中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)

2025 Preliminary Examination
Secondary Four Express / Five Normal Academic

CANDIDATE NAME

FORM CLASS / SUBJECT GROUP / INDEX NUMBER

MATHEMATICS 4052/02

Paper 2

19 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on 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 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.
You are reminded of the need for clear presentation in your answers.
Up to 2 marks may be deducted for improper presentation.

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.

Question Number	Marks Possible	Marks Obtained
1	11	
2	9	
3	11	
4	9	
5	8	
6	9	
7	12	
8	12	
9	9	
Presentation Deduction		– 1 / – 2
TOTAL	90	

This document consists of **20** printed pages.

Mathematical Formulae

Compound Interest

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

Measurement

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

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

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

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

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

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

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

Trigonometry

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

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

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)** Solve the equation $x^2+5x-32=0$ by completing the square.
Give your solutions correct to 2 decimal places.

$$x^2+5x-32=0$$
$$x^2+5x+\left(\frac{5}{2}\right)^2-\left(\frac{5}{2}\right)^2-32=0$$
$$\left(x+\frac{5}{2}\right)^2-\frac{25}{4}-32=0$$
$$\left(x+\frac{5}{2}\right)^2-38.25=0$$
$$\left(x+\frac{5}{2}\right)^2=38.25$$
$$x+\frac{5}{2}=\pm 6.1847$$
$$x=-8.68 \text{ or } 3.68$$

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

(b) Write as a single fraction in its simplest form $\frac{2x}{x^2-4}+\frac{5}{2-x}$.

$$\frac{2x}{(x+2)(x-2)}-\frac{5}{x-2}$$
$$=\frac{2x-5(x+2)}{(x+2)(x-2)}$$
$$=\frac{2x-5x-10}{(x+2)(x-2)}$$
$$=\frac{-3x-10}{(x+2)(x-2)}$$

Answer ..... [3]

(c) Solve the inequalities $x+5 \leq 3+2x < 21-x$.

$x+5 \leq 3+2x$ and $3+2x < 21-x$ $-x \leq -2$ $\quad 3x < 18$ $x \geq 2$ $\quad x < 6$ $\therefore\ 2 \leq x < 6$	

Answer ..... [3]

(d) Simplify $\left(\frac{256x^{12}}{y^8}\right)^{-\frac{3}{4}}$.

$\left(\frac{256x^{12}}{y^8}\right)^{-\frac{3}{4}} = \left(\frac{y^8}{256x^{12}}\right)^{\frac{3}{4}}$ $= \frac{y^6}{64x^9}$	

Answer ..... [2]

2 (a)

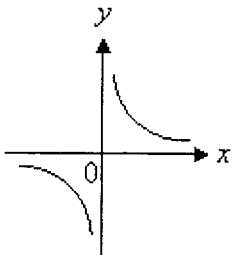


Figure 1

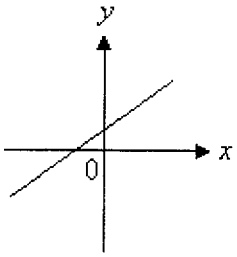


Figure 2

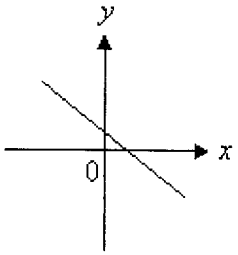


Figure 3

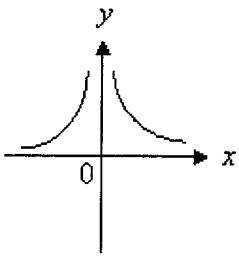


Figure 4

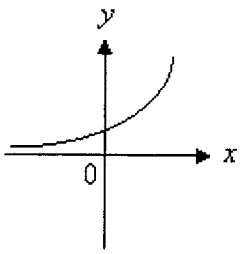


Figure 5

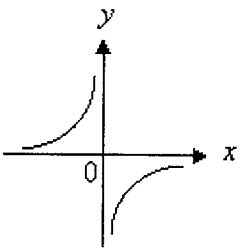


Figure 6

Which of the graphs shown above could be the graph of

(i) $y = 2^x$,

Figure 5	

Answer Figure..... [1]

(ii) $y = \frac{3}{x^2}$,

Figure 4	

Answer Figure..... [1]

(iii) $x + y = 1$?

Figure 3	

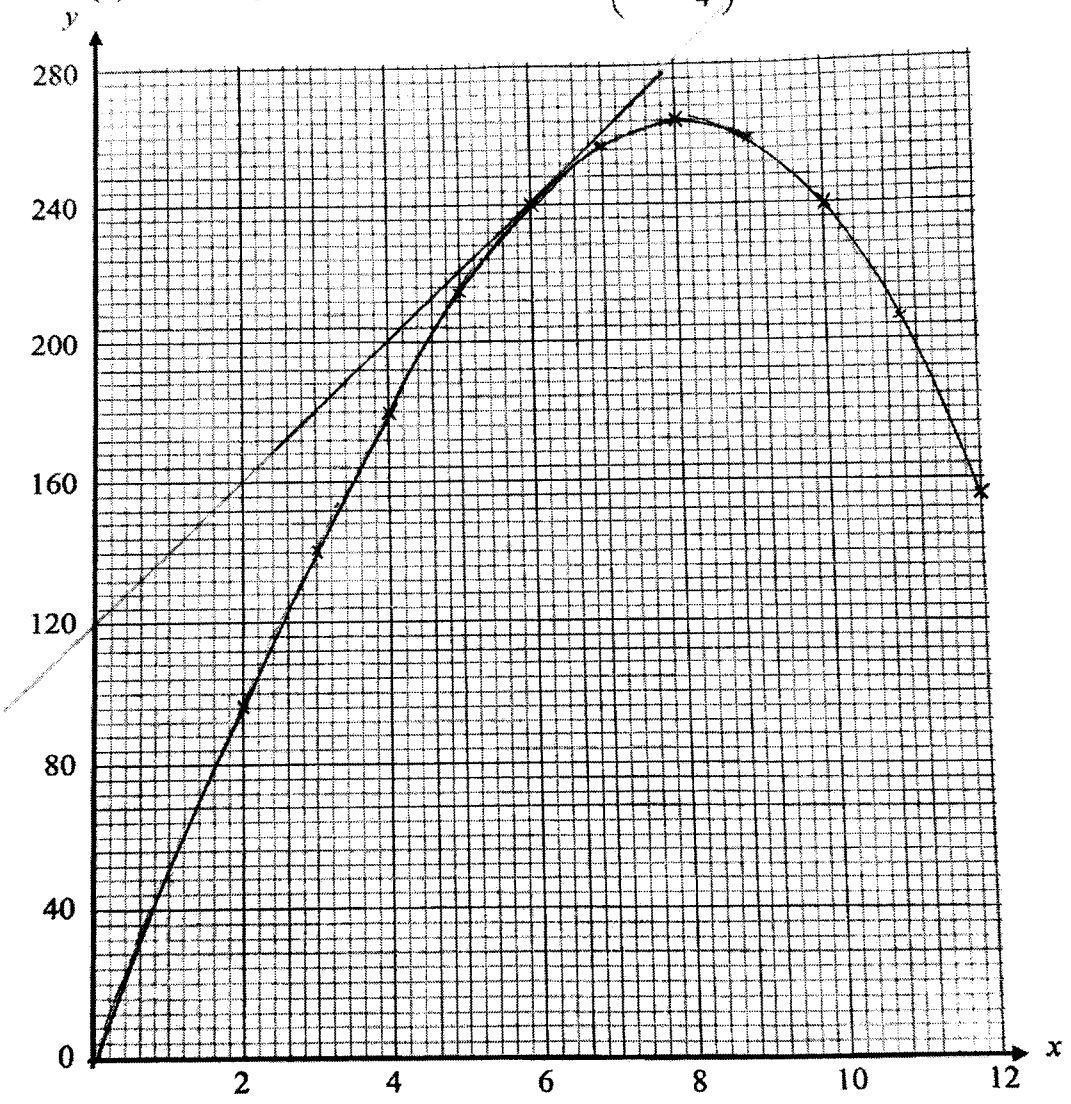
Answer Figure..... [1]

(b) (i) Complete the table of values for $y = x\left(49 - \frac{x^2}{4}\right)$.

x	0	2	4	6	8	10	12
y	0	96	180	**240**	264	240	156

[1]

(ii) On the grid, draw the graph of $y = x\left(49 - \frac{x^2}{4}\right)$ for $0 \le x \le 12$.



[3]

(iii) The line $y = kx + 120$, where k is a constant, is a tangent to the curve. By drawing a suitable straight line on the graph, find the value of k.

$k = \frac{240 - 160}{6 - 2}$ $= 20$	

Answer ..... [2]

3 **(a)** A packet contains a large number of flower seeds that produce white, yellow or red flowers. Half of the seeds produce white flowers and one third produce yellow flowers. The remainder of the seeds produce red flowers.

(i) Two seeds are chosen at random. Find the probability that

(a) one will produce a yellow flower and one will produce a white flower,

$P(\text{1 yellow, 1 white}) = \left(\frac{1}{2}\times\frac{1}{3}\right)+\left(\frac{1}{3}\times\frac{1}{2}\right)$ $= \frac{1}{3}$	

Answer ..... [2]

(b) neither will produce a red flower.

$P(\text{neither red}) = \frac{5}{6}\times\frac{5}{6}$ $= \frac{25}{36}$	

Answer ..... [2]

(ii) Three seeds are chosen at random. Find the probability that at most two seeds will produce white flowers.

$P(\text{at most 2}) = 1 - P(\text{all white})$ $= 1-\left(\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\right)$ $= \frac{7}{8}$	

Answer ..... [2]

(iii) Given that n seeds are chosen at random, find the probability that all the seeds will produce red flowers.

$P(\text{all red}) = \left(\frac{1}{6}\right)^n$	

Answer ..... [1]

(b) The stem and leaf diagram below shows the marks attained by 23 students in Class X for a Science quiz.

1	5	6	8	9	9	9		
2	0	0	1	1	2	3	4	7
3	3	4	4	5	6	8		
4	0	1	2					

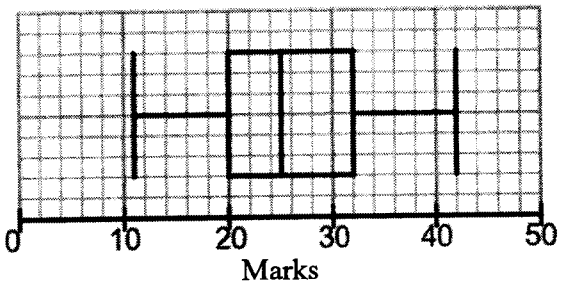
Key : 1 | 5 means 15 marks

(i) Using the data given, find the median mark.

23

Answer ..... marks [1]

(ii) The box-and-whisker plot shows the distribution of the results of students in Class Y for the same Science quiz.



Find the interquartile range.

Interquartile range = 32 – 20 = 12

Answer ..... marks [1]

(iii) Make two comparisons of the performance of the two classes X and Y for the Science quiz.

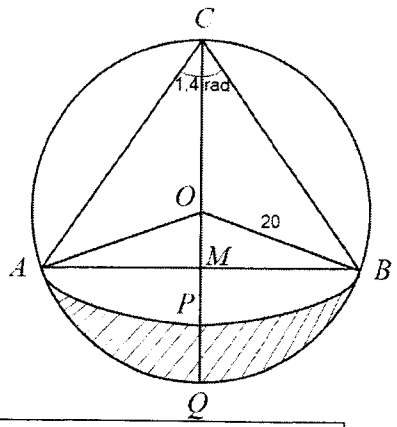
1. Class Y's students scored better on average, as Class Y has a higher median (25) than that of Class X (23).

2. The marks of Class Y's students are more consistent than that of Class X's, as Class Y (12) has a lower interquartile range than Class X (35 – 19 = 16).

.....

.....[2]

4 In the diagram, O is the centre of a circular picture $ACBQ$ of radius 20 m.
APB is an arc of a circle centre C and radii AC and BC.
COQ is a diameter of the circular picture $ACBQ$.
COQ bisects AB at M.



If angle $ACB = 1.4$ radians,

(a) show that AC is approximately 30.594 m,
Answer

$\angle AOB = 2(1.4)$ ($\angle$ at centre $= 2\angle$s at circumference) $= 2.8$ radians $\angle AOC = (\pi - 1.4)$ radians (Adj $\angle$s on a st. line) $AC^2 = 20^2 + 20^2 - 2\times 20\times 20\times \cos(\pi - 1.4)$ $AC \approx \sqrt{935.9737}$ ≈ 30.5936 ≈ 30.594 m (Shown)	

[3]

(b) calculate the perimeter of the shaded region,

Perimeter = Arc length APB + Arc length AQB $= 30.594\times 1.4 + 20\times 2.8$ $= 98.831$ ≈ 98.8 m	

Answer ..... m [3]

(c) calculate the total cost of painting the sector $OAQB$ if the painting cost is \$0.50 per square metre.

Area of sector $OAQB = \frac{1}{2}\times 20^2 \times 2.8$ $= 560$ m^2 Total cost $= \$(0.50\times 560)$ $= \$280$	

Answer \$ ..... [3]

5 Salim owns three cafes A, B and C which sell burgers and salad.
The cafes operates for 7 days a week. The sales on a weekend are on average half of that on a weekday.

(a) Suggest a reason why the sales on a weekend are lower than the sales on a weekday.

The cafés could be located in the CBD/business area/school area with more workers/students visiting the cafés for meals on the weekdays.

OR

the main clientele of the cafes are company workers and students who would get their burgers and salads during the weekdays.

The matrix, **F**, show the average number of food items that are sold on a weekday.

$$\mathbf{F} = \begin{matrix} \\ \text{Cafe A} \\ \text{Cafe B} \\ \text{Cafe C} \end{matrix} \begin{matrix} \text{Burger} & \text{Salad} \\ \begin{pmatrix} 120 & 11 \\ 12 & 135 \\ 80 & 92 \end{pmatrix} \end{matrix}$$

(b) Evaluate the matrix $\mathbf{W} = 6\mathbf{F}$.

$$\mathbf{W} = \begin{pmatrix} 720 & 66 \\ 72 & 810 \\ 480 & 552 \end{pmatrix}$$

Answer $\mathbf{W} =$ [1]

(c) In all of his three cafes, each burger costs \$12 and each plate of salad costs \$8.
Represent the costs of the food items in a 2×1 column matrix **C**.

$$\mathbf{C} = \begin{pmatrix} 12 \\ 8 \end{pmatrix}$$

Answer $\mathbf{C} =$ [1]

(d) Evaluate the matrix $\mathbf{R} = \mathbf{WC}$.

$$\mathbf{R} = \begin{pmatrix} 9168 \\ 7344 \\ 10176 \end{pmatrix}$$

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

(e) State what each of the elements of **R** represents.

The elements represent the amount of money collected from the sales of burgers and salads from café A, B and C respectively in a week.

[1]

(f) All the food items are sold for 40% profit.
By writing down a row matrix **T**, find **TR** which gives the total amount of profit all three cafes made in a week.

$$\mathbf{TR} = \begin{pmatrix} \frac{0.4}{1.4} & \frac{0.4}{1.4} & \frac{0.4}{1.4} \end{pmatrix} \begin{pmatrix} 9168 \\ 7344 \\ 10176 \end{pmatrix}$$

$$= \frac{2}{7}(9168 + 7344 + 10176)$$

$$= (7625.14) \text{ (2 d.p.)}$$

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

6 A is the point $(4, -2)$ and the line AB is parallel to the line $\frac{1}{2}x - 3y = 9$.

(a) Find the equation of the line AB. [2]

$\frac{1}{2}x - 3y = 9 \Rightarrow y = \frac{1}{6}x - 3$ Since the lines are parallel, they share the same gradient. $-2 = \frac{1}{6}(4) + c \Rightarrow c = -\frac{8}{3}$ The equation of line AB is $y = \frac{1}{6}x - \frac{8}{3}$.	

Answer ..... [2]

(b) The equation of the line BC is $2x + 9y + 52 = 0$.
Find the x-coordinate of B. [2]

$2x + 9\left(\frac{1}{6}x - \frac{8}{3}\right) + 52 = 0$ $2x + \frac{3}{2}x - 24 + 52 = 0$ $\frac{7}{2}x = -28$ $x = -8$	

Answer ..... [2]

(c) It is given that $\overrightarrow{AD} = \begin{pmatrix} 3 \\ 3 \end{pmatrix}$ and $\overrightarrow{AE} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$

(i) By considering their magnitudes, show that ADE is a right-angled triangle. [3]

$AD^2 = \left|\overrightarrow{AD}\right|^2 = 3^2 + 3^2 = 18$

$AE^2 = \left|\overrightarrow{AE}\right|^2 = 5^2 + 1^2 = 26$

$\overrightarrow{DE} = \begin{pmatrix} 5 \\ 1 \end{pmatrix} - \begin{pmatrix} 3 \\ 3 \end{pmatrix} = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$

$DE^2 = \left|\overrightarrow{DE}\right|^2 = 2^2 + (-2)^2 = 8$

Since $AD^2 + DE^2 = 18 + 8 = 26$, we have $AD^2 + DE^2 = AE^2$.
By the converse of Pythagoras' Theorem, ADE is a right-angled triangle.

(ii) F is the point $(0, -6)$. Showing your working, determine if F lies on DA extended. [2]

Since $\overrightarrow{AD} = \begin{pmatrix} 3 \\ 3 \end{pmatrix}$,

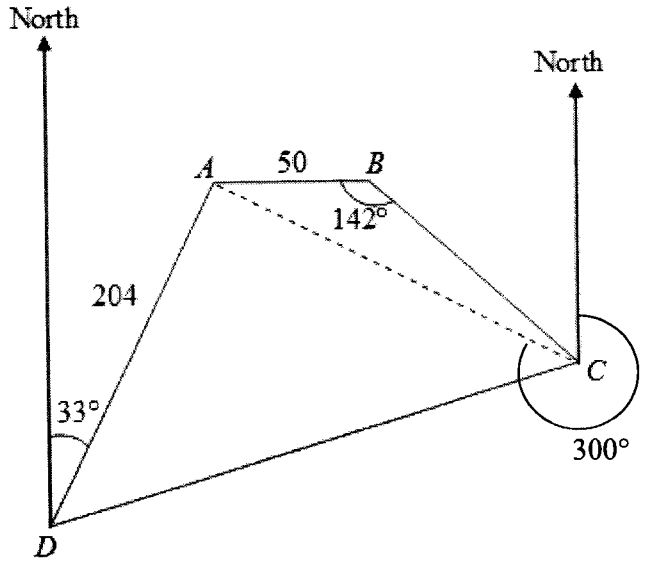
the gradient of the line DA is $\frac{3}{3} = 1$.

$-2 = 1(4) + c \Rightarrow c = -6$

The equation of the line DA is $y = x - 6$.

Since the point F is the y-intercept of the line DA, it lies on DA extended.

7



The diagram shows a plot of land with points $ABCD$ on level ground.
The bearing of A from D is 033° and the length of AD is 204 m.
B is 50 m due east of A.
Angle $ABC = 142°$ and the bearing of A from C is 300°.

(a) Find the bearing of C from A.

Bearing of C from $A = 180^\circ - (360^\circ - 300^\circ)$ $= 120^\circ$	

Answer ..... [1]

(b) Find angle BAC.

$\angle BAC = 120^\circ - 90^\circ$ $= 30^\circ$	

Answer ..... [1]

(c) Show that the distance AC is 221.19 m, correct to two decimal places.

$\frac{AC}{\sin 142^\circ} = \frac{50}{\sin 8^\circ}$ $AC = \frac{50 \sin 142^\circ}{\sin 8^\circ}$ ≈ 221.1855 ≈ 221.19 m (Shown)	

[2]

(d) Find the area of triangle ABC.

Area of triangle $ABC = \frac{1}{2} \times 50 \times 221.19 \sin 30^\circ$ $= 2764.875$ $\approx 2760 \text{ m}^2$	

Answer ..... m^2 [2]

(e) Find angle DAC.

$\angle DAC = 33^\circ + 60^\circ$ $= 93^\circ$	

Answer ..... [1]

(f) Hence, calculate the distance DC.

$DC^2 = 204^2 + 221.19^2 - 2 \times 202 \times 221.19 \cos 93^\circ$ $DC = \sqrt{95264.10}$ ≈ 308.6488 $\approx 309 \text{ m}$	

Answer ..... m [3]

(g) A tree, 15 m tall, stands vertically at A.

Find the angle of elevation of the top of the tree from D.

Let angle of elevation be θ. $\tan\theta = \frac{15}{204}$ $\theta = \tan^{-1}\left(\frac{15}{204}\right)$ ≈ 4.20536 $\approx 4.2^\circ \text{ (to 1 d.p)}$	

Answer ..... [2]

8 StreamGuru is a legal online media services provider that allows users to download music albums over the Internet.

It offers subscribers two choices of StreamGuru Plans, Standard and Elite.

(a) Under the Standard Plan, subscribers can download x albums in one hour.

Write an expression, in terms of x, for the time taken, in minutes, to download one album under the Standard Plan.

$\frac{60}{x}$	

Answer .....min [1]

(b) Under the Elite Plan, subscribers can download 5 more albums in one hour compared to the Standard Plan.

Write an expression, in terms of x, for the time taken, in minutes, to download one album under the Elite Plan.

$\frac{60}{x+5}$

Answer .....min [1]

(c) A StreamGuru subscriber can download an album under the Elite Plan 2 minutes faster than under the Standard Plan.

Write an equation in x to represent this information and show that it reduces to

$$x^2+5x-150=0.$$

$\frac{60}{x}-\frac{60}{x+5}=2$ $60(x+5)-60x=2x(x+5)$ $60x+300-60x=2x^2+10x$ $2x^2+10x-300=0$ $x^2+5x-150=0$ (Shown)	

[3]

(d) Solve the equation $x^2+5x-150=0$.

$x^2+5x-150=0$ $(x-10)(x+15)=0$ $x=10$ or $x=-15$	

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

(e) How many minutes does it take for a Elite Plan subscriber to download 2 music albums?

Amount of time under Elite Plan for 2 music albums $=\frac{60}{10+5}\times 2$ $=8$ minutes	

Answer .....min [2]

(f) Find the percentage of time saved by downloading one music album under the Elite Plan compared to under the Standard Plan.

Percentage of time saved $=\frac{6-4}{6}\times 100\%$ $=33\frac{1}{3}\%$	

Answer ..... % [2]

9 Irene is looking to buy furniture from EKAYA.
She identifies the following items from the catalogue that she needs to purchase, and lists down the approximate amount of time that she will take if she assembles each item.

Item	Retail Price per item (GST included)	Quantity	Approximate time to assemble each item (min)
Bed frame 218 x 155 x 40 cm 36.25 kg	\$249	1	95
Storage solution 12.30 kg	\$119	2	20
Desk with Drawers 140 x 78 x 75 cm 22.10 kg	\$149	1	35
Folding chair 100 x 45 x 47 cm 3.00 kg *wall-mountable, requires one hole*	\$29	5	10
Bookshelf 80 x 28 x 202 cm 22.50 kg	\$129	1	45
Alarm clock 15 x 13 x 5 cm 0.19 kg	\$19	1	Does not require assembly

(a) Calculate the total cost of the furniture that Irene intends to buy.

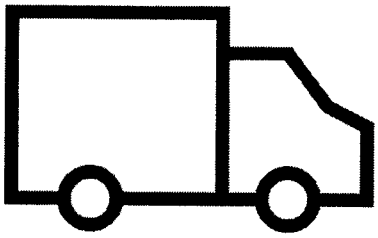
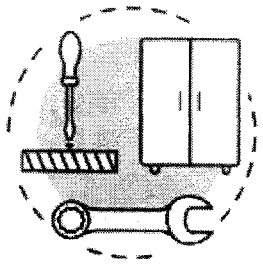
$249+119\times2+149+29\times5+129+19=\$929$

Answer \$ ..... [1]

Irene has \$1000 EKAYA credits from lucky draw that allows her to make a one-time purchase on the EKAYA online store.

Irene lives on the 4th floor of an old estate that does not have lift access.
She has back issues and would have difficulties handling weight above 25 kg.
She also wants to wall-mount all the folding chairs, but she does not have a drill.
She does not want to pay more than \$110 out of her pocket.
She does not want to spend more than 80 minutes assembling on her own.

EKAYA

Delivery	Assembly
You can take it home yourself – but you don't have to	**You can assemble it yourself – but you don't have to**
	
Home delivery is $35 for orders above 15kg. We'll pick and deliver as many products as you want. **Delivery typically takes place within 2-5 days from the date of order.** ^ Please note for home delivery, an additional flat rate of $20 will apply if there is no lift access, or if items cannot fit in the lift at the delivery address located in a building from the 3rd floor onwards. This service is applicable up to the 5th floor only.	**Service fees** 1. All other furniture that requires assembly: **20%** of the original product's retail price. 2. Drilling services are included as part of the assembly services. 3. A $5 charge per drilled hole applies to products, which require to be wall-mounted and where assembly service has not been booked.

All costs are subject to 9 % GST.

(b) Suggest how Irene could minimise both the costs spent and the time for assembly for all the furniture purchased.
Justify all the decisions you make and show your calculations clearly.

Answer

Total cost of furniture: $929

Since Irene has difficulties handling weight above 25 kg, then both delivery and lifting services are essential.

- Delivery: $35
- Lifting (no lift access): $20

In order to minimise cost and time, we can do a cost per min analysis.

Item	Assembly cost (20%)	Time (min)	Cost/min	Remarks
Bedframe	$249\times0.2=49.80$	95	-	> 80 min → assembly service
Storage solution	$119\times0.2\times2=47.60$	$20\times2=40$	1.19	
Desk with drawers	$149\times0.2=29.80$	35	0.851	
Folding Chair	$29\times0.2\times5=29$	$10\times5=50$	0.58	
Bookshelf	$129\times0.2=25.80$	45	0.573	

Considering that the cost of drilling (separate) is $25 + 50 min of self-assembly, paying $29 for assembly ($4 more to save 50 min) is recommended: **use assembly service for folding chairs.**

For the remaining 3 items, we do a breakdown as below:

	Storage and Desk	Desk and Bookshelf	Storage and Bookshelf
Pay for remaining	25.80 (bookshelf)	47.60 (storage)	29.80 (desk)
Time needed	40 + 35 = 75 min	35 + 45 = 80 min	40 + 45 = 85 min > 80

Irene should choose to assemble the storage solutions and desk with drawers by herself.
Because she would pay the least and spend the least amount of time to assemble.

In summary,
Services acquired: Delivery ($35) + Lifting ($20)
Assembly: Bedframe ($49.80) + Chairs ($29) + Bookshelf ($25.80)

$$\text{Total spending} = 929+(35+20+49.8+29+25.8)\times1.09-1000$$
$$=\$102.96<\$110$$
$$\text{Time needed} = 75 \text{ min} < 80 \text{ min}$$

.....

.....

..... [8]