HUA YI SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024

4-G3 / 5-G2

NAME

CLASS | INDEX NUMBER

MATHEMATICS **4052/02**

PAPER 2

19 August 2024

2 hour 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class, and index number 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.

Answer **all** the 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 with the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 90.

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.

For Examiner's Use	90

Setter: Ms Jasmine Tan

[Turn Over

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ is in radians

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

Trigonometry

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

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

Statistics

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

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

1 **(a)** Express as a single fraction in its simplest form $\frac{2}{7-3x}-\frac{1}{6-x}$.

Answer ..... [2]

(b) It is given that $v=\frac{3-5w}{w+2}+9$.

(i) Find v when $w=-6$.

Answer ..... [1]

(ii) Rearrange the formula to make w the subject.

Answer w = ... [3]

(c) Solve the equation $\frac{5}{x-2} - \frac{3}{x^2-4} = \frac{1}{7}$.

Give your solutions correct to two decimal places.

Answer x = ……..… , x = …… [5]

2 C is the point $(-9,1)$ and D is the point $(7,4)$.

$\overrightarrow{CE} = \begin{pmatrix} -2 \\ 8 \end{pmatrix}$.

(a) Calculate the length of the line CD.

Answer …… units [2]

(b) Determine the coordinates of point E.

Answer E (……. , ……..) [1]

(c) Find the equation of the line DE.

Leave your answer in the form $ax + by = c$, where a, b and c are constants.

Answer ……. [3]

3 **(a)** The first four terms of a sequence are 5, $\frac{9}{4}$, $\frac{13}{9}$, $\frac{17}{16}$.

(i) State the fifth term of the sequence.

Answer ..... [1]

(ii) Find an expression, in terms of n, for the nth term, T_n, of this sequence.

Answer T_n = ... [2]

(b) Elijah finds a number grid from his board game.

The diagram shows part of a number grid.

A rectangle outlining four numbers, as shown, can be placed anywhere on the grid.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37					

(i) If p represents the number in the top right corner of the rectangle, write down an expression, in terms of p, for the number in the bottom left corner of the rectangle.

Answer ..... [1]

(ii) Show that the difference between the products of the numbers in the opposite corners of the rectangle is always -7 .

Answer [2]

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(iii) Elijah says it is impossible for the sum of the four numbers in the rectangle to be 199.

Justify with relevant working, why he is correct.

Answer [3]

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4 **(a)** Sophie earns a monthly salary of $6875.
She gives 15% of this amount to her parents.
She puts 35% of the remainder into a savings account.

Calculate the amount she has left after giving to her parents and putting into her savings account. Leave your answer correct to the nearest dollar.

Answer $ ……. [3]

(b) The cash price of a sofa is $830.
Sophie buys this sofa on credit.
She pays a deposit of one quarter of the cash price.
She then pays 3 monthly payments of $260.

Calculate the total amount Sophie pays for the sofa.

Answer $ ……. [2]

(c) Sophie pays a monthly rent of $3174.20.
This is 18% more than her monthly rent last year.

Calculate her monthly rent last year.

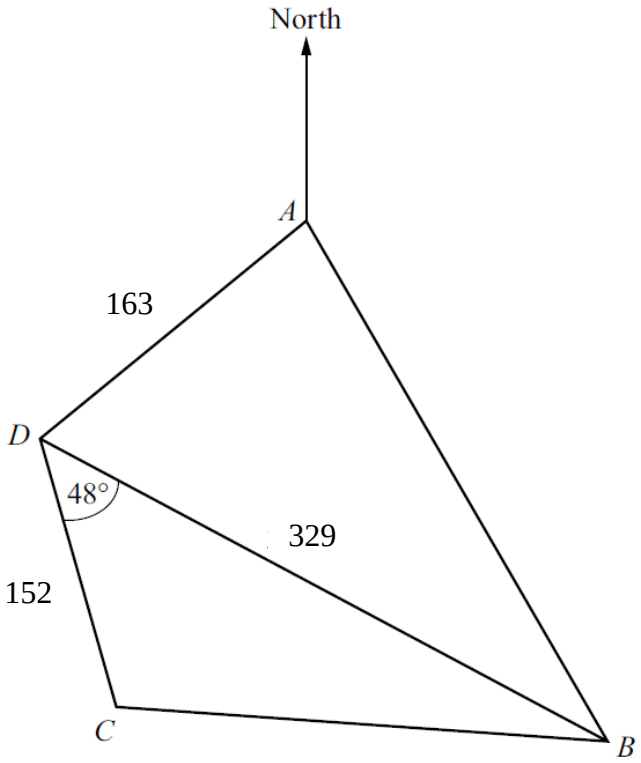
Answer $ ……. [2]

(d) During her vacation, Sophie visits her friend in Wellington.
Sophie spends NZD 940 in New Zealand using her credit card.
She is charged a 2.6% fee for the currency conversion.
The exchange rate between Singapore dollars (SGD) and New Zealand dollars (NZD) is SGD 100 = NZD 120.7206.

Calculate the total amount on Sophie's credit card bill, including the fee.
Give your answer in Singapore dollars, correct to the nearest cent.

Answer SGD ……. [3]

5



ABCD is a field on horizontal ground.

AD = 163 m, *BD* = 329 m, *CD* = 152 m and angle *BDC* = 48°.

The bearing of *B* from *A* is 151° and the bearing of *D* from *A* is 237°.

(a) Calculate the bearing of *D* from *B*.

Answer ..... ° [3]

(b) Calculate the distance from *B* to *C*.

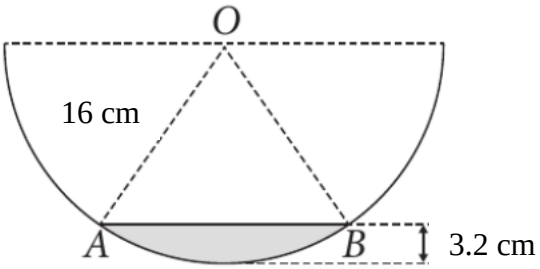
Answer ..... m [2]

(c) An aircraft is flying above *D*.

Find the angle of elevation of the aircraft from *C* when it is 245 m vertically above *D*.

Answer ..... ° [2]

6 The diagram shows a semicircle, centre O, radius 16 cm.



(a) Show that angle AOB = 1.287 radians, correct to 3 decimal places.

Answer [2]

(b) Calculate the area of the shaded region.

Answer ..... cm^2 [3]

(c) The semicircle is the cross section of a water trough of length 2.8 m, standing on level ground.

The shaded area represents the water in the trough.

(i) Calculate the volume of water, in cm^3, in the trough.

Leave your answer in standard form.

Answer …… cm^3 [3]

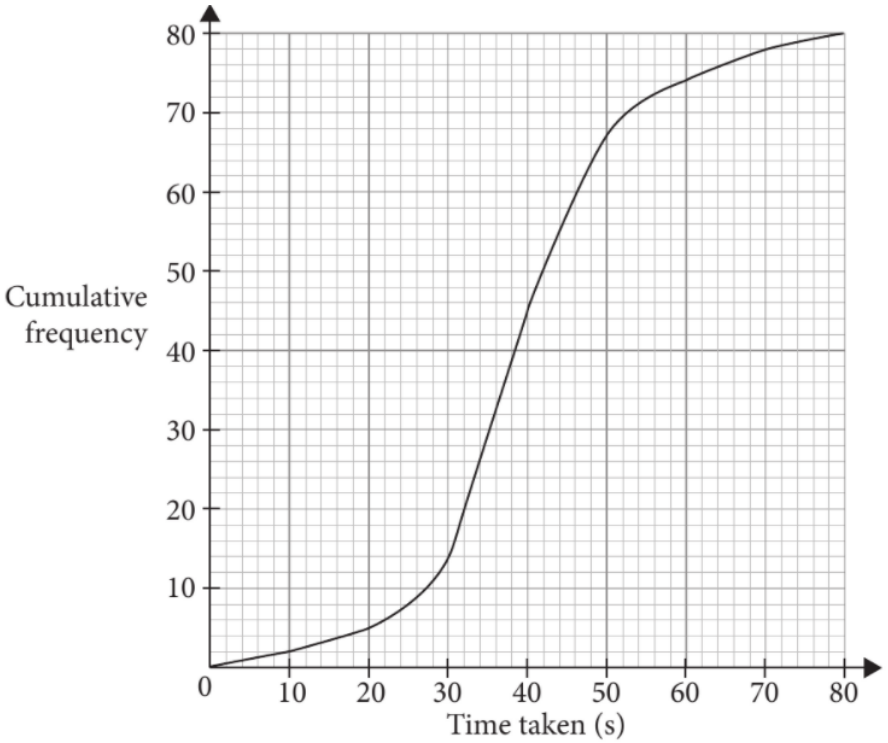
(ii) Calculate the number of litres of water that must be added to fill the trough.

Answer …… litres [3]

7 A researcher wants to conduct a study to find out if there is a correlation between the analytical skills of adults with age.

The researcher invited 80 adults to solve a number puzzle.

The cumulative frequency curve shows the distribution of the time taken.



(a) Use the curve to estimate

(i) the median time taken,

Answer ..... s [1]

(ii) the interquartile range of the time taken.

Answer ..... s [2]

(b) 20% of the adults took more than n seconds to solve the puzzle.

Find n.

Answer n = ... [2]

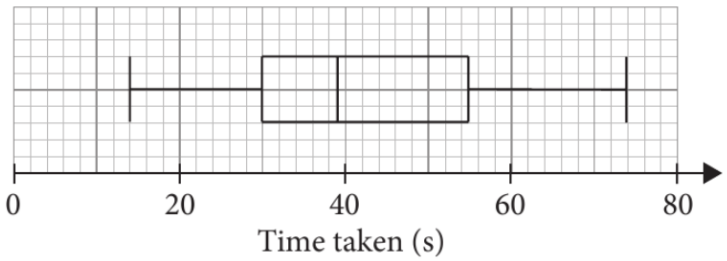
(c) The frequency distribution of the data for the 80 adults invited to solve the number puzzle is shown in the table.

Time taken, x (seconds)	*Frequency*
$0 < x \leq 20$	5
$20 < x \leq 40$	40
$40 < x \leq 60$	29
$60 < x \leq 80$	6

Find an estimate of the standard deviation of the time taken by the 80 adults to solve the number puzzle.

Answer ..... s [2]

(d) The same group of adults were each given a word puzzle to solve.
The box-and-whisker plot shows the distribution of the time taken.



Make two comparisons between the performances of the adults in solving the two puzzles.

Answer [2]

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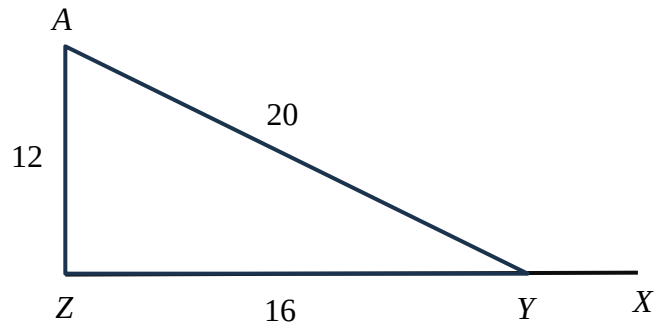
8 In the diagram, XYZ is a straight line.

AY = 20 m, AZ = 12 m and YZ = 16 m.

The ratio of XY : YZ is 1 : 4.



(a) Prove that triangle AYZ is right-angled.

Answer [2]

(b) Find the value of $\cos \angle AYX$, giving your answer as a fraction in its lowest terms.

Answer ..... [1]

(c) The area of triangle AXY is 24m^2.

Lenard says: In another triangle AYW, whereby the length $YW = YX$ and its area is the same as that of triangle AXY, it is possible for angle Y to be acute.

Explain why Lenard is correct. Use calculations to support your answer.

Answer [2]

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9 The variables x and y are connected by the equation $y = \frac{x^3}{2} - 5x - 2$.

Some corresponding values of x and y are given in the table.

x	–3	–2	–1	0	1	2	3	4
y	–0.5	4	2.5	–2	–6.5	k	–3.5	10

(a) Find the value of k.

Answer k = …….. [1]

(b) On the grid on **page 19**, draw the graph of $y = \frac{x^3}{2} - 5x - 2$ for $-3 \le x \le 4$. [2]

(c) The equation $\frac{x^3}{2} - 5x = 7$ has only one solution.

Explain how this can be deduced from your graph.

Answer [2]

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(d) By drawing a tangent, estimate the gradient of the curve at $(1, -6.5)$.

Answer Gradient = …….. [2]

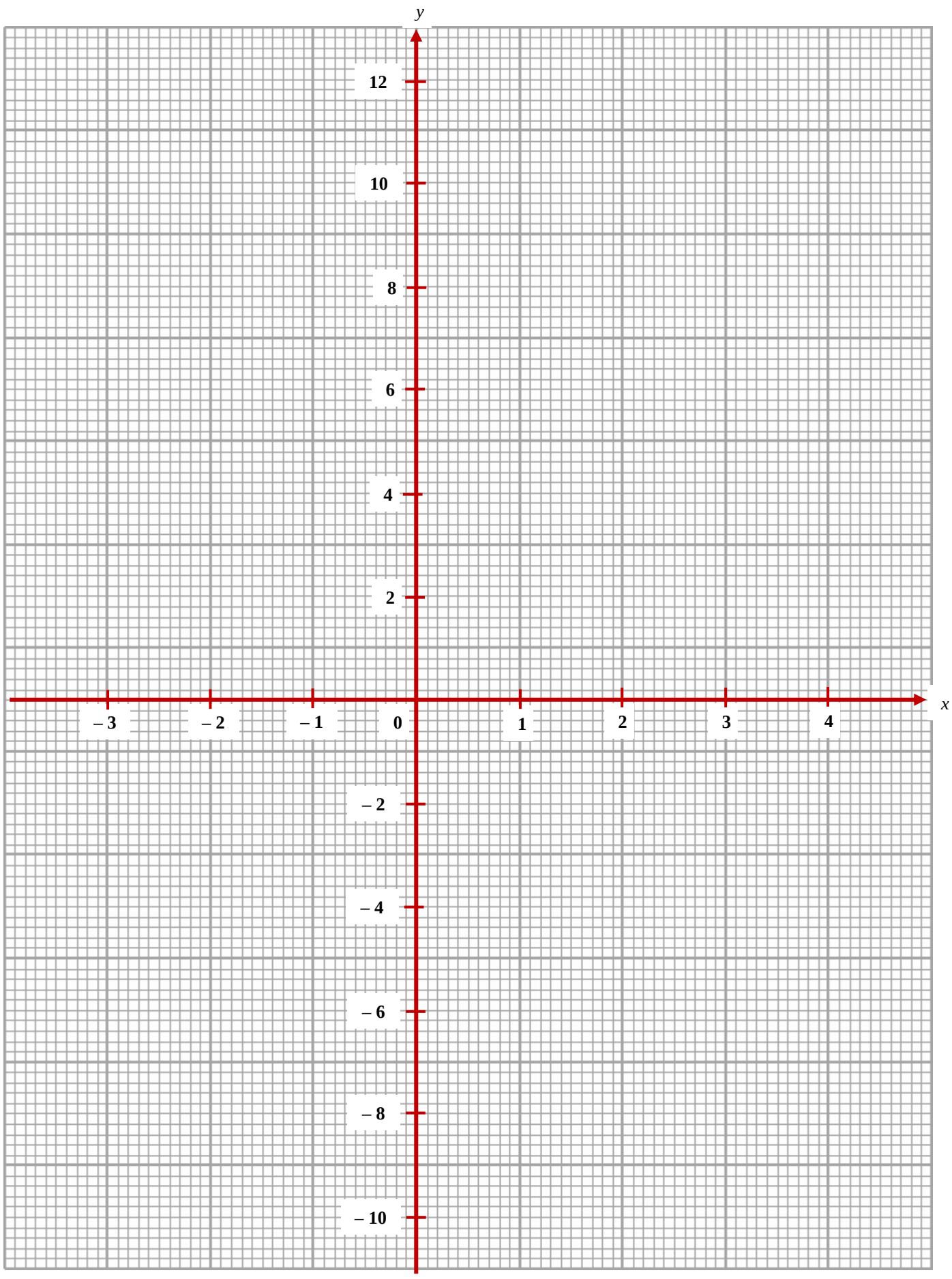
(e) **(i)** On the same grid, draw the line $y = 4 - x$ for $-1 \leq x \leq 4$. [2]

(ii) Write down the x-coordinate of the point where this line intersects the curve.

Answer $x =$ …….. [1]

(iii) This value of x is a solution of the equation $x^3 + Ax + B = 0$.
Find the value of A and the value of B.

Answer $A =$ ……. , $B =$ ……. [2]


y
12
10
8
6
4
2
– 3
– 2
– 1
0
1
2
3
4
x
– 2
– 4
– 6
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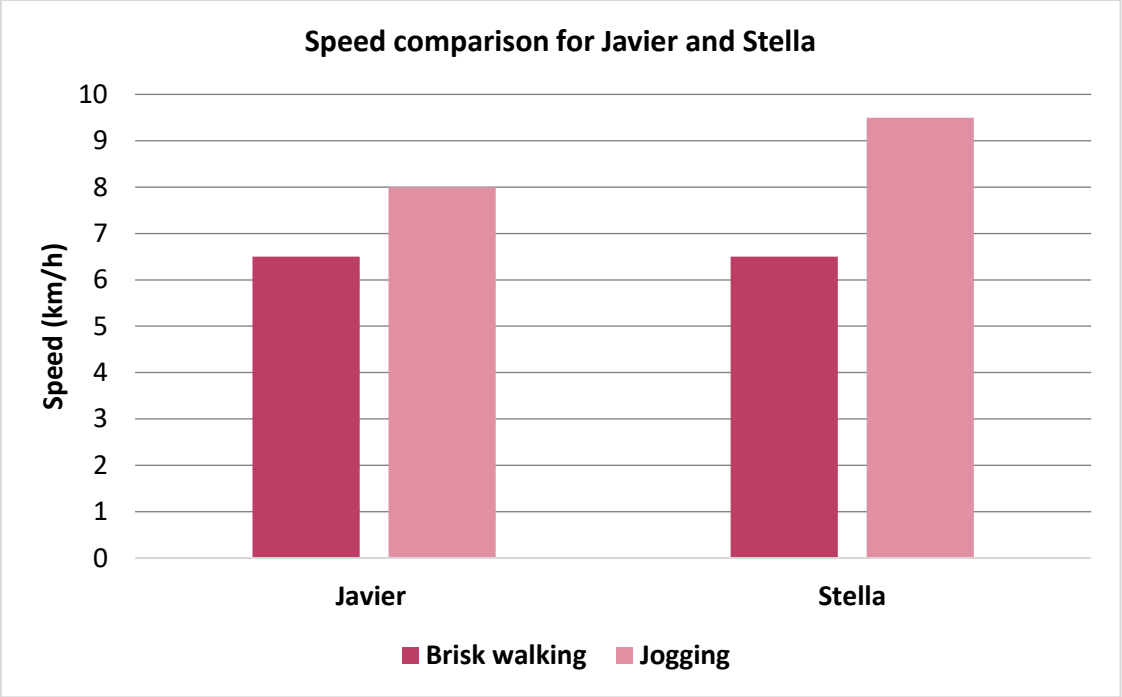
10 Javier and Stella are planning their exercise routines.

Javier and Stella have a body mass of 70 kg and 60 kg respectively.

The speed for walking and jogging of the two individuals are represented in the chart.



They research the following information about the benefits of exercise.

HEALTH ADVICE

For optimal health benefits, adults should do at least 150 minutes of moderate-intensity aerobic activity, or at least 75 minutes of vigorous-intensity aerobic activity per week.

For additional health benefits, adults should increase their moderate-intensity aerobic activity to 300 minutes per week, or an equivalent combination of moderate-intensity and vigorous-intensity aerobic activity.

1 minute of vigorous-intensity aerobic activity is equivalent to 2 minutes of moderate-intensity aerobic activity.

E.g. 10 minutes of jogging = 20 minutes of brisk walking.

Muscle-strengthening activities should be done on 2 or more days per week.

Approximate calories burned during 30 minutes of aerobic exercise

	Body mass			
	60 kg	**70 kg**	**80 kg**	**90 kg**
Walking 5 km/h	105	120	135	150
Walking 6.5 km/h	130	150	170	190
Jogging 8 km/h	240	280	315	350
Jogging 9.5 km/h	300	345	390	435

Non-aerobic muscle-strengthening activities

- 1 hour of yoga burns approximately 3 calories per kilogram of body mass
- 1 hour of weight training burns approximately 4 calories per kilogram of body mass

(a) In their first week of exercise, they each plan to go for four brisk walks.
They will walk the same route each time.
The four walks together meet the minimum target for the time for optimal health benefits in one week.

(i) Find the distance of one of these walks.

Answer ..... km [2]

(ii) Find out how many more calories Javier burns in these four walks than Stella.

Answer …….. calories [1]

(b) After one month, they change their routines.

Javier wants to gain additional health benefits.

He decides to do a 4 km walk 3 times per week and do a 6 km jog 2 times per week.

He will also attend a 45-minute yoga class 2 times per week.

Stella wants to maintain optimal health benefits.

She decides to do an 8 km jog 2 times per week.

She will also attend a 30-minute weight training session 2 times per week.

Javier says:

We will both meet our targets for exercise.

However, I will burn about 50% more calories than Stella during our exercise per week.

Is Javier correct?

Justify your decision with clear calculations.

Answer [7]

Answer space for **10 (b)**

Answer space for **10 (b)**

Javier is ..……………………………………………………………………………………..…

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END OF PAPER