EXAMINATIONS COUNCIL OF LESOTHO
Lesotho General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | | | | | | | |

**MATHEMATICS** **0178/04**

Paper 4 (Extended) **May/June 2017**

**2 hours 30 minutes**

Candidates answer on the Question Paper.

Additional Materials: Electronic Calculator
Geometrical Instruments
Tracing Paper (optional)

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
If working is needed for any question it must be shown below that question.
Electronic calculators should be used.
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.

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 130.

1 The first three diagrams in a sequence are shown below.
The diagrams are made up of dots and lines.
Each line is one centimetre long.

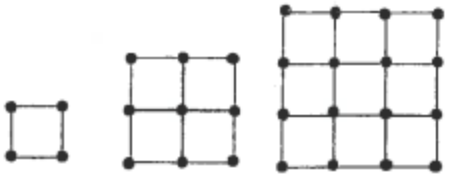


Diagram 1 Diagram 2 Diagram 3 Diagram 4

**(a)** Draw the next diagram in the sequence. [1]

**(b)** The table shows some information about the diagrams.

| Diagram | 1 | 2 | 3 | 4 | | $n$ |
|---|---|---|---|---|---|---|
| Perimeter | 4 | 8 | 12 | $s$ | | $v$ |
| Area | 1 | 4 | 9 | 16 | | $w$ |
| Number of lines | 4 | 12 | 24 | $t$ | | $x$ |

(i) Write down the values of $s$ and $t$.

*Answer (b)*(i) $s$ = .....

..... [2]

(ii) Write expressions for $v$, $w$ and $x$, in terms of $n$.

*Answer (b)*(ii) $v$ = .....

$w$ = ..... .....

$x$ = ..... ..... [4]

(iii) Find the perimeter of the shape in Diagram 20.

*Answer (b)*(iii) ..... ..... [1]

(c) The **total number** of lines in the first $n$ diagrams is given by the expression

$$\frac{2}{3}n^3 + hn^2 + kn.$$

(i) Show that

(a) $h + k = \frac{10}{3}$ for $n = 1$,

(b) $4h + 2k = \frac{32}{3}$ for $n = 2$. [1]

[2]

(ii) Find

(a) the values of $h$ and $k$,

*Answer (c)(ii)(a)* $h =$ .....

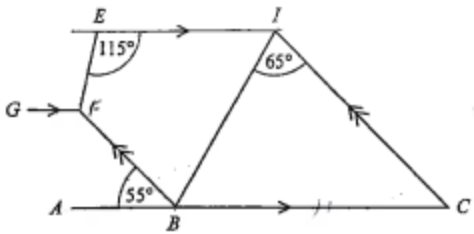
$k =$ ..... [3]

(b) the total number of lines in the first 12 diagrams.

*Answer (c)(ii)(b)* ..... [1]

2 In the diagram, the straight line $ABC$ is parallel to $GF$ and $ED$.
$BF$ and $CD$ are also parallel.
Angle $ABF = 55°$, angle $DEF = 115°$ and angle $BDC = 65°$.

NOT TO SCALE




(a) State, with reasons, the value of

(i) angle $BCD$,

... ... ...° because .....

..... [2]

(ii) angle $ABD$,

....° because .....

..... [2]

(iii) angle $BFG$.

.....° because .....

..... [2]

(b) $ED$ is produced to the point $H$ such that $DH = BC$.

State with the reason the name of the quadrilateral $BDHC$.

... because ...

..... [2]

3 (a) Rearrange the formula to make $a$ the subject.

$$P = \frac{y^2 + a}{y + a}$$

*Answer (a)* $a =$ ..... [3]

(b) Factorise fully.

$$(x^2 - y^2) - (x - y)^2$$

*Answer (b)* ..... [3]

(c) Simplify.

(i) $\dfrac{y - 2}{2y^2 - 3y - 2}$

*Answer (c)*(i) ..... [3]

(ii) $\dfrac{ax - ab + bx + b^2}{ax^2 - abx}$

*Answer (c)*(ii) ..... [3]

4 (a) Neo buys a roof-bike which has a price of M 7200.
He pays 60% of this price and then pays M800 per month for 6 months.

(i) How much does Neo pay altogether?

*Answer (a)*(i) M ..... [2]

(ii) How much more or less than the original price does Neo pay for the bike?

*Answer (a)*(ii) M ..... [1]

(iii) Express your answer in **part (a)(ii)** as a percentage of M7200.

*Answer (a)*(iii) ..... .....% [2]

(b) Tau pays M8075 for a giant-bike in a sale.
The original price had been reduced by 15%.

*Answer (b)* M ..... [3]

4 (a) Neo buys a roof-bike which has a price of M 7200.
He pays 60% of this price and then pays M800 per month for 6 months.

(i) How much does Neo pay altogether?

*Answer (a)*(i) M ..... [2]

(ii) How much more or less than the original price does Neo pay for the bike?

*Answer (a)*(ii) M ..... [1]

(iii) Express your answer in **part (a)(ii)** as a percentage of M7200.

*Answer (a)*(iii) ..... .....% [2]

(b) Tau pays M8075 for a giant-bike in a sale.
The original price had been reduced by 15%.

*Answer (b)* M ..... [3]

**(c)** Two brothers, Mpho and Lefa, invest money at two different Banks, A and B.
Mpho invests M 3000 at Bank A at 5% **simple** interest per year.
Lefa invests M 3000 at Bank B at 4.9% **compounded** interest per year.

**(i)** How much will Mpho have at the end of 4 years?

*Answer (c)*(i) M .... ..... [2]

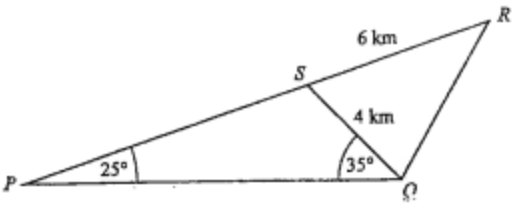
**(ii)** Who will have more money after 4 years?
Support your answer with working.

*Answer (c)*(ii) ... ... ... ..... [3]

**(iii)** How much more will one brother have than the other?

*Answer (c)*(iii) M ... ..... [1]

5 The diagram shows the positions $P$, $Q$, $R$ and $S$ of four locations on an island.
$P$, $S$ and $R$ are on a straight line.
$QS = 4$ km, $RS = 6$ km, angle $SPQ = 25°$, angle $PQS = 35°$ and $Q$ is due East of $P$.




NOT TO SCALE

Calculate

(a) $PQ$,

Answer (a) ..... km [3]

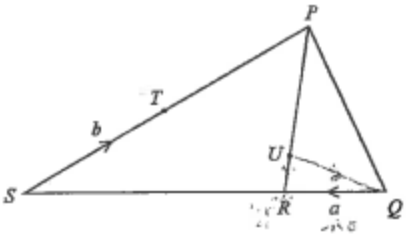
(b) $QR$

Answer (b) ..... km [4]

(c) the area of the triangle $QRS$.

Answer (c) ..... $km^2$ [2]

6 In the diagram, $\overrightarrow{QR} = \mathbf{a}$ and $\overrightarrow{ST} = \mathbf{b}$.
$R$ is the point on $QS$ such that $\overrightarrow{QS} = 3\overrightarrow{QR}$.
$U$ is the point on $RP$ such that $\overrightarrow{RP} = 4\overrightarrow{RU}$.
$T$ is the midpoint of $SP$.




**(a)** Express, as simply as possible, in terms of **a** and/or **b**,

(i) $\overrightarrow{RS}$,

*Answer (a)*(i) ..... [1]

(ii) $\overrightarrow{RP}$

*Answer (a)*(ii) ..... [1]

(iii) $\overrightarrow{UQ}$,

*Answer (a)*(iii) ..... [2]

(iv) $\overrightarrow{TQ}$

*Answer (a)*(iv) ..... [1]

**(b)** Write down two facts about the points $T$, $U$ and $Q$.

*Answer (b)*

.....

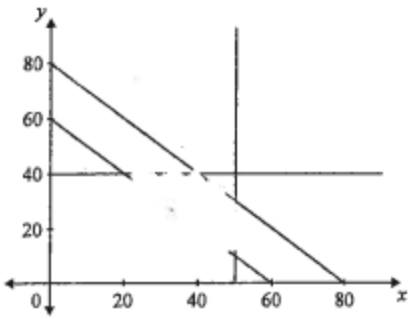
[2]

7 A factory makes two types of jeans, type A and type B.
Each month, $x$ of type A and $y$ of type B jeans are made.

The following constraints control the daily production:

- Not more than 50 jeans of type A can be made.
- Not more than 40 jeans of type B can be made.
- The total number of jeans must be at least 60.
- The maximum total number of jeans that can be made is 80

The diagram shows the four constraints.




NOT TO SCALE

One of the constraints is $x + y \leqslant 80$.

(a) Write down in terms of $x$ and/or $y$ the other three constraints.

*Answer (a)* .....

.....

.....

..... [4]

(b) On the diagram, shade the region that satisfies all the constraints. [1]

(c) $y = -2x + \frac{P}{150}$ is the function that represents the profit, P, in Maloti.

Find the profit of each type of pair of jeans.

*Answer (c)* Type A. .....

Type B. [2]

**(d)** How many of each type of jeans should be produced per day to maximise profit?

*Answer (d)* Type A ..... .....

Type B ..... ..... [2]

**(e)** What is the maximum profit?

*Answer (e)* M .... ..... [1]

**(f)** Explain how the profit would be affected if the profit function was $y = -x + \frac{P}{150}$.

*Answer (f)* ..... [1]

8 The numbers 0, 0, 1, 1, 1, 2, $p$, 9, 10, 13, $q$, 16 are in order.
Their mean is 6 and their median is 3.5.

**(a)** State the mode.

*Answer (a)* ..... [1]

**(b)** Find the range.

*Answer (b)* ..... [1]

**(c)** Find the value of

**(i)** $p$,

*Answer (c)(i)* $p =$ ..... [1]

**(ii)** $q$.

*Answer (c)(ii)* $q =$ ..... [2]

**(d)** Find the probability that a number chosen at random is 0 or 1.

*Answer (d)* ..... [1]

**(e)** One number is chosen and not replaced.
A second number is then chosen.

Calculate the probability that the two numbers are both 0 or both 1.

*Answer (e)* ..... [3]

9 The table shows the time ($t$ seconds) taken by 100 candidates to answer a given question.

| $t$ | $0 < t \leqslant 20$ | $20 < t \leqslant 30$ | $30 < t \leqslant 40$ | $40 < t \leqslant 50$ | $50 < t \leqslant 60$ | $60 < t \leqslant 80$ |
|---|---|---|---|---|---|---|
| Frequency | 10 | 10 | 43 | 22 | 7 | 8 |

**(a)** Calculate an estimate of the mean time taken.
Show your working.

*Answer (a)* ..... [4]

**(b)** The data is regrouped to give the following table.

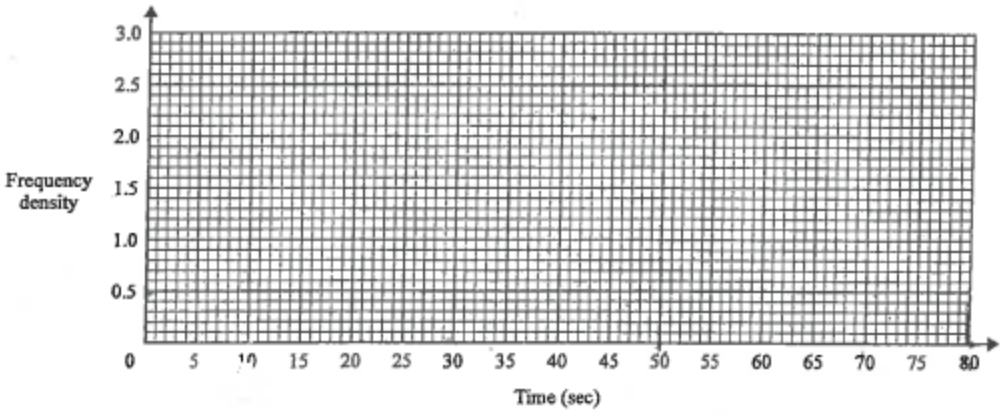
| $t$ | $0 < t \leqslant 20$ | $20 < t \leqslant 50$ | $50 < t \leqslant 80$ |
|---|---|---|---|
| Frequency | 10 | $v$ | $w$ |

**(i)** Write the values of $v$ and $w$.

*Answer (b)(i)* $v$ = .....

$w$ = ..... [2]

**(ii)** On the grid, draw a histogram which shows the information in the table in part (b).




[3]

**10** Thabiso runs 34 km at an average speed of $x$ km/h.

(a) Write down, in terms of $x$, an expression for the time taken.

*Answer (a)* ..... h [1]

(b) Lipuo runs 34 km at an average speed of 2 km/h greater than Thabiso's speed.

Write down, in terms of $x$, an expression for the time taken by Lipuo.

*Answer (b)* ..... ..... [1]

(c) It is given that Lipuo took **15 minutes** less than Thabiso to compete the 34 km.

Write down an equation in terms of $x$ and show that it simplifies to

$x^2 + 2x - 272 = 0$.

[3]

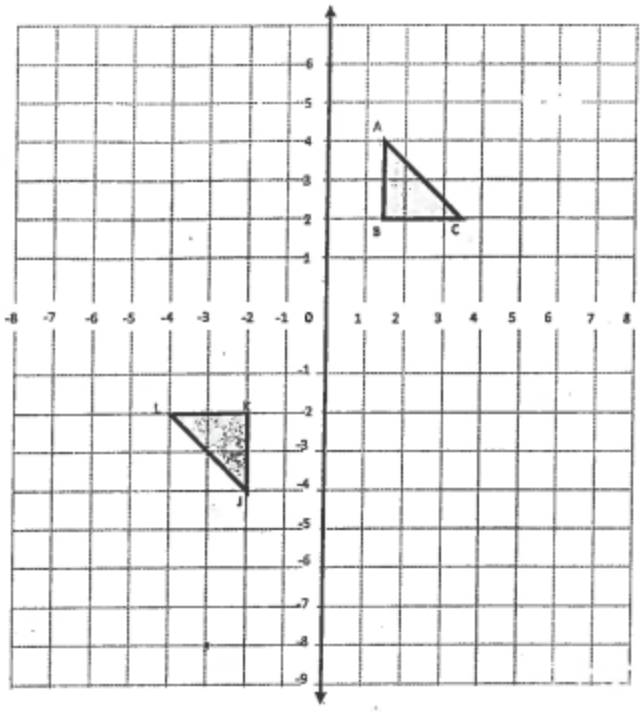
(d) Solve the equation $x^2 + 2x - 272 = 0$.
Give your answers correct to one decimal place

*Answer (d)* $x$ = .... ..... or $x$ = ... ... [4]

(e) Calculate, in hours and minutes, the time taken by Thabiso to complete the 34 km.

*Answer (e)* ..... ..... h ..... ..... min [2]

11




(a) A reflection in the line $x = -1$ maps triangle *ABC* onto triangle *DEF*.

Draw and label triangle *DEF*. [2]

(b) A shear with shear factor 2 and invariant line $y = 2$ maps triangle *ABC* onto triangle *GHI*.

Draw and label triangle *GHI*. [2]

(c) Describe fully the single transformation which maps triangle $ABC$ onto triangle $JKL$.

*Answer (c)* .....

.....

.....

..... [3]

(d) Triangle $JKL$ is mapped onto triangle $MNP$.
The vertices of triangle $MNP$ are $M(-3, -8)$, $N(-3, -4)$ and $P(-5, -4)$.

Find a matrix which fully describes a single transformation which maps triangle $JKL$ onto triangle $MNP$.

*Answer (d)* ..... [2]

12 The functions f and g are defined as follows:

$$f : x \to \frac{2(x-1)}{x^2-2x-3} - \frac{1}{x-3}, \; x > 3, \text{ and } g : x \to 2x - 3.$$

**(a)** Show that $f(x) = \frac{1}{x+1}$.

[3]

**(b)** Find

**(i)** $f^{-1}(x)$,

*Answer (b)*(i) ..... ..... [2]

**(ii)** $g^{-1}(x)$.

*Answer (b)*(ii) ..... ..... [2]

**(iii)** $fg(x)$,

*Answer (b)*(iii) ..... ..... [2]

**(iv)** $(fg)^{-1}(x)$.

*Answer (b)*(iv) ..... ..... [2]

(c) Solve $\mathrm{fg}(x) = \frac{1}{8}$.

*Answer (c)* $x =$ ..... ..... [2]

(d) Show that $(\mathrm{fg})^{-1}(x) = \mathrm{g}^{-1}\mathrm{f}^{-1}(x)$

[3]

EXAMINATIONS COUNCIL OF LESOTHO
Lesotho General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | | | | | | | |

**MATHEMATICS** **0178/04**

Paper 4 (Extended) **May/June 2017**

**2 hours 30 minutes**

Candidates answer on the Question Paper.

Additional Materials: Electronic Calculator
Geometrical Instruments
Tracing Paper (optional)

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
If working is needed for any question it must be shown below that question.
Electronic calculators should be used.
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.

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 130.

1 The first three diagrams in a sequence are shown below.
The diagrams are made up of dots and lines.
Each line is one centimetre long.

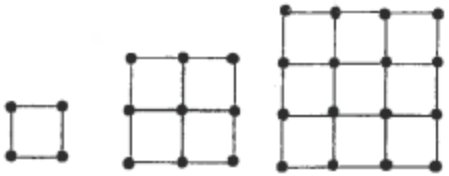


Diagram 1 Diagram 2 Diagram 3 Diagram 4

**(a)** Draw the next diagram in the sequence. [1]

**(b)** The table shows some information about the diagrams.

| Diagram | 1 | 2 | 3 | 4 | | $n$ |
|---|---|---|---|---|---|---|
| Perimeter | 4 | 8 | 12 | $s$ | | $v$ |
| Area | 1 | 4 | 9 | 16 | | $w$ |
| Number of lines | 4 | 12 | 24 | $t$ | | $x$ |

(i) Write down the values of $s$ and $t$.

*Answer (b)*(i) $s$ = .....

..... [2]

(ii) Write expressions for $v$, $w$ and $x$, in terms of $n$.

*Answer (b)*(ii) $v$ = .....

$w$ = ..... .....

$x$ = ..... ..... [4]

(iii) Find the perimeter of the shape in Diagram 20.

*Answer (b)*(iii) ..... ..... [1]

(c) The **total number** of lines in the first $n$ diagrams is given by the expression

$$\frac{2}{3}n^3 + hn^2 + kn.$$

(i) Show that

(a) $h + k = \frac{10}{3}$ for $n = 1$,

(b) $4h + 2k = \frac{32}{3}$ for $n = 2$. [1]

[2]

(ii) Find

(a) the values of $h$ and $k$,

*Answer (c)(ii)(a)* $h =$ .....

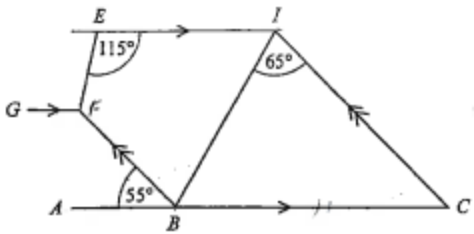
$k =$ ..... [3]

(b) the total number of lines in the first 12 diagrams.

*Answer (c)(ii)(b)* ..... [1]

2 In the diagram, the straight line $ABC$ is parallel to $GF$ and $ED$.
$BF$ and $CD$ are also parallel.
Angle $ABF = 55°$, angle $DEF = 115°$ and angle $BDC = 65°$.

NOT TO SCALE




(a) State, with reasons, the value of

(i) angle $BCD$,

... ... ...° because .....

..... [2]

(ii) angle $ABD$,

....° because .....

..... [2]

(iii) angle $BFG$.

.....° because .....

..... [2]

(b) $ED$ is produced to the point $H$ such that $DH = BC$.

State with the reason the name of the quadrilateral $BDHC$.

... because ...

..... [2]

3 (a) Rearrange the formula to make $a$ the subject.

$$P = \frac{y^2 + a}{y + a}$$

*Answer (a)* $a =$ ..... [3]

(b) Factorise fully.

$$(x^2 - y^2) - (x - y)^2$$

*Answer (b)* ..... [3]

(c) Simplify.

(i) $\dfrac{y - 2}{2y^2 - 3y - 2}$

*Answer (c)*(i) ..... [3]

(ii) $\dfrac{ax - ab + bx + b^2}{ax^2 - abx}$

*Answer (c)*(ii) ..... [3]

4 (a) Neo buys a roof-bike which has a price of M 7200.
He pays 60% of this price and then pays M800 per month for 6 months.

(i) How much does Neo pay altogether?

*Answer (a)*(i) M ..... [2]

(ii) How much more or less than the original price does Neo pay for the bike?

*Answer (a)*(ii) M ..... [1]

(iii) Express your answer in **part (a)(ii)** as a percentage of M7200.

*Answer (a)*(iii) ..... .....% [2]

(b) Tau pays M8075 for a giant-bike in a sale.
The original price had been reduced by 15%.

*Answer (b)* M ..... [3]

4 (a) Neo buys a roof-bike which has a price of M 7200.
He pays 60% of this price and then pays M800 per month for 6 months.

(i) How much does Neo pay altogether?

*Answer (a)*(i) M ..... [2]

(ii) How much more or less than the original price does Neo pay for the bike?

*Answer (a)*(ii) M ..... [1]

(iii) Express your answer in **part (a)(ii)** as a percentage of M7200.

*Answer (a)*(iii) ..... .....% [2]

(b) Tau pays M8075 for a giant-bike in a sale.
The original price had been reduced by 15%.

*Answer (b)* M ..... [3]

**(c)** Two brothers, Mpho and Lefa, invest money at two different Banks, A and B.
Mpho invests M 3000 at Bank A at 5% **simple** interest per year.
Lefa invests M 3000 at Bank B at 4.9% **compounded** interest per year.

**(i)** How much will Mpho have at the end of 4 years?

*Answer (c)*(i) M .... ..... [2]

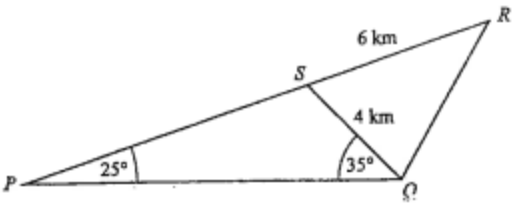
**(ii)** Who will have more money after 4 years?
Support your answer with working.

*Answer (c)*(ii) ... ... ... ..... [3]

**(iii)** How much more will one brother have than the other?

*Answer (c)*(iii) M ... ..... [1]

5 The diagram shows the positions $P$, $Q$, $R$ and $S$ of four locations on an island.
$P$, $S$ and $R$ are on a straight line.
$QS = 4$ km, $RS = 6$ km, angle $SPQ = 25°$, angle $PQS = 35°$ and $Q$ is due East of $P$.




NOT TO SCALE

Calculate

(a) $PQ$,

Answer (a) ..... km [3]

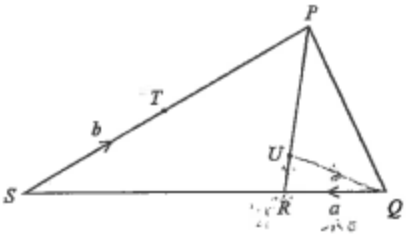
(b) $QR$

Answer (b) ..... km [4]

(c) the area of the triangle $QRS$.

Answer (c) ..... $km^2$ [2]

6 In the diagram, $\overrightarrow{QR} = \mathbf{a}$ and $\overrightarrow{ST} = \mathbf{b}$.
$R$ is the point on $QS$ such that $\overrightarrow{QS} = 3\overrightarrow{QR}$.
$U$ is the point on $RP$ such that $\overrightarrow{RP} = 4\overrightarrow{RU}$.
$T$ is the midpoint of $SP$.




**(a)** Express, as simply as possible, in terms of **a** and/or **b**,

(i) $\overrightarrow{RS}$,

*Answer (a)*(i) ..... [1]

(ii) $\overrightarrow{RP}$

*Answer (a)*(ii) ..... [1]

(iii) $\overrightarrow{UQ}$,

*Answer (a)*(iii) ..... [2]

(iv) $\overrightarrow{TQ}$

*Answer (a)*(iv) ..... [1]

**(b)** Write down two facts about the points $T$, $U$ and $Q$.

*Answer (b)*

.....

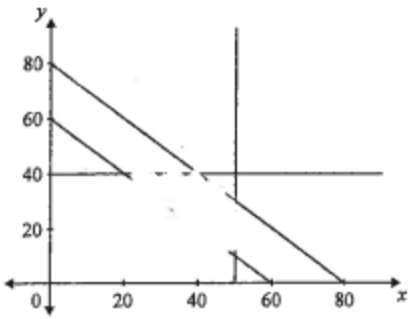
[2]

7 A factory makes two types of jeans, type A and type B.
Each month, $x$ of type A and $y$ of type B jeans are made.

The following constraints control the daily production:

- Not more than 50 jeans of type A can be made.
- Not more than 40 jeans of type B can be made.
- The total number of jeans must be at least 60.
- The maximum total number of jeans that can be made is 80

The diagram shows the four constraints.




NOT TO SCALE

One of the constraints is $x + y \leqslant 80$.

(a) Write down in terms of $x$ and/or $y$ the other three constraints.

*Answer (a)* .....

.....

.....

..... [4]

(b) On the diagram, shade the region that satisfies all the constraints. [1]

(c) $y = -2x + \frac{P}{150}$ is the function that represents the profit, P, in Maloti.

Find the profit of each type of pair of jeans.

*Answer (c)* Type A. .....

Type B. [2]

**(d)** How many of each type of jeans should be produced per day to maximise profit?

*Answer (d)* Type A ..... .....

Type B ..... ..... [2]

**(e)** What is the maximum profit?

*Answer (e)* M .... ..... [1]

**(f)** Explain how the profit would be affected if the profit function was $y = -x + \frac{P}{150}$.

*Answer (f)* ..... [1]

8 The numbers 0, 0, 1, 1, 1, 2, $p$, 9, 10, 13, $q$, 16 are in order.
Their mean is 6 and their median is 3.5.

**(a)** State the mode.

*Answer (a)* ..... [1]

**(b)** Find the range.

*Answer (b)* ..... [1]

**(c)** Find the value of

**(i)** $p$,

*Answer (c)(i)* $p =$ ..... [1]

**(ii)** $q$.

*Answer (c)(ii)* $q =$ ..... [2]

**(d)** Find the probability that a number chosen at random is 0 or 1.

*Answer (d)* ..... [1]

**(e)** One number is chosen and not replaced.
A second number is then chosen.

Calculate the probability that the two numbers are both 0 or both 1.

*Answer (e)* ..... [3]

9 The table shows the time ($t$ seconds) taken by 100 candidates to answer a given question.

| $t$ | $0 < t \leqslant 20$ | $20 < t \leqslant 30$ | $30 < t \leqslant 40$ | $40 < t \leqslant 50$ | $50 < t \leqslant 60$ | $60 < t \leqslant 80$ |
|---|---|---|---|---|---|---|
| Frequency | 10 | 10 | 43 | 22 | 7 | 8 |

**(a)** Calculate an estimate of the mean time taken.
Show your working.

*Answer (a)* ..... [4]

**(b)** The data is regrouped to give the following table.

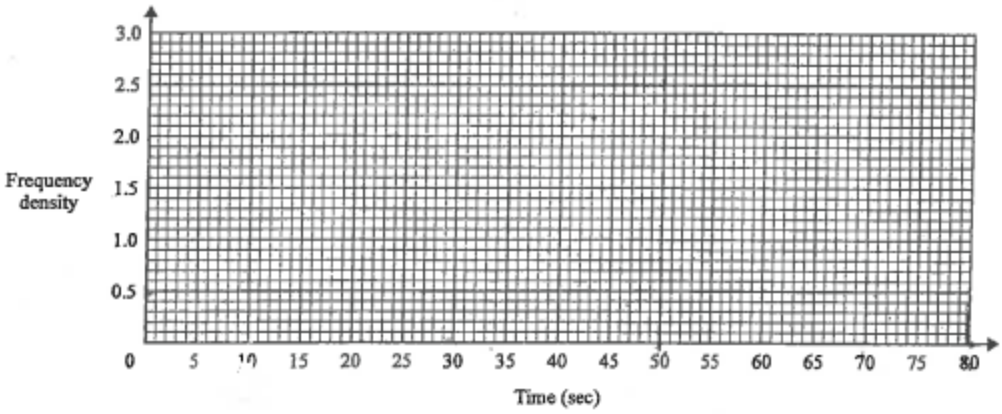
| $t$ | $0 < t \leqslant 20$ | $20 < t \leqslant 50$ | $50 < t \leqslant 80$ |
|---|---|---|---|
| Frequency | 10 | $v$ | $w$ |

**(i)** Write the values of $v$ and $w$.

*Answer (b)(i)* $v$ = .....

$w$ = ..... [2]

**(ii)** On the grid, draw a histogram which shows the information in the table in part (b).




[3]

**10** Thabiso runs 34 km at an average speed of $x$ km/h.

(a) Write down, in terms of $x$, an expression for the time taken.

*Answer (a)* ..... h [1]

(b) Lipuo runs 34 km at an average speed of 2 km/h greater than Thabiso's speed.

Write down, in terms of $x$, an expression for the time taken by Lipuo.

*Answer (b)* ..... ..... [1]

(c) It is given that Lipuo took **15 minutes** less than Thabiso to compete the 34 km.

Write down an equation in terms of $x$ and show that it simplifies to

$x^2 + 2x - 272 = 0$.

[3]

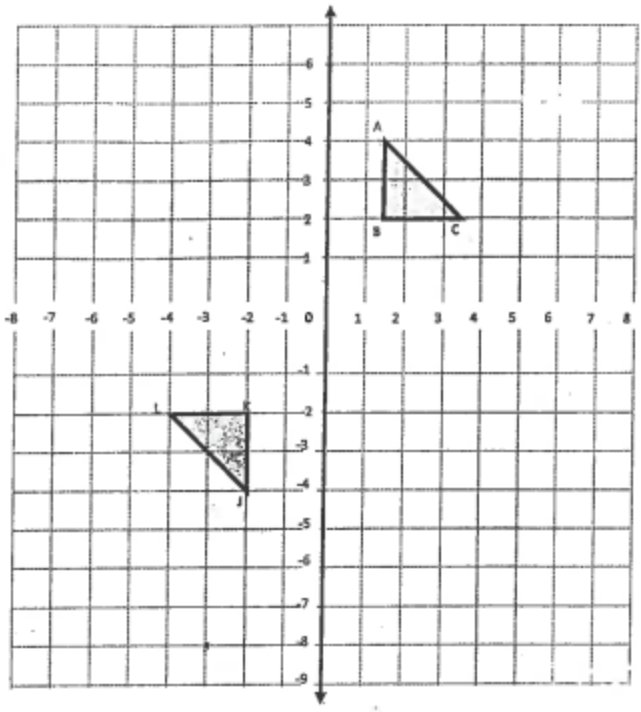
(d) Solve the equation $x^2 + 2x - 272 = 0$.
Give your answers correct to one decimal place

*Answer (d)* $x$ = .... ..... or $x$ = ... ... [4]

(e) Calculate, in hours and minutes, the time taken by Thabiso to complete the 34 km.

*Answer (e)* ..... ..... h ..... ..... min [2]

11




(a) A reflection in the line $x = -1$ maps triangle *ABC* onto triangle *DEF*.

Draw and label triangle *DEF*. [2]

(b) A shear with shear factor 2 and invariant line $y = 2$ maps triangle *ABC* onto triangle *GHI*.

Draw and label triangle *GHI*. [2]

(c) Describe fully the single transformation which maps triangle $ABC$ onto triangle $JKL$.

*Answer (c)* .....

.....

.....

..... [3]

(d) Triangle $JKL$ is mapped onto triangle $MNP$.
The vertices of triangle $MNP$ are $M(-3, -8)$, $N(-3, -4)$ and $P(-5, -4)$.

Find a matrix which fully describes a single transformation which maps triangle $JKL$ onto triangle $MNP$.

*Answer (d)* ..... [2]

12 The functions f and g are defined as follows:

$$f : x \to \frac{2(x-1)}{x^2-2x-3} - \frac{1}{x-3}, \; x > 3, \text{ and } g : x \to 2x - 3.$$

**(a)** Show that $f(x) = \frac{1}{x+1}$.

[3]

**(b)** Find

**(i)** $f^{-1}(x)$,

*Answer (b)*(i) ..... ..... [2]

**(ii)** $g^{-1}(x)$.

*Answer (b)*(ii) ..... ..... [2]

**(iii)** $fg(x)$,

*Answer (b)*(iii) ..... ..... [2]

**(iv)** $(fg)^{-1}(x)$.

*Answer (b)*(iv) ..... ..... [2]

(c) Solve $\mathrm{fg}(x) = \frac{1}{8}$.

*Answer (c)* $x =$ ..... ..... [2]

(d) Show that $(\mathrm{fg})^{-1}(x) = \mathrm{g}^{-1}\mathrm{f}^{-1}(x)$

[3]