



Mathematics Skills for Computing

[Day] [Month] [Year]

Examination Paper

Answer ALL questions.

Clearly cross out surplus answers.

Time: 3 hours

The maximum mark for this paper is 100.

Any reference material brought into the examination room must be handed to the invigilator before the start of the examination.

SECTION A - Multiple Choice Question
Circle ONE (1) correct answer from A, B, C, or D for each question.
Each question is worth 1 mark.

Question 1

Simplify the following expression $x^5 + x + 2x^2 + x + x^2$

- | | |
|-----------------------|----------------------------|
| A $x^5 + 3x^2$ | B $x^5 + 2x + 3x^2$ |
| C $6x^9$ | D $x^9 + 2x$ |

1 mark

Question 2

Simplify the following expression $3m^2 \times 5m^3 \times m$

- | | |
|------------------|------------------|
| A $15m^8$ | B $5m^6$ |
| C $15m^6$ | D $15m^5$ |

1 mark

Question 3

Simplify the following expression $\frac{6y^5}{2y^2}$

- | | |
|--------------------|-------------------|
| A $3y^7$ | B $3y^3$ |
| C $3y^{-3}$ | D y^{10} |

1 mark

Question 4

Simplify the following expression $(3p^2)^3$

- | | | | |
|----------|--------|----------|---------------|
| A | $3p^6$ | B | $27p^6$ |
| C | $9p^5$ | D | $3p^5 + 3p^5$ |

1 mark**Question 5**

Simplify this expression $(5x^2)^{-2}$

- | | | | |
|----------|-------------------|----------|-------------------|
| A | $\frac{1}{10x^2}$ | B | $\frac{5}{x^4}$ |
| C | $\frac{25}{x^4}$ | D | $\frac{1}{25x^4}$ |

1 mark**Question 6**

Expand the equation $(r + 7)(r - 2)$

- | | | | |
|----------|-----------------|----------|-----------------|
| A | $r^2 + 5r - 14$ | B | $r^2 - 5r - 14$ |
| C | $r^2 + 14r - r$ | D | $r^2 + 5r - 5$ |

1 mark**Question 7**

Marks

Factorise $6x^2 + x - 15$

A $(x - 3)(6x + 5)$

B $(2x - 3)(3x - 5)$

C $(6x - 3)(x + 5)$

D $(2x - 3)(3x + 5)$

1 mark

Question 8

Factorise $x^4 - 81$

A $(x^2 + 9)(x^2 - 9)$

B $(x^4 + 9)(x^4 - 9)$

C $(x^2 + 9)(x^2 + 9)$

D $(x + 9)(x - 9)$

1 mark

Question 9

Simplify $\frac{x^2 - 25}{x + 5}$

A $(x - 5)$

B $(x + 5)$

C $(x + 5)(x - 5)$

D $5x$

1 mark

Question 10

Simplify $16 \times a^0$

A 1

B 16

C 0

D $\frac{1}{16}$

1 mark

Question 11

Marks

If $S \subset T$ and $T = \{1, 2, 5, 7, 10\}$, which of these statements could be true

A $S = \{0, 1, 2\}$

B $S = \{25\}$

C $S = \{10, 7, 5\}$

D $S = \{1, 2, 5, 8\}$

1 mark

Question 12

Given a universal set $\xi =$ whole numbers 11 – 15 and subset A is even numbers.
Find the set A'

A $A' = \{11, 12, 13, 14, 15\}$

B $A' = \{11, 13, 14, 15\}$

C $A' = \{12, 14\}$

D $A' = \{11, 13, 15\}$

1 mark

Question 13

Find the cardinality of the set $A = \{2, 3, 5, 7, 11, 15, 20\}$

A 8

B 7.87

C $\{2, 20\}$

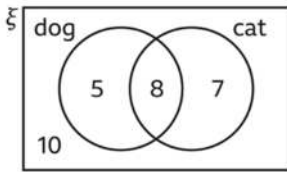
D 7

1 mark

Question 14

Consider the Venn diagram showing a class survey of pets.

How many people took part in the survey?



- A 22
- B 30
- C 38
- D 20

1 mark

Question 15

What is the order of the matrix

$$\begin{pmatrix} 2 & 3 \\ 4 & 5 \\ 6 & 7 \end{pmatrix}$$

- A 1
- B 2 x 3
- C 3 x 2
- D 6

1 mark

Question 16

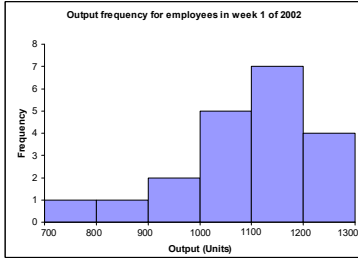
Name the type of matrix shown here $\begin{pmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{pmatrix}$

- A Identity Matrix
- B Scalar Matrix
- C Triangular Matrix
- D Zero Matrix

1 mark

Question 17

Name the type of graph shown below



A Bar Chart

B Pie Chart

C Histogram

D Ogive

1 mark

Question 21

Which of these calculations does **not** feature on a box plot diagram

- A** Lowest quartile **B** Highest quartile
C Median **D** Mean

1 mark**Question 22**

What type of correlation is shown in the scatter graph below?



- A** Strong positive correlation **B** No correlation
C Negative correlation **D** Weak positive correlation

1 mark**Question 23**

A data set is given by $M = \{10, 8, 5, 0, -2, 5, 9\}$. Calculate the mode of this data set.

- A** 10 **B** 5
C 7 **D** 6

1 mark

Question 24

A data set is given by $M = \{10, 8, 5, 0, -2, 5, 9\}$. Calculate the median of this data set.

A 0**B** 5**C** -2**D** 10**1 mark**

Question 29

A spinner has been spun FIFTY (50) times and has the following results.

Red	25 times spun
Blue	10 times spun
Green	15 times spun

What is the probability of spinning **not green** as a fraction in its lowest form

- A** $\frac{15}{50}$ **B** $\frac{35}{50}$
- C** $\frac{7}{10}$ **D** $\frac{5}{7}$

1 mark

Question 30

Using the same table in question 29 why would a Venn diagram **not** be a useful representation of the data.

- A** It would not be large enough to show all the data **B** It can not be used to show probability
- C** The outcomes are mutually exclusive events so there is no overlapping data sets to be shown **D** The outcomes are too complex to be shown on a Venn diagram

1 mark

Mark Scheme:

1: B	11: C	21:D
2: C	12: D	22:A
3: B	13: D	23:B
4: B	14: B	24:B
5: D	15: C	25:B
6: A	16: B	26:D
7: D	17: D	27:B
8: A	18: C	28:A
9: A	19: B	29:C
10: B	20: C	30:C

If the answer is ticked rather than circled award marks

If more than ONE (1) answer is selected award no marks even if the correct answer is selected

SECTION B
ANSWER ALL QUESTIONS

Question 31		Marks
a)	<p>TWO (2) new factories are employing workers at different rates.</p> <ul style="list-style-type: none"> Factory A starts with ZERO (0) workers and increases its workers at a rate of THIRTY (30) people per week. Factory B has an initial worker level of 250 workers but starts reducing it at a rate of TWENTY (20) people per week. <p>After how many weeks will the worker levels from both factories be equal?</p>	2
<p>Mark Scheme</p> <ul style="list-style-type: none"> $30x = 250 - 20x$ $50x = 250$ $x = 5$ (5 weeks) <p>(1 work for setting up equations, 1 mark for solving)</p>		
b)	<p>Solve the quadratic equation $2x^2 + x - 16 = 1$</p>	2
<p>Mark Scheme</p> $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-1 \pm \sqrt{1^2 - 4(2)(-17)}}{2(2)}$ $x = \frac{-1 \pm \sqrt{1 - -136}}{4}$ $x = \frac{-1 \pm \sqrt{137}}{4}$ $x = -3.17 \text{ or } x = 2.67$ <p>(1 mark for working out, 1 mark for both answers (+ and – must be seen))</p>		

c) TWO (2) linear equations are given as:

$$2x - 5 = y$$

$$3x + 7 = y$$

i) Solve the simultaneous equations.

3

Mark Scheme

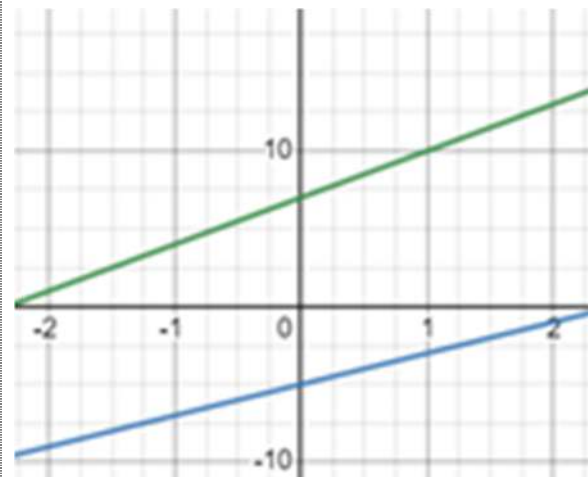
- **Eliminate y by subtracting formula 1 from 2 $\Rightarrow x + 12 = 0 \Rightarrow x = -12$**
- **Substituting $x = -12$ into formula 1 $= (2 \times -12) - 5 = y \Rightarrow y = -29$**
- **$x = -12 \quad y = -29$**

(1 mark for subtracting to find x , 1 mark for substitution, 1 mark for both correct answers)

ii) Plot line graphs for both equations on the same graph paper for values $-2 < x < 2$.

3

Mark Scheme

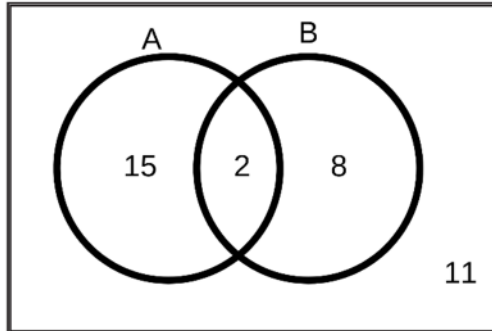


Total 10 Marks

Question 32

A class of students were asked in a healthy eating survey whether they had eaten at least one apple (Event A) or a banana (Event B) in the last week.

The results were captured in a Venn Diagram.



a) Find the number of students in each of the following sets.

i) $A \cap B$

1

Mark Scheme

- 2

(1 mark)

ii) B'

1

Mark Scheme

- 26

(1 mark)

iii) $A \cup B$

1

Mark Scheme

- 25

(1 mark)

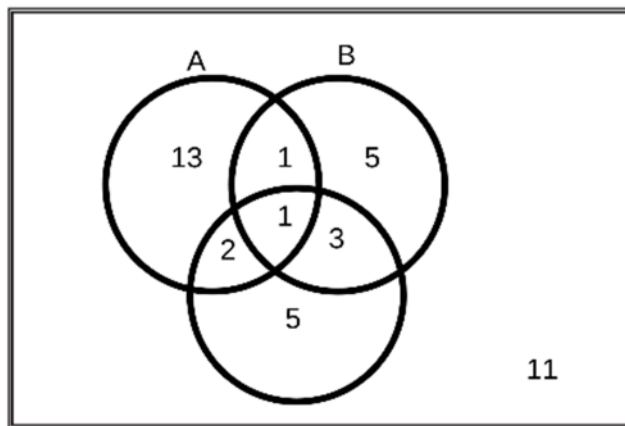
b) The students were then asked if they had eaten at least ONE (1) carrot (Event C). The results were as follows:

5

- TEN (10) students in total had eaten at least ONE (1) carrot
- TWO (2) students had eaten an apple and a carrot
- THREE (3) students had eaten a banana and a carrot
- ONE (1) student had eaten all THREE (3) in the last week

Draw a new Venn Diagram to represent the class survey results when the new Event C is added to the original data.

Mark Scheme

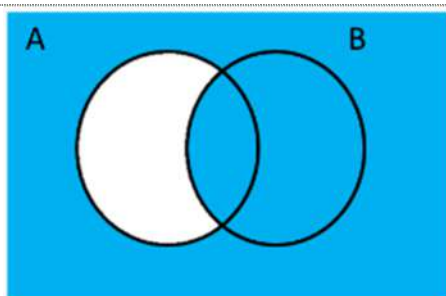


(1 mark for changing A values to 13 and 1, 1 mark for changing B values to 5 and 1)

(1 mark for 5 being in C on its own, 1 mark for 1 being in the centre, 1 mark for 2 and 3 being in correct positions in A and B respectively)

c) State the set notation for the following shaded areas of each Venn diagram.

i)



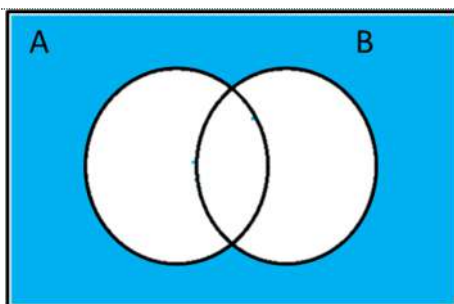
1

Mark Scheme

$A' \cap B$

(1 mark)

ii)



1

Mark Scheme

$$A' \cap B'$$

(1 mark)**Total 10 Marks****Question 33**

a) TWO (2) matrices are given as:

$$G = \begin{pmatrix} 5 & 4 \\ 4 & 5 \end{pmatrix} \quad H = \begin{pmatrix} 2 & -1 \\ 4 & \frac{1}{2} \end{pmatrix}$$

i) Calculate GH

2

Mark Scheme

$$= \begin{pmatrix} 26 & -3 \\ 28 & -1.5 \end{pmatrix}$$

(1 mark per correct column)ii) Using your answer in part (i) show that $GH \neq HG$.

3

Mark Scheme

Calculates $HG = \begin{pmatrix} 6 & 3 \\ 22 & 18.5 \end{pmatrix}$

Compares $\begin{pmatrix} 26 & -3 \\ 28 & -1.5 \end{pmatrix} \neq \begin{pmatrix} 6 & 3 \\ 22 & 18.5 \end{pmatrix}$

(2 marks for calculating fully correct HG, only 1 mark if only TWO (2)-THREE (3) correct components)
(1 mark for comparison with GH)

iii)	Show that the matrix $J = \begin{pmatrix} 3 & 6 \\ 1 & 2 \end{pmatrix}$ is a singular matrix.	2
<p>Mark Scheme</p> <ul style="list-style-type: none"> • Determinant = $(3 \times 2) - (6 \times 1) = 0$ • States division by zero is impossible and therefore the matrix has no inverse and is therefore singular <p>(1 mark for determinant calculation, 1 mark for correct statement around inverse)</p>		
iv)	<p>The matrix $K = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$.</p> <p>State the matrix K^T</p>	1
<p>Mark Scheme</p> $= \begin{pmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{pmatrix}$ <p>(1 mark)</p>		
v)	<p>The matrix $L = \begin{pmatrix} 2 & 2 \\ 0 & 4 \end{pmatrix}$ is mapped onto the point P with co-ordinate vector $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$.</p> <p>Find the new co-ordinate of P and state the effect of the matrix L.</p>	2
<p>Mark Scheme</p> <ul style="list-style-type: none"> • $\begin{pmatrix} 4 \\ 4 \end{pmatrix}$ • Enlargement of scale 4 <p>(1 mark for co-ordinate, 1 mark for effect)</p>		
Total 10 Marks		

Question 34

a) TWELVE (12) college lecturers were questioned by a doctor about their blood pressure. **3**

Their results were recorded as follows:

108 95 95 97 85 90 90 100 105 112 120 120

Present this information in a stem and leaf diagram

Mark Scheme:

```

8 | 5
9 | 0 0 5 5 7
10 | 0 5 8
11 | 2
12 | 0 0
    
```

(1 mark for FIVE (5) correct stems, 1 mark for all TWELVE (12) data entries, 1 mark for correct ordering of each leaf)

b) A doctor keeps a record of how many appointments his patients miss over TWELVE (12) months. The table shows the results:

Appointments missed	Frequency
0-1	100
2-3	40
4-5	20
5-6	15
7-8	10
8-10	5

i) Calculate the cumulative frequency of the data. **1**

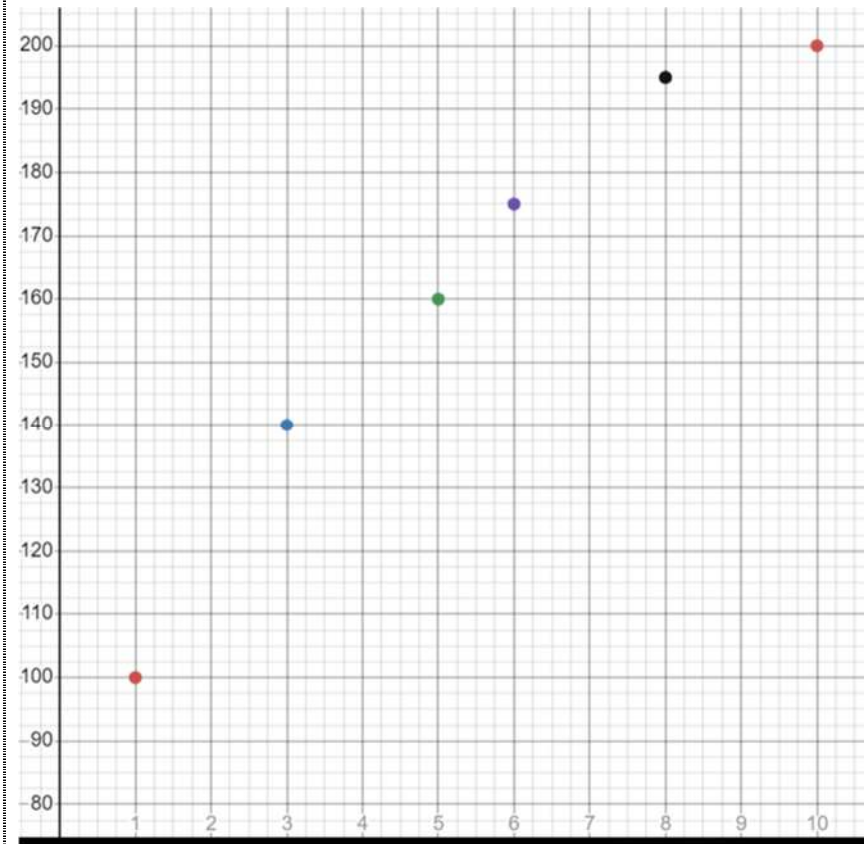
Mark Scheme

Appointments missed	Frequency	Cumulative Frequency
0-1	100	100
2-3	40	140
4-5	20	160
5-6	15	175
7-8	10	185
8-10	5	190

ii) Eman has been asked to draw a cumulative frequency graph of the data. Her graph is shown below.

3

Give **THREE** (3) different ways in which the graph needs to be improved.



Mark Scheme

- *A title can be added to the graph*
- *The axis labels need to be added to the graph.*
- *The last data point is plotted incorrectly*
- *There needs to be a smooth line connecting the points*
- *The y-axis can start from 100, not 80.*

(1 mark for each bullet to a max of 3, do not allow the x axis label and y-axis label as separate points)

c) Look at the two-way table below showing data collected about a set of patients.

	Left Handed	Right Handed
Blue Eyes	8	65
Brown Eyes	7	25
Neither	10	35

i) Find the probability that a patient selected at random is a right-handed student with brown eyes. Express your answer as a decimal.

1

Mark Scheme

$$\frac{25}{150} = \frac{1}{6} = 0.17$$

(1 mark)

ii) Find the probability that a patient selected at random does **not** have blue eyes. Express your answer as a percentage to one significant figure.

2

Mark Scheme

$$\frac{77}{150} = 0.513 = 51\% = 50\% \text{ (to 1 s.f.)}$$

(1 mark for fraction, 1 mark for answer)

Total 10 Marks

Question 35

a) MathsStar is an international maths competition where children across the world take part to answer HUNDRED maths questions.

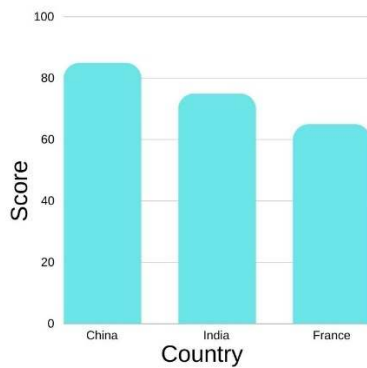
THREE (3) countries took part in the competition. The results are given in the table.

Country	Average Result
China	85
India	75
France	65

i) Draw an appropriate graph which best shows the comparison of this data. You may choose the type of graph you draw.

3

Mark Scheme



(1 mark for selecting a bar chart, 1 mark for labelling the x and y axis, 1 mark for THREE (3) correct bars)

ii) A school in France believed the international test was unfairly difficult so the school asked FIVE (5) children to do their school test to compare the results.

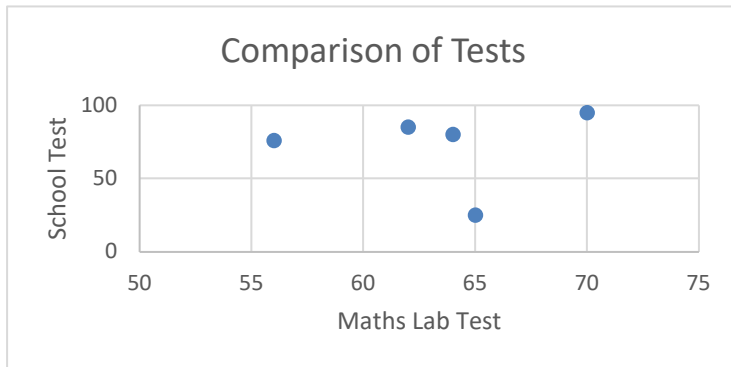
4

The results are given in the table.

Draw a scatter graph to show these results.

Student	MathsStar Result	School Test Result
A	56	76
B	62	85
C	65	25
D	70	95
E	64	80

Mark Scheme



(1 mark for THREE (3) correctly plotted points, 1 mark for all points plotted correctly, 1 mark for x and y axis labels – Maths lab and School Test and 1 mark for the title - ‘Comparison of tests’)

iii) State the student who is classed as an outlier.

1

Mark Scheme

Student C

(1 mark)

iv)	Describe whether your graph in part ii) supports the school's claim that the international maths test was too hard.	2
	<p>Mark Scheme</p> <ul style="list-style-type: none"> <i>The graph shows a positive correlation but not at the same rate, students performed better on the school test.</i> <i>The school claim is proven.</i> <p><i>(1 mark for stating the case is proven, 1 mark for explanation using the graph in part iii)</i></p>	

Total 10 Marks

Question 36

a) Consider the data set:

5	8	8	8	12	16	17	20	20	6
---	---	---	---	----	----	----	----	----	---

i)	Find the median value.	1
----	------------------------	----------

	<p>Mark Scheme</p> <p>= 10 (1 mark)</p>	
--	--	--

ii)	Find the interquartile range.	3
-----	-------------------------------	----------

	<p>Mark Scheme</p> <ul style="list-style-type: none"> <i>First quarter = 8</i> <i>Third quarter = 17</i> <i>IQR = 17-8 = 9</i> <p><i>(1 mark for 1st quarter, 1 mark for third quarter, 1 mark for IQR)</i></p>	
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iii) Draw a box plot diagram to represent this data.

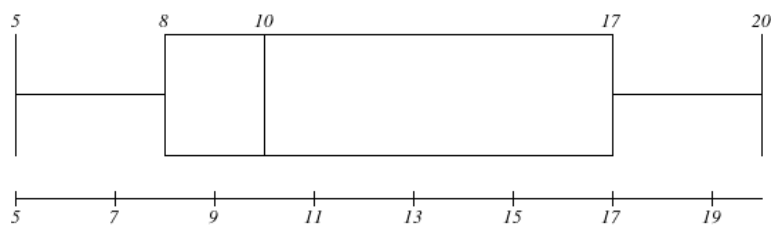
3

Mark Scheme

- **Median is shown at 10**
- **LQR and UQR are set at 8 and 17 (allow carry through if part ii is incorrect)**
- **Min and max amounts are shown at 5 and 20 and lines connecting the box are drawn**

Ignore any additional lines

1 mark for each correct bullet



iv) Calculate the mean deviation for the data set.

4

Mark Scheme

Calculate the mean = 12

Data item	$x = 12$	$x - \bar{x}$
5	12	7
6	12	6
8	12	4
8	12	4
12	12	0
16	12	4
17	12	5
20	12	8
20	12	8

$$\frac{\sum |x - \bar{x}|}{n}$$
$$= \frac{46}{10}$$
$$= 4.6$$

(1 mark for the mean, 1 mark for correct mean subtractions, 1 mark for use of formula, 1 mark for correct answer)

Total 10 Marks

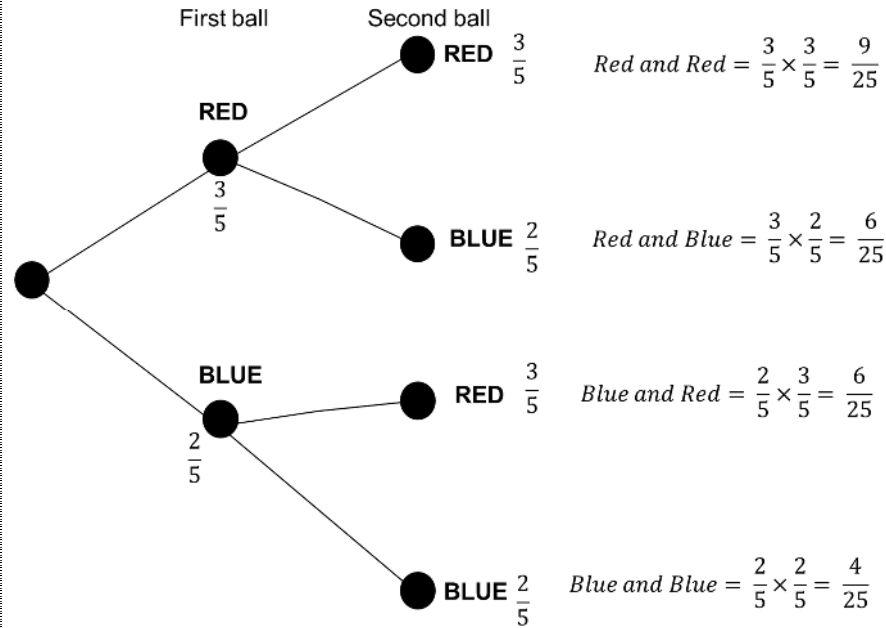
Question 37

a) A bag contains THREE (3) red balls and TWO (2) blue balls. A ball is drawn at random, its colour noted, and then it is placed back into the bag. After replacing, a second ball is drawn.

i) Draw a tree diagram to represent this information **and** calculate the probabilities for each TWO (2)-ball combination

6

Mark Scheme



(1 mark for each correct sub-branch, 1 mark x 4 for correct calculations)

ii) Calculate the probability of drawing **at least ONE (1)** red ball.

2

Mark Scheme

$P(\text{drawing at least 1 red}) = 1 - P(\text{drawing no reds})$

$= 1 - \frac{4}{25} = \frac{21}{25}$

(1 mark for method, 1 mark for answer, allow follow through if using wrong answer from part a)

iii)	Calculate the probability of drawing TWO (2) balls of the same colour	2
<p>Mark Scheme</p> <p><i>P(drawing TWO (2) balls same) = P(drawing TWO (2) reds) + P(drawing TWO (2) blue)</i></p> $= \frac{4}{25} + \frac{9}{25} = \frac{13}{25}$ <p><i>(1 mark for method, 1 mark for answer, allow follow through if using Wrong answer from a)</i></p>		
Total 10 Marks		

End of paper

Learning Outcomes matrix

Question	Learning Outcomes assessed	Marker can differentiate between varying levels of achievement
1 – 30	All	Yes
31	LO2, LO3	Yes
32	LO4	Yes
33	LO5	Yes
34	LO6	Yes
35	LO6 LO7	Yes
36	LO7	Yes
37	LO8	Yes

Grade descriptors

Learning Outcome	Pass	Merit	Distinction
Be able to perform a range of algebraic calculations	Demonstrate ability to perform calculations	Demonstrate ability to perform calculations consistently well	Demonstrate ability to perform all calculations to the highest standard
Be able to solve a range of basic equations	Demonstrate ability to perform techniques	Demonstrate ability to perform techniques consistently well	Demonstrate ability to perform techniques to the highest standard
Be able to represent and solve algebraic equations through graphical solutions	Demonstrate ability to perform techniques	Demonstrate ability to perform techniques consistently well	Demonstrate ability to perform techniques to the highest standard
Understand the fundamentals of Set Theory	Demonstrate adequate understanding of techniques	Demonstrate robust understanding of techniques	Demonstrate highly comprehensive understanding of techniques
Understand the fundamentals of Matrices	Demonstrate adequate understanding of techniques	Demonstrate robust understanding of techniques	Demonstrate highly comprehensive understanding of techniques
Be able to present data and relationships in graphical form	Demonstrate adequate understanding of techniques	Demonstrate robust understanding of techniques	Demonstrate highly comprehensive understanding of techniques
Understanding and use simple descriptive statistics	Demonstrate adequate understanding of techniques	Demonstrate robust understanding of techniques	Demonstrate highly comprehensive understanding of techniques
Understand the fundamentals of Probability	Demonstrate adequate understanding of techniques	Demonstrate robust understanding of techniques	Demonstrate highly comprehensive understanding of techniques