ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2024

SECONDARY 4 EXPRESS / 4 NORMAL (ACADEMIC) SBB /
5 NORMAL (ACADEMIC)

Candidate's Name	Class	Register Number

MATHEMATICS 4052/01

PAPER 1

21 August 2024
2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use paper clips, glue or correction fluid.

Answer **all** the questions.

If working is needed for any question, it must be shown with the answer.
Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.
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 π, 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 **90**.

90

Setter: Ms Estee Teo
Vetter: Mr Francis Tan

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Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

$$a^2 = b^2 + c^2 - 2(b)(c)\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

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Answer **all** the questions.

1 **(a)** Expand and simplify $2a-3(a+5b)$.

Answer ..... [1]

(b) Factorise completely $-3x^2+12y^2$.

Answer ..... [2]

---

2 **(a)** Calculate $\dfrac{5048.9^2-30140}{14.69+9.656}$.

Write your answer correct to 5 significant figures.

Answer ..... [1]

(b) Write your answer to **part (a)** in standard form.

Answer ..... [1]

---

3 Given that $\sin\theta = 0.4$, find the two possible values for angle θ, where $0° \le \theta \le 180°$.

Answer θ = ... or ..... [2]

[Turn over]

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4 **(i)** A stack of coloured paper contains green, purple and blue sheets of paper.
A piece of paper is selected at random from the stack.
The probability that the paper is green is 10%.
The probability that the paper is purple is $\frac{7}{20}$.
Find the probability that the paper is blue.

Answer ..... [1]

(ii) A few pieces of green paper were added to the stack.
The probability of picking a piece of purple paper from this stack at random is now $\frac{1}{3}$.

If there were 120 sheets of paper initially, find the new probability of picking a blue piece of paper.

Answer ..... [3]

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5 5.4 4.8 7.8 6.4 1.9 9.3 6.3 8.7

(a) Find the median of the set of numbers.

Answer ..... [1]

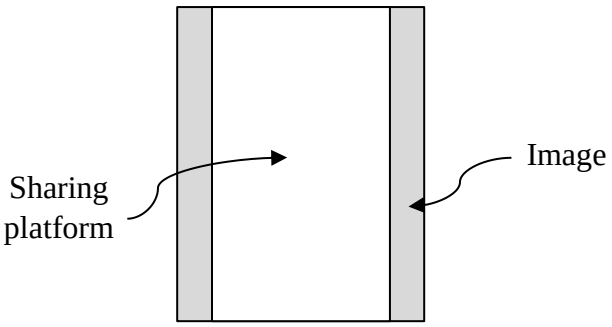
(b) Find the range of the set of numbers.

Answer ..... [1]

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6 A picture taken on a particular handphone has dimensions in the ratio width : height = 3 : 4.
On a sharing platform, the recommended dimensions for the picture are in the ratio width : height = 9 : 16.

When uploaded, the picture only fills the height of the sharing platform and not the width, as shown in the diagram, with the grey areas representing the portions of the image that will not be seen on the sharing platform.



Find the fraction of the image that will not be seen on the sharing platform.
Give your answer in its lowest terms.

Answer ..... [3]

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7 Simplify $\dfrac{(-2q)^4}{6\sqrt{p^5}} \times \dfrac{3\sqrt{p}}{-q}$. Leave your answer in positive index notation.

Answer ..... [3]

---

8 The cost of a pen is $\$a$.
The cost of a marker is $\$b$.

Amelia buys 5 pens and 3 markers for \$11.90.
Benny buys 8 pens and 2 markers for \$14.

Form and solve two simultaneous equations to find the cost of a pen and the cost of a marker.

Answer Pen \$ .....

Marker \$ ..... [3]

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9 In this scale drawing, *A* is a house on a piece of land.

Scale : 1 cm to 10 m



An object is buried 100m from house *A* at a bearing of 200°.

(a) Mark and label on the drawing the position, *T*, of the object. [2]

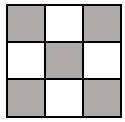
(b) A house *B* is located equidistant between house *A* and the object *T*, and is on a bearing of between 90° and 180° from house *A*.

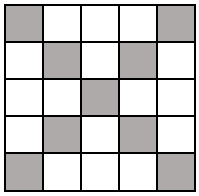
Mark and label on the drawing a possible location of house *B*. [2]

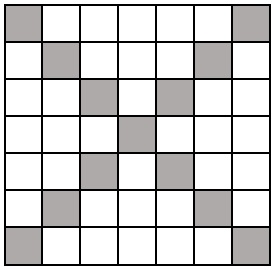
[Turn over]

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10 The first four diagrams in a sequence are shown below.


Diagram 1


Diagram 2


Diagram 3

(a) Find the number of grey squares in Diagram 5.

Answer ..... [1]

(b) Find an expression, in terms of n, for the number of grey squares in Diagram n.

Answer ..... [2]

(c) Diagram n has 400 white squares.
Find n.

Answer Diagram ..... [3]

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11 264 1-cm cubes are to be arranged to form a cuboid.
Only one length of the cuboid is a prime number.

Find a possible set of dimensions of the cuboid.

Answer ..... cm by ..... cm by ..... cm [2]

---

12 A model of a school is made.
The actual floor area of the school field is 4050 square metres.

(a) On the model, the area of the school field is 20 cm^2.
Find the scale of the model in the form 1 : *n*, where *n* is correct to two significant figures.

Answer 1 : ..... [2]

(b) The scale on another model is 1 : 4000.
Find the area of the school field on this model.

Answer ..... cm^2 [2]

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13 The table shows the heights of 50 students, measured in January 2023.

Heights, h cm	Frequency
$130 \leq h < 140$	1
$140 \leq h < 150$	4
$150 \leq h < 160$	16
$160 \leq h < 170$	27
$170 \leq h < 180$	2

(a) Calculate an estimate for

(i) the mean height of the students,

Answer ..... cm [1]

(ii) the standard deviation of the heights.

Answer ..... cm [1]

(b) The heights of the same group of students were measured again in January 2024.

The shortest height measured was 146 cm.
The tallest height measured was 180 cm.

State how the mean and standard deviation will change in January 2024.

.....

..... [1]

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14 Given that $9^{2x} = 243 \times 3^{x}$, find x.

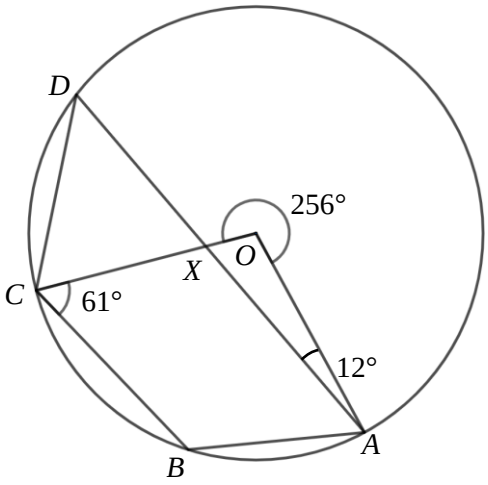
Answer ..... [2]

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15 Factorise $10x^2 + 11x - 6$.

Answer ..... [2]

16



A, *B*, *C* and *D* are four points on a circle, centre *O*.
Angle *OCB* = 61°, angle *OAD* = 12° and reflex angle *AOC* = 256°.
OC and *AD* intersect at the point *X*.

Find angle *BAD*.
Give reasons for each step of your working.

Answer Angle *BAD* = ... [3]

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17 Jade has a sum of money in her bank account.
She gives half of it to her mother and uses \$150.
She receives \$500 on her pay day into the bank account.
She then uses 20% of the amount in her bank account and is left with **not more than** \$800.

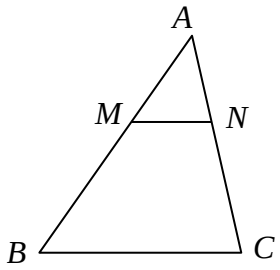
(a) By using x to represent the original sum of money in Jade's bank account, write down an inequality in x.

Answer ..... [2]

(b) Solve your inequality to find the largest possible value of x.

Answer ..... [2]

18



In the diagram, M and N lie on AB and AC respectively such that $AM : MB = AN : NC = 1 : 3$.

Show that MN is parallel to BC.
Give a reason for each statement you make.

Answer

[4]

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19 $2a = \dfrac{x}{3x - 2y}$

Rearrange the formula to make x the subject.

Answer $x =$ ..... [3]

---

20 Write as a single fraction in its simplest form $\dfrac{6x}{18x - 3} - \dfrac{1}{1 - 6x}$.

Answer ..... [3]

[Turn over]

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21 The population of a town was tracked across a few decades.

The population, P, after t years can be modelled by the equation $P = n \times 2^{0.1t}$ where n is the population in the year 1960.

(a) The initial population of the town was 310 people.
Find n.

Answer ..... [1]

(b) Find the population of the town in the year 2000.

Answer ..... [1]

(c) From the above data, Geraldine concluded that the population in the year 2040 will be 32 times the population in the year 1960.

By using calculations, explain whether Geraldine is correct.

Answer

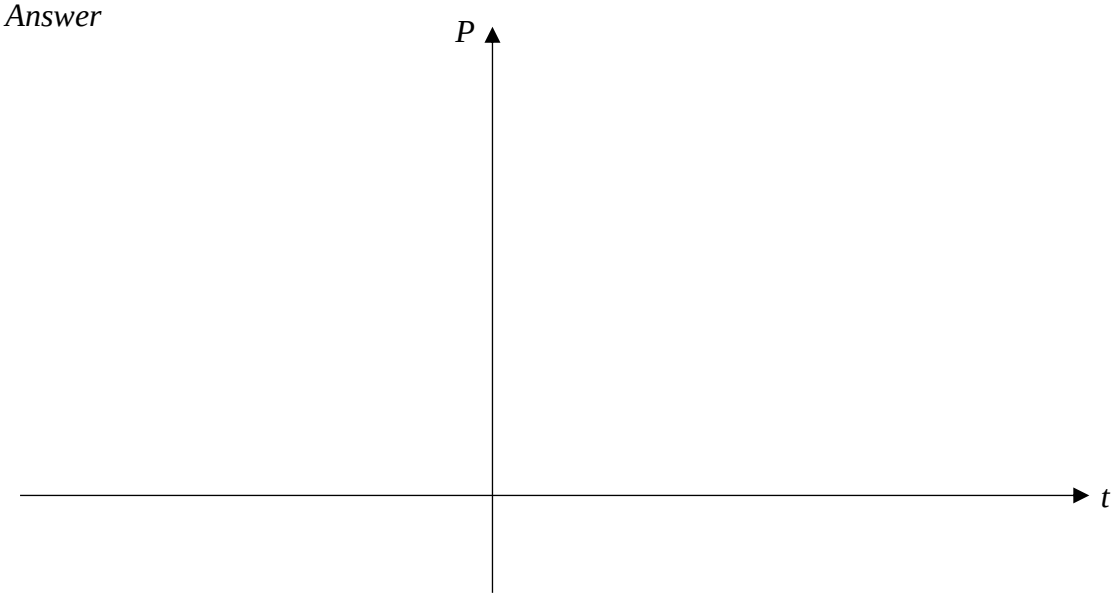
[3]

[Turn over]

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21 **(d)** Sketch the graph of the function $P = n \times 2^{0.1t}$, using the information obtained in parts **(a)** and **(b)**. Show the values on the axes clearly.

Answer



[2]

---

22 On Monday, a car travelling from work to home at an average speed of p km/h takes 30 minutes to complete the journey.

On Tuesday, the car decreased its average speed by q% and took 45 minutes instead to complete the same journey.

Find the value of q.

Answer ..... [3]

[Turn over]

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23 Gwee is making cookies and brownies.

A single chocolate cookie requires 14g of sugar, 10g of butter and 10g of chocolate.
A slice of brownie requires 30g of sugar, 19g of butter and 25g of chocolate.
This information can be represented by the matrix $\mathbf{A} = \begin{pmatrix} 14 & 10 & 10 \\ 30 & 19 & 25 \end{pmatrix}$.

Gwee wants to make x cookies and 20 brownies.
This information can be represented by the matrix $\mathbf{B} = \begin{pmatrix} x & 20 \end{pmatrix}$.

(a) Find, in terms of x, the matrix $\mathbf{T} = \mathbf{BA}$.

Answer $\mathbf{T} =$ [2]

(b) Explain what the elements of the matrix **T** represent.

.....

..... [1]

(c) In the supermarket, the ingredients are sold in the following quantities:

1 pack of sugar (500g)
1 packet of butter (200g)
1 pack of chocolate (240g)

If Gwee buys 2 packets of sugar, find the largest integer value of x.

Answer $x =$ ..... [2]

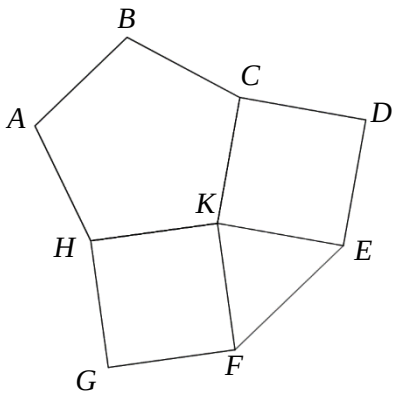
(d) State the corresponding quantity of butter and chocolate required.

Answer ..... packets of butter

..... packs of chocolate [2]

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24



The diagram shows a regular pentagon, two squares and a triangle.

(a) Find angle *ABC*.

Answer ..... [2]

(b) Explain why the triangle *KFE* is not an equilateral triangle.

.....

.....

.....

..... [2]

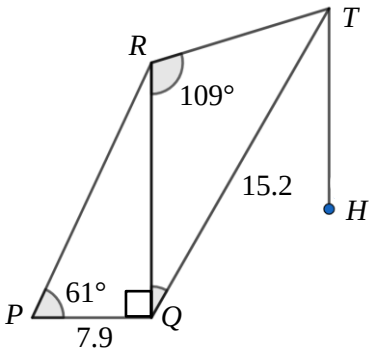
(c) A polygon has interior angle *BCD*.
Find the number of sides of the polygon.

Answer ..... [3]

[Turn over]

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25



The diagram shows a simplified diagram of a crane with base *PQ* lifting a load *H*.
PQ is perpendicular to *RQ* and *TH*.
TQ is a fixed beam that moves through angle *RQT*.
PQ = 7.9 m, *TQ* = 15.2 m, angle *RPQ* = 61° and angle *QRT* = 109°.

The safe working angle for angle *RQT* is between 10° to 90°.
Determine if the crane is safe for use when angle *QRT* = 109°.

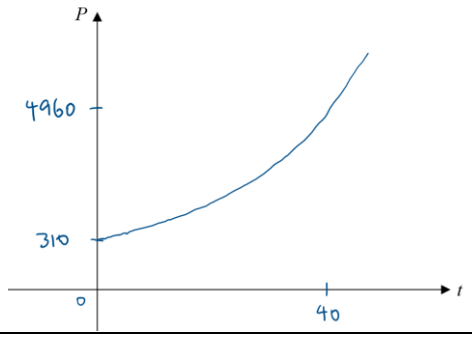
Answer

[4]

End of Paper

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Zhonghua Secondary School
2024 4Exp/5NA/4NA SBB Preliminary Examinations
4052/1 Mathematics Paper 1
Answer Key

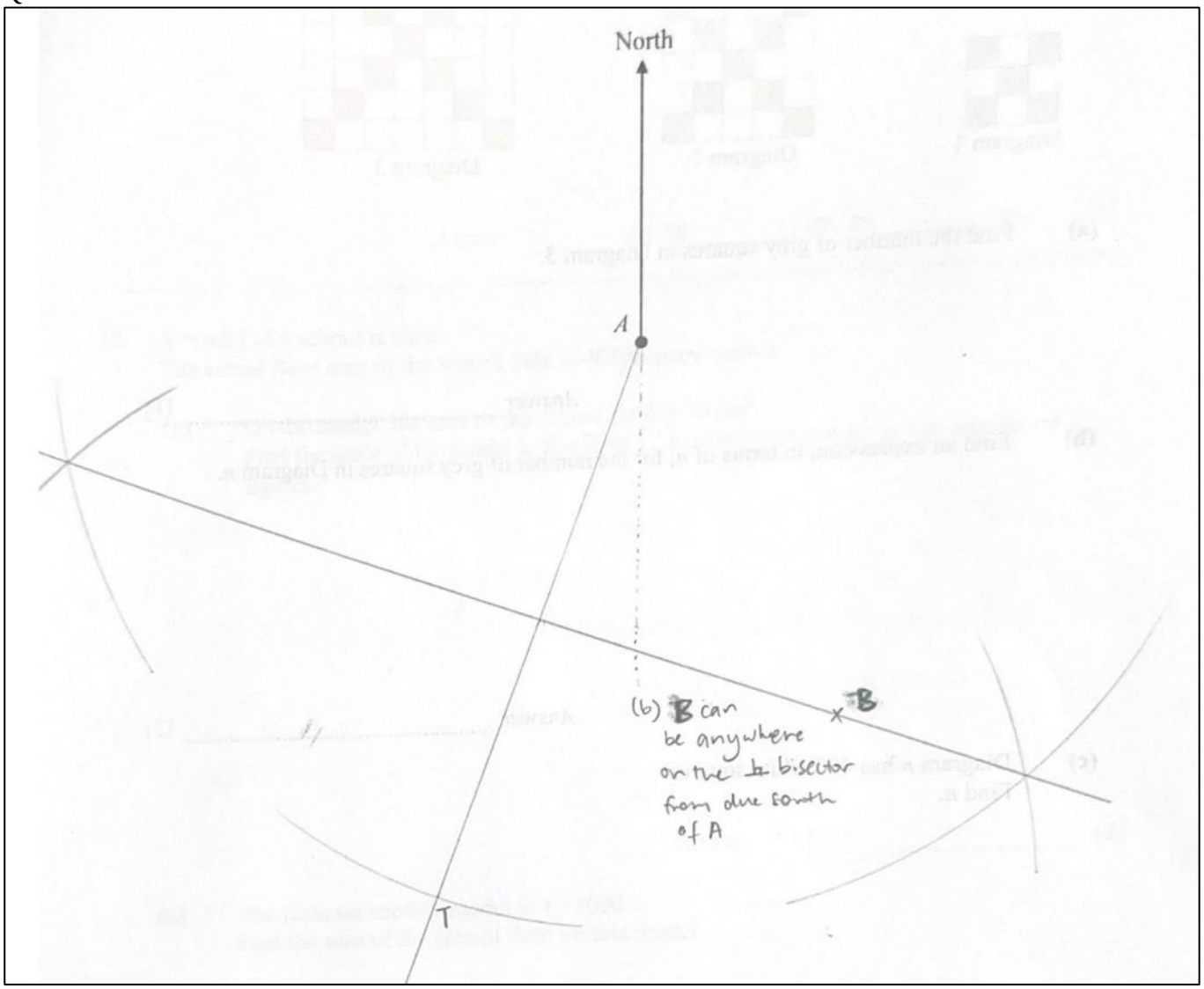
1a	$-a-15b$	17a	$\left[\left(\frac{x}{2}-150\right)+500\right]\times 0.8\le 800$
1b	$-3(x-2y)(x+2y)$		
2a	1045800	17b	1300
2b	1.0458×10^6	18	$\angle MAN = \angle BAC$ (common angle) $\frac{AM}{AB}=\frac{AN}{AC}=\frac{1}{4}$ (given) ΔMAN is similar to ΔBAC as two pairs of sides are in the same ratio and the included angle is equal (SAS similarity) $\angle AMN = \angle ABC$ (corresponding angles of similar triangles) => MN // BC (converse of corresponding angles)
3	23.6° or 156.4°		
4i	$\frac{11}{20}$		
4ii	$\frac{11}{21}$		
5a	6.35		
5b	7.4		
6	$\frac{1}{4}$		
7	$-\frac{8q^3}{p^2}$	19	$x=\frac{4ay}{6a-1}$
8	Pen = \$1.30; Marker = \$1.80	20	$\frac{2x+1}{6x-1}$
9	*See next page*		
10a	21	21a	310
10b	2(2n + 1) – 1 or 4n + 1	21b	4960
10c	10	21c	Population in 2040 = $310\times 2^{0.1(80)}$ = 79360 No. of times the population increased from 1960 to 2040 = 79360 ÷ 310 = 256 Hence, Geraldine is incorrect as it is 256 times and not 32 times.
11	2cm by 6cm by 22cm 3cm by 4cm by 22cm 4cm by 6cm by 11cm		
12a	1400		
12b	2.53125		
13ai	160		
13aii	7.81		
13b	The mean height will increase. *[shortest height has increased, more taller heights]* The standard deviation will decrease. *[slightly smaller range of values as there are no more values in the smallest class interval]*	21d	
14	$\frac{5}{3}$		
15	(5x – 2) (2x + 3)	22	$\frac{100}{3}$
16	55°		

[Turn over]

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23a	$\mathbf{T} = \begin{pmatrix} 14x+600 & 10x+380 & 10x+500 \end{pmatrix}$	24a	108°
23b	T represents the total amount of sugar, butter and chocolate respectively that is required to make x cookies and 20 brownies.	24b	$\angle HKE / \angle BCD = 360° - 72° - 90° - 90° = 72°$ For triangle KFE to be an equilateral triangle, each interior angle must be 60°. Since $\angle HKE = 72° \neq 60°$, triangle KFE is not equilateral.
23c	28	24c	20
23d	4 packets of butter 4 packs of chocolate	25	$\angle RQT = 8.5575°$ Since $\theta = 8.5575° < 10°$, the crane is not safe for use when angle $QRT = 109°$.

Question 9



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