Liao wants to cycle around Singapore.
 He finds the following information below about the two types of shared e-bikes that he can choose from.

Bike A

С	ost Rates		Cost Rates
Regular	\$1.00 per min	Regular	\$1.00 for first 30 mins
Family	\$4.00 per min	_	\$0.50 for every next 10 mins
		Family	\$4.00 per 30 mins
Special Pass*		Special Pass**	
7-Day Pass	\$6.90	7-Day Pass	\$5.90
30-Day Pass	\$9.90	30-Day Pas	ss \$9.90
90-Day Pass	\$26.90	90-Day Pas	ss \$24.90
*Free for first 30mins, \$1.00 for		**Free for f	first 60 mins, \$0.50 for every
every subsequent 30mins. (only for		subsequent	10 mins. (only for regular
regular bikes)	× •	bikes)	

Bike B

(a) Liao cycles with his family in Sembawang Park for 40 mins. He chooses the Family Bike A. He estimates that the total cost is \$240. Show that Liao is correct. [1] (b) Liao buys the 7-Day Pass for Bike A. He wants to travel around the perimeter of Singapore. The distance travelled is about 150 km. He travels about 30 km/h. How much does he need to pay including the special pass? [2] (c) Liao and Abid cycle together in East Coast Park. Liao chooses Regular Bike A. He buys the 7-Day Pass. Abid chooses Regular Bike B. The distance of East Coast Park is about 15 km. Liao travels 20 km/h while Abid travels 15 km/h more than Liao. The price for the bike will keep increasing even if they are not cycling. Abid waits for Liao at the end of their journey. Abid claims that he needs to pay more because he waits for Liao. Is his claim correct? Justify your decision. Show all your workings. [7] 2 A petrol oil tanker is a motor vehicle designed to transport gasoline to petrol filling stations. Its tank is shaped like a cylindrical container, with a diameter 3 m and a length 15 m as shown in **Diagram I**.

Diagram II shows the cross-sectional view of the tank containing a certain amount of liquid gasoline. The line *AB* represents the width of the horizontal surface of the liquid in contact with the cylindrical tank.

To satisfy the safety storage conditions for transportation, the liquid gasoline must **not** exceed 95% of the tank.



Diagram I



- (a) It is given that AB = 1.8 m and $\angle BMO = 90^{\circ}$. Show that the volume in this liquid is safe for transportation. [3]
- (b) Calculate the height of the liquid gasoline from line *AB*. [1]
- (c) A petrol filling station requires an underground tank of 40 000 gallons of liquid gasoline. Petrol tankers are dispatched to the station to top up once its total petrol quantity is 20% of its maximum amount.

Calculate the minimum number of petrol tankers required for each top up.

Justify your decision. Show all your workings.

[6]

3 Zhang wanted to have a shed house of his own in his backyard as shown below. The shed house, shaped like a prism, has a length of 7 m and has four sloping roofs. It also has a door of 2 m. CD = DE = EF = FG = 1.2 m AG = BC = 1.5 m and AB = 5.1 m.

CDEFG is part of a regular heptagon (7-sided).



Shed House

(a) Find angle *DEF*.

[1]

(b) Zhang wanted to put up a 'Welcome' sign board on the line DF.What is the length of the board? [2]

(c) Zhang has a budget of \$2000 to spend on buying a shed house flooring. A sketch of the floor plan is shown below. All angles shown in the diagram are right angles and all dimensions are in meters.



Zhang planned to use porcelain tiles to cover the areas that are **not** the bedroom and use wooden tiles to cover his bedroom.

He found this information about the two tiles as shown below.

Types of tiles	Dimensions	Price
Porcelain	30 cm by 30 cm	A box of 20 tiles costs \$71.80
Wooden	20 cm by 20 cm	A box of 25 tiles costs \$80.20

Are both types of flooring materials within Zhang's budget? Justify your decisions. Show **all** your workings.

[7]

4 A factory manufactures ceramic bowls and glass cups.

A ceramic bowl is made by removing the bottom part from an opened hemisphere with diameter 15 cm as shown in **Figure 1a**. The circular area of the bottom part has a diameter of 7 cm. The shaded part is the bottom part that should be removed.

Figure 1b shows the cross-sectional view of the bowl.



(a) Show that the height of a bowl is approximately 6.63 cm. [1]

Bowls are arranged such that after each bowl, a piece of cardboard (black rectangles) with a thickness of about 5 mm, is placed to ensure that the bowls are in place and that they are not being scratched. The top view of how the bowls is arranged, as shown below. Each box has only one layer of bowls. (1 cm = 10 mm)



Top view

(b) A cuboid box measures 30 cm by 6.63 cm by 70.8 cm. How many such bowls can the box fit? [2] (c) A glass cup, usually shaped like an opened cylinder, is used to contain beverages like soda and beers. It has a diameter of 7 cm and a height of 15 cm.



Two companies suggested the following types of container used to store the cups. The information of both companies is shown below.



The factory wanted to pack and sell 50 cups in a day.

Which company should he choose? Justify your decision. Show **all** your workings.

[7]

5 Every National Day, decorations are put up on streets and housing estates. Flags are commonly used as decorations.

The figure below shows two flags.



Flag 1 is an isosceles triangular flag with AC = BC = 27 cm and angle $ACB = 22^{\circ}$. Flag 2 is a rectangular flag by removing an equilateral triangle *XRS* (shaded part) from rectangle *PQRS*. *PQ* : AB = 3 : 4. Both flags have the same height.

(a) In Flag 1 , show that $AB = 20$ cm.	[1]
--	-----

(b) Find the height of Flag 2.

[2]

(c) Mr Tan, a town council manager, plans on hanging flags near a HDB housing estate.

He finds the information below:



Flags

- Material used: Polyester
- 1 cm² of polyester costs \$0.03 (per flag)
- It is sold in area measured in whole number

Strings

- Material used: Nylon
- 1 m of nylon costs \$0.10 (sold in rolls)
- It is sold in length measured in 3 significant figures

HDB blocks

- The standard floor-to-ceiling height is about 2.6 meters.
- Top floor units have higher ceiling, about a height of 2.75 meters.

The HDB housing estate block has 13 storeys from ground. The 13th storey is the top floor unit.

Mr Tan, a town council, plans to hang the flags to the 13th storey such that it is 68° from ground.

Which flag should he choose? Justify your decision. Show **all** your workings.

[7]

6 Xuan is going to stay in a hotel in Kular Lumpur for a week.She needs to work out how much money, in Singapore dollars, she will need to cover her living expenses.She finds the information below to help her work out her expenses.

The costs are all given in Ringgit (RM).

Estimate costs in Rulai Lumpul (101 a week)		
Item	Cost	
Hotel	RM 2390	
Transportation to hotel	RM 230	
Air ticket	RM 382	
Meal	RM 70 per day	
Local transportation	RM 119 per day	

Estimate costs in Kular Lumpur (for a week)

(a) The exchange rate between Ringgit and Singapore dollars changes every month. The graph below shows the monthly exchange rate in 2023.



Exchange rate in 2023

- Write down the exchange rate between Singapore Dollars and Ringgit in May. Give your answer correct to 3 decimal places. [1]
- (ii) Xuan wants to convert her daily meal cost to dollars. Use the graph to work out the difference between the greatest and least possible daily meal costs in dollars. Give your answer correct to the nearest cents. [3]

(b) Xuan plans on going to Kular Lumpur in December. Her parents will give her allowance, in dollars, to cover her total costs including hotel and travel. She must tell them how much money she will need for the week. Her parents will add an extra 15% in this amount to cover any extra costs.

Suggest a suitable amount, in dollars, for Xuan's parents to give her for the week.

Justify any decisions that you make. Show **all** your workings. [6]



ABCD is a park on a horizontal circular ground crossed by two paths, AC and BD. A is due north of D. AB = 650 m, BC = 900 m and AD = 460 m.Angle $ACD = 32^{\circ}$. Path *BC* is the bisector of angle *ADC*. *E* is a point where the two paths meet. Angle ADC is obtuse.

(a)	Find angle <i>ABD</i> . Give reason for your answer	[1]
(b)	Find angle <i>ADB</i> .	[2]

(c) Mara and Ali are jogging in the park. Mara jogs at a speed of 9.7 km/h along path AC. Ali jogs at a speed of 8.9 km/h along path BD.

Ali claims that he will finish jogging first.	
Do you agree?	
Justify your decision. Show all your workings.	[7]

8 The diagram below shows a ceiling clothes drying rack, which can help to hang, dry and cool the clothes when hung on the ceiling. It has length of 76 cm, width of 42 cm and has four horizontal extensions of length 36 cm. It also has two extension supports.



(a) An extension support (as shown above) is made up of four identical rhombus and has a height *h*. Angle $CMD = x^{\circ}$. Each rhombus has sides of 15 cm.

All are straight lines and are parallel to each other.

Points *M*, *N*, *O*, *P* and *Q* are midpoints of each of its lines. For example, *M* is the midpoint of *AD* where AM = MD = 15 cm.

The height, h and the angle x vary when the extension supports stretched outwards or inwards.

- (i) In rhombus *CNDM*, given that the horizontal diagonal *CD* is 18 cm, show that h = 120 cm. [2]
- (ii) Find angle *x*.

[2]

(c) Mr Tan uses the rack to hang and dry his clothes and bedsheets in his house. He wanted to find out the amount of power drive by the motor. He finds these information below.

intermetter about the rach		
Length	1.3 m	
Extension	Up to 2 m	
Width	0.5 m	
Type of bedsheet	King size	
that can hold	_	
Max mass	50 kg	
No. of poles	7	
Drying method	Solar Drying	
	(60°C)	
Drying duration	3 hours	
Power of the motor	100 W	
(recommended)		
Lifting duration	10 s	
Efficiency rate	70%	

Information about the rack

Estimate mass of clothes

Clothes	Mass
King size bedsheet	1.8 kg
T-shirts	0.3 kg
Jeans (Heavy)	3 kg

- Find the mass of clothes hang on the rack $(kg) \times 10 = \text{total weight } (N)$
- Find the height of the extension support that you adjusted (m)
- Energy used (kWh) = total weight × height
- Power (W) = energy used ÷ time (s)
- Power with efficiency = power ÷ efficiency rate
- 1 kW = 1000 W

Mr Tan adjusted the rack to a height of 90 cm. He hangs 6 king size bedsheets, 12 T-shirts and 6 jeans on the rack.

Does the power with efficiency of the motor exceed the recommendation? Justify your answer. Show **all** your workings.

[6]



The diagram shows a Warren truss bridge. It is made out of 5 equilateral triangles on each two sides of the bridge. The bridge is supported by a pin and a roller. One side is a shape of a trapezium *ABCDEFG*. Each straight line represents a truss member.

AD is the bottom chord. *AG*, *BG*, *BF*, *CF*, *CE* and *DE* are diagonals. *EG* is the top chord. Points *A*, *B*, *C*, *D*, *E*, *F* and *G* are joints. Angle $GAB = x^{\circ}$.

Bottom chord AD has a length of 90 m.

Materials	Density (kg/m ³)	Length (m)	Width (m)	Height (m)
А	7850	10	4	0.5
В	2400	20	5	0.2
С	1100	2	2	0.2
D	2700	10	1	0.5
Е	1600	15	2	0.5

Information about materials used in bridge building is shown in the table below.

(a) Find the height of the bridge. [2]

[3]

- (b) Find the diagonal line *AE*.
- (c) The mass of the bridge ranges from 30 tonnes to 50 tonnes.
 1 tonne = 1000 kg
 1 kg = 10 N
 1 kN = 1000 N
 Suggest which material is suitable for building the bridge.



The diagram shows a circular gold pendant, diameter of 48 mm with centre *O*. A regular hexagon *ABCDEF* is inscribed in the circle. 6 identical rhombus are removed from the circle to make the pendant. Each rhombus has diagonals of 24 mm and 10 mm as shown below.



- (a) Find the area of gold needed to make the pendant in mm². [4]
- (b) The pendant is decorated with a string of pearl beads around its perimeter. Show that the required length of the string is $(48\pi + 312)$ mm. [4]

(c) The thickness of the pendant is 0.2 cm. The density of gold is 19.32 g per one cubic centimetre.

There are two shops that are selling the same pendant at different prices. The information about the two shops is shown in the table below.

Shop A	Shop B
Price per gram (gold): \$105.17	Price per gram (gold): \$113.20
(excluding GST)	(excluding GST)
GST: 9%	GST: 9%
Discount: 10%	Discount: 15%
Delivery fee: \$8.00	Delivery fee: \$7.18
Credit card discount: 5%	Credit card discount: 5%

Ms Kim wants to buy a pendant for herself using her credit card. Which shop should she buy from? 1 cm = 10 mm.

Justify your decision. Show **all** your workings. [8]