 and sold, some years later, for \$460.  
Find the percentage increase in its value.

Answer (a) \_\_\_\_\_ % [2]

- (b) Mr Chin sold a computer for \$640. He made a loss of 20% of the price he paid for it. Find the original price of the computer.

Answer (b) \$ \_\_\_\_\_ [2]

- (c) Mr Xu invested \$600 for 4 years at 5.5 % per year simple interest.  
Find the total amount that Mr Xu will get back at the end of the 4 years.

Answer (c) \$ \_\_\_\_\_ [2]

- 10 Tom chooses either an apple, an orange or a pear from a bag.  
The probability that he chooses an apple is 0.4.  
The probability that he chooses an orange is 0.5.

Find the probability that

- (a) he does **not** choose an apple,

Answer (a) \_\_\_\_\_ [1]

- (b) he chooses a pear,

Answer (b) \_\_\_\_\_ [1]

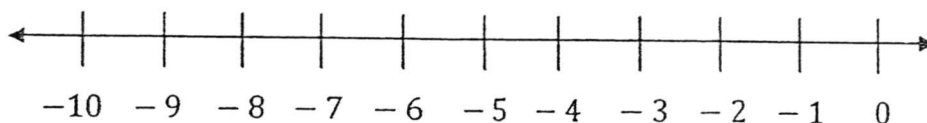
- (c) he chooses a banana.

Answer (c) \_\_\_\_\_ [1]

- 11 (a) Solve the following inequality  $-3a \leq 18$ .

Answer (a) \_\_\_\_\_ [1]

- (b) Illustrate the solution on the number line given below.



[1]

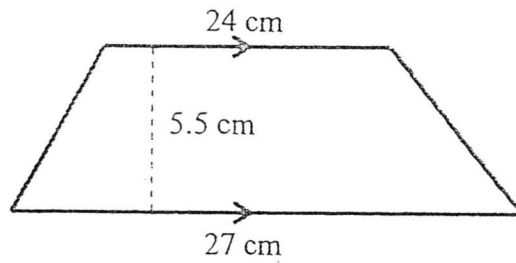
12 (a) Solve the equation  $4x - 7 = 2x + 2$ .

Answer (a)  $x =$  \_\_\_\_\_ [2]

(b) Solve the equation  $\frac{2}{5z-3} = \frac{3}{7z-5}$ .

Answer (b)  $z =$  \_\_\_\_\_ [3]

- 13 The figure below shows a trapezium.



- (a) Find the area of the trapezium.

Answer (a) Area = \_\_\_\_\_  $cm^2$  [2]

- (b) Convert the area of the trapezium from  $cm^2$  to  $m^2$ .

Answer (b) Area = \_\_\_\_\_  $m^2$  [2]

- 14 (a) Find the next two terms in the sequence.

$$1, \quad \frac{1}{4}, \quad \frac{1}{9}, \quad \frac{1}{16}, \quad \dots \quad \dots$$

Answer (a) \_\_\_\_\_ [1]

- (b) Write down an expression for the  $n^{\text{th}}$  term of this sequence.

$$1, \quad \frac{1}{4}, \quad \frac{1}{9}, \quad \frac{1}{16}, \quad \dots \quad \dots$$

Answer (b) \_\_\_\_\_ [1]

- (c) Use your answer to (b) to write down an expression for the  $n^{\text{th}}$  term of this sequence.

$$\frac{1}{2}, \quad \frac{1}{5}, \quad \frac{1}{10}, \quad \frac{1}{17}, \quad \dots \quad \dots$$

Answer (c) \_\_\_\_\_ [1]

**End of Paper**  
*Have you checked your work?*

|                  |                |                |                     |                   |
|------------------|----------------|----------------|---------------------|-------------------|
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You are expected to use a scientific calculator to evaluate explicit numerical expressions.

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For  $\pi$ , use either your calculator value or 3.142.

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|                    |

This paper consists of 12 printed pages including the cover page

|   |     |                                                                                                                                                                       |            |                                  |
|---|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------|
| 1 | (a) | Evaluate $10 + 2(10 - \frac{10}{3})$ .                                                                                                                                |            |                                  |
|   |     |                                                                                                                                                                       | Answer (a) | $23\frac{1}{3}$ or 23.3 [B1] [1] |
|   | (b) | Evaluate $\frac{7 - \sqrt{41}}{(3.142)^2}$ , leaving your answer correct to 2 significant figures.                                                                    |            |                                  |
|   |     |                                                                                                                                                                       | Answer (b) | 0.060 [B1] [1]                   |
| 2 |     | $\frac{2}{5}$ of the children in class walk to school, $\frac{1}{3}$ of the remaining children travel by bus and the rest travel by car. What fraction travel by car? |            |                                  |
|   |     | $1 - (\frac{2}{5} + \frac{1}{3} \times \frac{3}{5})$ [M1]                                                                                                             |            |                                  |
|   |     |                                                                                                                                                                       | Answer     | $\frac{2}{5}$ [A1] [2]           |

|   |         |                                                                                                                                                                                |     |
|---|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 3 | Express |                                                                                                                                                                                |     |
|   | (a)     | $127\frac{1}{2}\%$ as a fraction in its lowest term.                                                                                                                           |     |
|   |         |                                                                                                                                                                                |     |
|   |         | <i>Answer (a)</i> $\frac{51}{40}$ or $1\frac{11}{40}$ [B1]                                                                                                                     | [1] |
|   | (b)     | $\frac{7}{17}$ as a decimal.                                                                                                                                                   |     |
|   |         |                                                                                                                                                                                |     |
|   |         | <i>Answer (b)</i> 0.412 [B1]                                                                                                                                                   | [1] |
| 4 | (a)     | The temperature outside a building is $-17^{\circ}\text{C}$ . The temperature inside the building is $27^{\circ}\text{C}$ higher. What is the temperature inside the building? |     |
|   |         |                                                                                                                                                                                |     |
|   |         | <i>Answer (a)</i> 10 [B1] $^{\circ}\text{C}$                                                                                                                                   | [1] |
|   | (b)     | By rounding each number to 1 significant figure, estimate the value of $64.93 \times 8.65$<br>2.98<br>You must show your working.                                              |     |
|   |         | $= \frac{60 \times 9}{3}$ [M1]<br><br>$= 180$                                                                                                                                  |     |
|   |         | <i>Answer (b)</i> 180 [A1]                                                                                                                                                     | [2] |

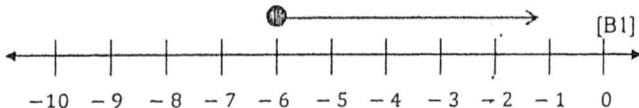
|   |     |                                                                                                                                    |     |
|---|-----|------------------------------------------------------------------------------------------------------------------------------------|-----|
| 5 | (a) | A sum of money is divided in the ratio 7 : 5.<br>The larger part is \$19.60.<br>Find the smaller part.                             |     |
|   |     | 7 units - \$19.60<br>1 unit - $\$ \frac{19.6}{7}$ [M1]<br>5 unit - $\frac{19.6}{7} \times 5 = \$14$                                |     |
|   |     | <i>Answer (a)</i> \$ 14 [A1]                                                                                                       | [2] |
|   | (b) | Express the ratio 600 ml to 1.85 l in its lowest terms.<br>Give your answers in the form $m : n$ , where $m$ and $n$ are integers. |     |
|   |     | 600:1850 [M1]                                                                                                                      |     |
|   |     | <i>Answer (b)</i> 12:37 [A1]                                                                                                       | [2] |

|     |                                                                                                                                                                             |                              |     |  |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----|--|
| 6   | 60 expressed as a product of its prime factors is $2^2 \times 3 \times 5$ .                                                                                                 |                              |     |  |
| (a) | Express 90 as a product of its prime factors.                                                                                                                               |                              |     |  |
|     | <div> <div>2</div> <div>90</div> </div> <div> <div>3</div> <div>45</div> </div> <div> <div>3</div> <div>15</div> </div> <div> <div>5</div> <div>5</div> </div> <div>1</div> | [M1]                         |     |  |
|     | Answer (a)                                                                                                                                                                  | $2 \times 3^2 \times 5$ [A1] | [2] |  |
| (b) | Find                                                                                                                                                                        |                              |     |  |
|     | (i) the highest common factor of 60 and 90,                                                                                                                                 |                              |     |  |
|     |                                                                                                                                                                             |                              |     |  |
|     | Answer b(i)                                                                                                                                                                 | 30 [B1]                      | [1] |  |
|     | (ii) the smallest number that is divisible by both 60 and 90.                                                                                                               |                              |     |  |
|     |                                                                                                                                                                             |                              |     |  |
|     | Answer b(ii)                                                                                                                                                                | 180 [B1]                     | [1] |  |
|     | (iii) the smallest positive integer, $k$ , such that $60k$ is a perfect square.                                                                                             |                              |     |  |
|     |                                                                                                                                                                             |                              |     |  |
|     | Answer b(iii)                                                                                                                                                               | 15 [B1]                      | [1] |  |

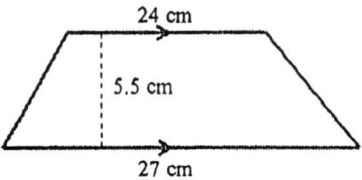
|   |     |                                                    |                                                                         |                                        |     |
|---|-----|----------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------|-----|
| 7 | (a) | Simplify $x^2 + \frac{1}{3}x^2 - \frac{3}{5}x^2$ . |                                                                         |                                        |     |
|   |     |                                                    |                                                                         |                                        |     |
|   |     |                                                    | Answer (a)                                                              | $\frac{11}{15}x^2$ [B1]                | [1] |
|   | (b) | (i)                                                | Simplify $3(y-2) - (y+3)$ ,                                             |                                        |     |
|   |     |                                                    |                                                                         |                                        |     |
|   |     |                                                    |                                                                         | $= 3y - 6 - y - 3$ [M1]                |     |
|   |     |                                                    | Answer b(i)                                                             | $2y - 9$ [A1]                          | [2] |
|   |     | (ii)                                               | Hence, or otherwise, find the value of $3(y-2) - (y+3)$ when $y = -4$ . |                                        |     |
|   |     |                                                    |                                                                         |                                        |     |
|   |     |                                                    |                                                                         | $= 2(-4) - 9$<br>$= -8 - 9$<br>$= -17$ |     |
|   |     |                                                    | Answer b(ii)                                                            | -17 [B1]                               | [1] |

|   |         |                                                                 |               |     |
|---|---------|-----------------------------------------------------------------|---------------|-----|
| 8 | (a)     | Simplify $\frac{3a}{4} + \frac{9a^2}{10}$ .                     |               |     |
|   |         | $= \frac{3a}{4} \times \frac{10}{9a^2}$ [M1]                    |               |     |
|   |         | $\frac{5}{6a}$ [A1]                                             | Answer (a)    | [2] |
|   | (b) (i) | Factorise $y^2 - 4$ ,                                           |               |     |
|   |         |                                                                 | Answer b(i)   |     |
|   |         | $(y+2)(y-2)$ [B1]                                               |               | [1] |
|   | (ii)    | Factorise $y^2 + y - 2$ ,                                       |               |     |
|   |         |                                                                 | Answer b(ii)  |     |
|   |         | $(y+2)(y-1)$ [B1]                                               |               | [1] |
|   | (iii)   | Hence, simplify $\frac{3xy}{y^2-4} \times \frac{y^2+y-2}{6y}$ . |               |     |
|   |         | $= \frac{3xy}{(y+2)(y-2)} \times \frac{(y+2)(y-1)}{6y}$         |               |     |
|   |         | $\frac{x(y-1)}{2(y-2)}$ [B1]                                    | Answer b(iii) | [1] |

|   |     |                                                                                                                                                  |            |     |
|---|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|
| 9 | (a) | A painting was bought at \$150 and sold, some years later, for \$460.<br>Find the percentage increase in its value.                              |            |     |
|   |     | $= \frac{460-150}{150} \times 100\%$ [M1]                                                                                                        |            |     |
|   |     | $206\frac{2}{3}$ or 207 [A1] %                                                                                                                   | Answer (a) | [2] |
|   | (b) | Mr Chin sold a computer for \$640. He made a loss of 20% of the price he paid for it. Find the original price of the computer.                   |            |     |
|   |     | 80% - \$640                                                                                                                                      |            |     |
|   |     | $1\% = \frac{640}{80}$ [M1]                                                                                                                      |            |     |
|   |     | $100\% = \frac{640}{80} \times 100$                                                                                                              |            |     |
|   |     | \$ 800 [A1]                                                                                                                                      | Answer (b) | [2] |
|   | (c) | Mr Xu invested \$600 for 4 years at 5.5 % per year simple interest.<br>Find the total amount that Mr Xu will get back at the end of the 4 years. |            |     |
|   |     | $I = PRT$                                                                                                                                        |            |     |
|   |     | $= 600 \times 4 \times \frac{5.5}{100}$ [M1]                                                                                                     |            |     |
|   |     | $= \$132$                                                                                                                                        |            |     |
|   |     | Total = \$600 + \$132 = \$732                                                                                                                    |            |     |
|   |     | 732 [A1]                                                                                                                                         | Answer (c) | [2] |

|    |                                                                                                                                                                                                        |                                                                                     |                      |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| 10 | Tom chooses either an apple, an orange or a pear from a bag.<br>The probability that he chooses an apple is 0.4.<br>The probability that he chooses an orange is 0.5.<br><br>Find the probability that |                                                                                     |                      |
|    | (a)                                                                                                                                                                                                    | he does not choose an apple,                                                        |                      |
|    |                                                                                                                                                                                                        |                                                                                     |                      |
|    |                                                                                                                                                                                                        | Answer (a)                                                                          | 0.6 [B1] [1]         |
|    | (b)                                                                                                                                                                                                    | he chooses a pear,                                                                  |                      |
|    |                                                                                                                                                                                                        |                                                                                     |                      |
|    |                                                                                                                                                                                                        | Answer (b)                                                                          | 0.1 [B1] [1]         |
|    | (c)                                                                                                                                                                                                    | he chooses a banana.                                                                |                      |
|    |                                                                                                                                                                                                        |                                                                                     |                      |
|    |                                                                                                                                                                                                        | Answer (c)                                                                          | 0 [B1] [1]           |
| 11 | (a)                                                                                                                                                                                                    | Solve the following inequality $-3a \leq 18$ .                                      |                      |
|    |                                                                                                                                                                                                        |                                                                                     |                      |
|    |                                                                                                                                                                                                        | Answer (a)                                                                          | $a \geq -6$ [B1] [1] |
|    | (b)                                                                                                                                                                                                    | Illustrate the solution on the number line given below.                             |                      |
|    |                                                                                                                                                                                                        |  | [B1] [1]             |

|    |     |                                                                                           |                                    |
|----|-----|-------------------------------------------------------------------------------------------|------------------------------------|
| 12 | (a) | Solve the equation $4x - 7 = 2x + 2$ .                                                    |                                    |
|    |     | $4x - 7 = 2x + 2$<br><br>$2x = 9$ [M1]                                                    |                                    |
|    |     | Answer (a)                                                                                | $x = 4\frac{1}{2}$ or 4.5 [A1] [2] |
|    | (b) | Solve the equation $\frac{2}{5z-3} = \frac{3}{7z-5}$ .                                    |                                    |
|    |     | $2(7z-5) = 3(5z-3)$ [M1]<br><br>$14z - 10 = 15z - 9$ [M1]<br><br>$-z = 1$<br><br>$z = -1$ |                                    |
|    |     | Answer (b)                                                                                | $z = -1$ [A1] [3]                  |

|     |                                                                                                                                                      |                                     |     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----|
| 13  | <p>The figure below shows a trapezium.</p>                          |                                     |     |
| (a) | Find the area of the trapezium.                                                                                                                      |                                     |     |
|     | $\text{Area of trapezium} = \frac{1}{2} \times (24 + 27) \times 5.5 \quad [\text{M1}]$                                                               |                                     |     |
|     | Answer (a)                                                                                                                                           | Area = 140.25 [A1] cm <sup>2</sup>  | [2] |
| (b) | Convert the area of the trapezium from cm <sup>2</sup> to m <sup>2</sup> .                                                                           |                                     |     |
|     | $1 \text{ cm}^2 = \frac{1}{100 \times 100} \text{ m}^2 \quad [\text{M1}]$ $140.25 \text{ cm}^2 = \frac{1}{100 \times 100} \times 140.25 \text{ m}^2$ |                                     |     |
|     | Answer (b)                                                                                                                                           | Area = 0.014025 [A1] m <sup>2</sup> | [2] |

|    |     |                                                                                                                                                                            |                                          |
|----|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| 14 | (a) | Find the next two terms in the sequence.<br>1, $\frac{1}{4}$ , $\frac{1}{9}$ , $\frac{1}{16}$ , ...                                                                        |                                          |
|    |     | Answer (a)                                                                                                                                                                 | $\frac{1}{25}$ , $\frac{1}{36}$ [B1] [1] |
|    | (b) | Write down an expression for the $n^{\text{th}}$ term of this sequence.<br>1, $\frac{1}{4}$ , $\frac{1}{9}$ , $\frac{1}{16}$ , ...                                         |                                          |
|    |     | Answer (b)                                                                                                                                                                 | $\frac{1}{n^2}$ [B1] [1]                 |
|    | (c) | Use your answer to (b) to write down an expression for the $n^{\text{th}}$ term of this sequence.<br>$\frac{1}{2}$ , $\frac{1}{5}$ , $\frac{1}{10}$ , $\frac{1}{17}$ , ... |                                          |
|    |     | Answer (c)                                                                                                                                                                 | $\frac{1}{n^2 + 1}$ [B1] [1]             |

End of Paper  
Have you checked your work?

1 At a concert,  $x$  tickets were sold at \$15 each and  $y$  tickets were sold at \$20 each.

(a) Altogether 80 tickets were sold, write down an equation in  $x$  and  $y$ . [1]

(b) If the total amount raised was \$1360, write down a second equation in  $x$  and  $y$ . [1]

(c) Solve for the values of  $x$  and  $y$ . [3]

2 (a) Simplify  $\frac{1}{3}[2x - 5(x + 6y)]$ . [2]

(b) Expand and simplify  $(2d + 1)(d - 3)$ . [2]

(c) Express  $\frac{3}{(x-3)^2} - \frac{2}{3(x-3)}$  as a single fraction, in its simplest form. [3]

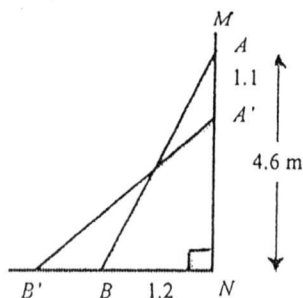
(d) Solve the equation  $\frac{2b}{5} - 4 = 6$ . [2]

3 (a) Convert 25 m/s to kilometres per hour. [2]

(b) (i) A car travels at 35 m/s for 40 seconds. Calculate the distance travelled. [1]

(ii) The car then travels at 20 m/s for  $2\frac{1}{2}$  minutes. Calculate the average speed of the car for the whole journey. [3]

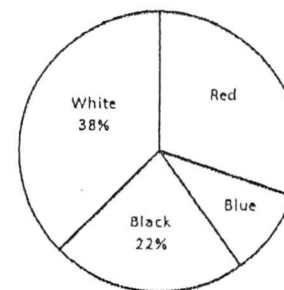
4 The figure shows a straight pole  $AB$  leaning against a vertical wall  $MN$ . Given  $AN = 4.6$  m and  $BN = 1.2$  m,



(a) Calculate the length of the pole  $AB$ . [1]

(b) The upper end of the pole,  $A$ , slides down 1.1 m to a point  $A'$ . Find  $BB'$ , the distance the lower end of the pole has slid away from its original position  $B$ . [3]

5 John recorded the colour of cars travelling through his village. His results are shown in the pie chart below.

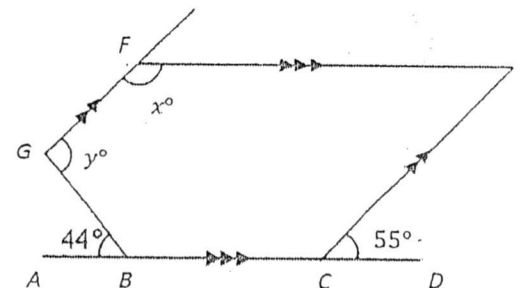


(a) Calculate the cars in black as a percentage of the cars in white. [1]

(b) There were thrice as many red cars as blue cars. Find the angle representing red cars. [3]

(c) Given that there were 600 red cars, find the total number of cars that travel through John's village. [2]

6 In the diagram,  $BC$  is parallel to  $FE$  and  $CE$  is parallel to  $GF$ . Given that  $\angle DCE = 55^\circ$  and  $\angle ABG = 44^\circ$ . Stating the reasons clearly, find the values of



(a) reflex  $\angle CEF$ , [2]

(b)  $\angle x$ , [1]

(c)  $\angle y$ . [2]

- 7 Study the following figures that are formed by squares of the same size.



Figure 1

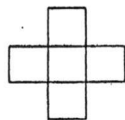


Figure 2

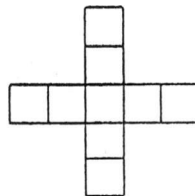


Figure 3

- (a) Draw Figure 5.

[1]

- (b) Complete the table.

| Figure number       | 1 | 2 | 3 | 4 | 5 | 6 |
|---------------------|---|---|---|---|---|---|
| Number of square(s) | 1 | 5 | 9 |   |   |   |

[1]

- (c) How many squares are there in Figure 9?

[1]

- (d) Write down an expression, in terms of  $n$ , for the number of squares in Figure  $n$ .

[1]

- (e) How many squares would be drawn in Figure 50?

[1]

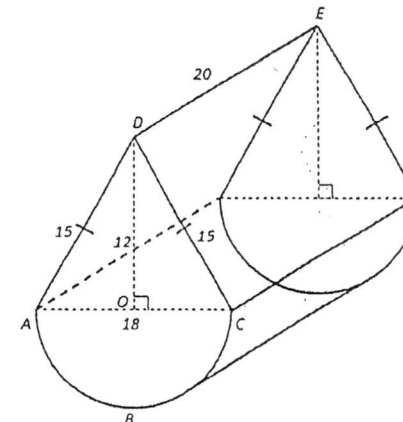
- (f) Which Figure would have 121 squares?

[1]

- (g) Write down a reason why it is not possible to have a Figure with 188 squares.

[1]

- 8 The diagram shows a toy block made from a triangular prism and half of a cylinder. The cross section  $ABCD$  is made up of a semicircle and an isosceles triangle.  $AD = CD = 15$  cm,  $AC = 18$  cm,  $OD = 12$  cm,  $DE = 20$  cm and angle  $COD = 90^\circ$ .



- (a) Find the total cross sectional area,  $ABCD$ , of the toy block.

[3]

- (b) Find the volume of the toy block.

[1]

- (c) The toy block is melted down to form a solid cube. Find the length of one edge of the cube.

[2]

- (d) Find the total surface area of the solid cube.

[2]

End of Paper  
Have you checked your work?

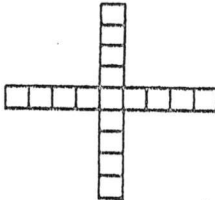
|    |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Comments |
|----|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1. | (a) | $x + y = 80 \dots\dots\dots(1)$ [B1]                                                                                                                                                                                                                                                                                                                                                                                                                        |          |
|    | (b) | $15x + 20y = 1360 \dots\dots\dots(2)$ [B1]                                                                                                                                                                                                                                                                                                                                                                                                                  |          |
|    | (c) | <u>Elimination method:</u><br><br>$(1) \times 15; 15x + 15y = 1200 \dots\dots\dots(3)$ [M1]<br>$(3) - (2); \quad 5y = 160$<br>$y = 32$ [M1]<br>Sub to (1); $x + 32 = 80$<br>$x = 48$ [A1]<br><br><u>QR</u><br><u>Substitution method:</u><br><br>$(1); \quad x = 80 - y \dots\dots\dots(3)$<br>Sub (3) to (2); $15(80 - y) + 20y = 1360$ [M1]<br>$1200 - 15y + 20y = 1360$<br>$5y = 160$<br>$y = 32$ [M1]<br><br>Sub to (1); $x + 32 = 80$<br>$x = 48$ [A1] |          |

|   |     |                                                                                                                                                                                                                                  |  |
|---|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 2 | (a) | $\frac{1}{3}[2x - 5(x + 6y)]$<br><br>$= \frac{1}{3}[2x - 5x - 30y]$ [M1]<br><br>$= \frac{1}{3}[-3x - 30y]$<br><br>$= -x - 10y$ [A1]                                                                                              |  |
|   | (b) | $(2d + 1)(d - 3)$<br>$= 2d^2 - 6d + d - 3$ [M1]<br>$= 2d^2 - 5d - 3$ [A1]                                                                                                                                                        |  |
|   | (c) | $\frac{3}{(x-3)^2} - \frac{2}{3(x-3)}$<br><br>$= \frac{9}{3(x-3)^2} - \frac{2(x-3)}{3(x-3)^2}$ [M1]<br><br>$= \frac{9 - 2(x-3)}{3(x-3)^2}$<br><br>$= \frac{9 - 2x + 6}{3(x-3)^2}$ [M1]<br><br>$= \frac{-2x + 15}{3(x-3)^2}$ [A1] |  |
|   | (d) | $\frac{2b}{5} - 4 = 6$<br>$\frac{2b}{5} = 10$<br>$2b = 50$ [M1]<br>$b = 25$ [A1]                                                                                                                                                 |  |

|   |         |                                                                                                                                                                                                                                                                                       |                      |                                                 |
|---|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------|
| 3 | (a)     | $\frac{25\text{m}}{1\text{s}}$ $= \frac{25}{1} \frac{\text{m}}{\text{s}}$ $= \frac{25}{3600} \frac{\text{km}}{\text{h}}$ $= 90 \text{ km/h}$ <p>OR</p> $1\text{s} = 25 \text{ m}$ $1\text{h} = 25 \times 3600 \text{ m}$ $= 90\,000 \text{ m}$ $= 90 \text{ km}$ <p>Thus, 90 km/h</p> | [M1]<br>[A1]         |                                                 |
|   | (b)(i)  | $\text{Distance} = \text{speed} \times \text{time}$ $= 35 \times 40$ $= 1400 \text{ m}$                                                                                                                                                                                               | [B1]                 |                                                 |
|   | (b)(ii) | $\text{Distance} = \text{speed} \times \text{time}$ $= 20 \times 2 \frac{1}{2} \times 60$ $= 3000 \text{ m}$ <p>Average speed = <math>\frac{\text{Total distance}}{\text{total time}}</math></p> $= \frac{1400 + 3000}{40 + 150}$ $= 23.2 \text{ or } 23 \frac{3}{19} \text{ m/s}$    | [M1]<br>[M1]<br>[A1] | Marks awarded for changing of minute to seconds |

|   |     |                                                                                                                                                                                                                                                                                                                                                   |                      |  |
|---|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--|
| 4 | (a) | $a^2 + b^2 = c^2$ $(4.6)^2 + (1.2)^2 = c^2$ $c = \pm \sqrt{(4.6)^2 + (1.2)^2}$ $c = 4.75 \text{ or } -4.75(\text{NA})$                                                                                                                                                                                                                            | [B1]                 |  |
|   | (b) | $(A'N)^2 + (B'N)^2 = (A'B')^2$ $(4.6 - 1.1)^2 + (B'N)^2 = (4.75394573)^2$ $B'N = \sqrt{(4.75394573)^2 - 3.5^2}$ $B'N = 3.217141588 \text{ or } -3.217141588(\text{NA})$ $BB' = 3.217141588 - 1.2$ $BB' = 2.02(3\text{sf})$                                                                                                                        | [M1]<br>[M1]<br>[A1] |  |
| 5 | (a) | $\frac{22}{38} \times 100\%$ $= 57.9\% \text{ or } 57 \frac{17}{19} (3\text{s.f})$                                                                                                                                                                                                                                                                | [B1]                 |  |
|   | (b) | <p>Let <math>x</math> be the percentage of blue cars<br/>Therefore, percentage of red cars is <math>3x</math></p> $22 + 38 + x + 3x = 100$ $60 + 4x = 100$ $4x = 40$ $x = 10$ <p>Thus, percentage of red car = <math>3(10) = 30\%</math></p> <p>Angles representing the red cars = <math>\frac{30}{100} \times 360^\circ</math></p> $= 108^\circ$ | [M1]<br>[M1]<br>[A1] |  |
|   | (c) | $108^\circ \rightarrow 600 \text{ cars}$ $1^\circ \rightarrow \frac{600}{108}$ $360^\circ \rightarrow \frac{600}{108} \times 360^\circ$ $\rightarrow 2000 \text{ cars}$                                                                                                                                                                           | [M1]<br>[A1]         |  |

|   |     |                                                                                                                                                                                           |                                                    |
|---|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| 6 | (a) | $\angle CEF = 55^\circ$ (Alternate angle) [B1]<br>$\angle CEF = 360 - 55$ (Angle at a point)<br>$\angle CEF = 305^\circ$ [B1]                                                             | No marks awarded for answer with no reasons stated |
|   | (b) | $\angle x + \angle CEF = 180^\circ$ (Interior angle)<br>$\angle x = 180 - 55$<br>$= 125^\circ$ [B1]                                                                                       | No marks awarded for answer with no reasons stated |
|   | (c) | $\angle y = \angle ABG + (180^\circ - \angle x)$<br>$\angle y = 44^\circ + (180^\circ - 125^\circ)$ [M1]<br>$\angle y = 44^\circ + (180^\circ - 125^\circ)$<br>$\angle y = 99^\circ$ [A1] | No marks awarded for answer with no reasons stated |

|                     |     |                                                                                                                                                                                                                           |               |                                      |    |    |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
|---------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------------|----|----|---|---|---|---------------------|---|---|---|----|----|----|------|--------------------------------------------------|
| 7                   | (a) |                                                                                                                                        | [B1]          |                                      |    |    |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
|                     | (b) | <table border="1"><tr><td>Figure number</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Number of square(s)</td><td>1</td><td>5</td><td>9</td><td>13</td><td>17</td><td>21</td></tr></table> | Figure number | 1                                    | 2  | 3  | 4 | 5 | 6 | Number of square(s) | 1 | 5 | 9 | 13 | 17 | 21 | [B1] | 1 mark awarded only if all 3 answers are correct |
| Figure number       | 1   | 2                                                                                                                                                                                                                         | 3             | 4                                    | 5  | 6  |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
| Number of square(s) | 1   | 5                                                                                                                                                                                                                         | 9             | 13                                   | 17 | 21 |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
|                     | (c) | 33                                                                                                                                                                                                                        | [B1]          |                                      |    |    |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
|                     | (d) | $1 + 4(n - 1)$<br>$= 4n - 3$                                                                                                                                                                                              | [B1]          |                                      |    |    |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
|                     | (e) | $4(50) - 3$<br>$= 197$                                                                                                                                                                                                    | [B1]          |                                      |    |    |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
|                     | (f) | $4n - 3 = 121$<br>$4n = 124$<br>$n = 31$                                                                                                                                                                                  | [B1]          |                                      |    |    |   |   |   |                     |   |   |   |    |    |    |      |                                                  |
|                     | (g) | It is not possible as because of the $n^{\text{th}}$ term $4n - 3$ will always be an odd number .<br>Or<br>$4n - 3 = 188$<br>$4n = 191$<br>$n = 47.75$<br>As $n$ must be an integer, it will not be possible.             | [B1]          | Accept any other logical explanation |    |    |   |   |   |                     |   |   |   |    |    |    |      |                                                  |

|   |     |                                                                                                                                                                                                                                                                                                                                                       |  |
|---|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 8 | (a) | $\text{Area of triangle } ACD = \frac{1}{2} \times 18 \times 12$ $= 108\text{cm}^2 \quad [\text{M1}]$<br>$\text{Area of semicircle } ABC = \frac{1}{2} \times \pi \times 9^2$ $= 127.2345025\text{cm}^2 \quad [\text{M1}]$<br>$\text{Total cross sectional area of } ABCD$ $= 108 + 127.2345025$ $= 235.2345025$ $= 235\text{cm}^2 \quad [\text{A1}]$ |  |
|   | (b) | $\text{Volume of toy block} = ACS \times h$ $= 235.2345025 \times 20$ $= 4704.690049$ $= 4700\text{cm}^3 \text{ (3sf)} \quad [\text{B1}]$                                                                                                                                                                                                             |  |
|   | (c) | $l \times l \times l = 4704.690049$ $l^3 = 4704.690049 \quad [\text{M1}]$ $l = \sqrt[3]{4704.690049}$ $l = 16.75625672$ $l = 16.8\text{cm} \quad [\text{A1}]$                                                                                                                                                                                         |  |
|   | (d) | $\text{Total surface area of cube} = 6 \times ACS$ $= 6 \times (16.75625672)^2 \quad [\text{M1}]$ $= 1684.632837$ $= 1680\text{cm}^2 \text{ (3sf)} \quad [\text{A1}]$                                                                                                                                                                                 |  |