1. Two cities are connected by a railway line in the shape of a circular arc. The radius and the angle at the centre of the line are 29 700 m and 56° respectively. On a map, the length of the line is 6π cm.

(a) Find the scale of the map in the form $1:n$.

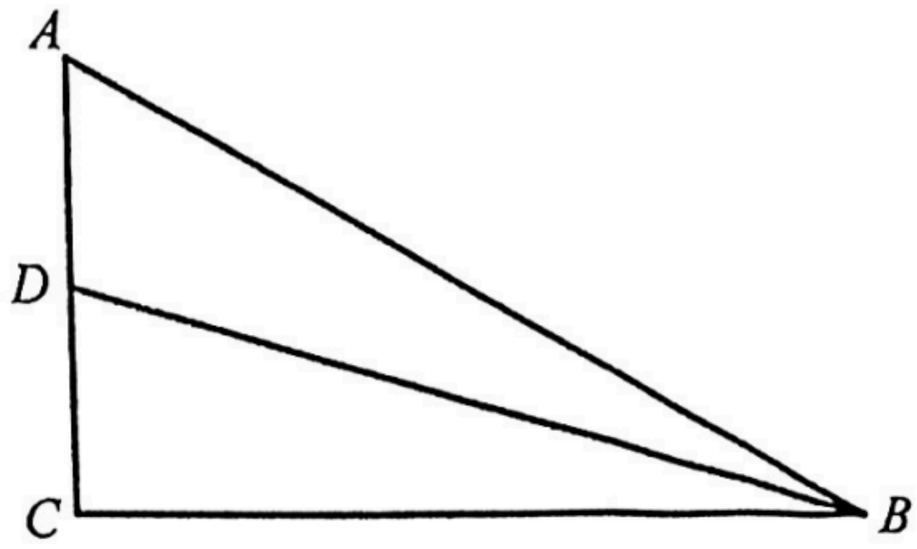
(4 marks)

(b) For safety reasons, the speed of trains on this line cannot exceed 175 km/h. Can a journey on this line be completed by a train within 8 minutes? Explain your answer.

(3 marks)

2. <u>In this question, **do not** use a calculator.</u>

In the figure, ADC is a straight line. $AD = 8 - \sqrt{48}$, $CD = \frac{12}{\sqrt{12}}(2 - \sqrt{3})$, $BD = 6\sqrt{2} - 2\sqrt{6}$ and $BC = 2\sqrt{3}$.



(a) (i) Find the length of CD. (Express your answer in the form $p\sqrt{3} + q$, where p and q are rational numbers.)

(ii) Hence, show that ΔBCD is right-angled at C.

(5 marks)

(b) Find the exact value of $\sin \angle ABC$.

(4 marks)

3. Figure (1) shows a hollow cylinder used as a decoration outside a hair stylist's. When the cylinder is cut along AB and is flattened out, it becomes a rectangle shown in Figure (2). It is given that the length of the diagonal BA' of the rectangle is 51 cm and the lengths of AB and BB' are in the ratio $8:15$.

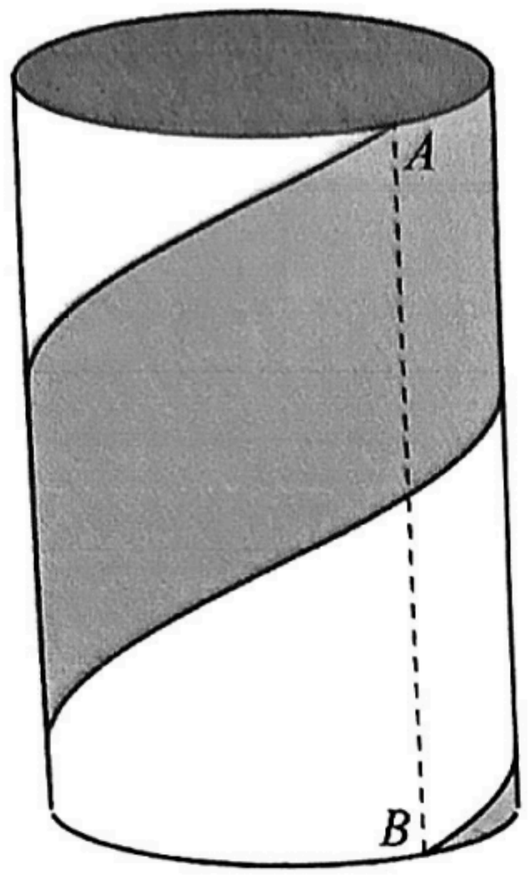


Figure (1)

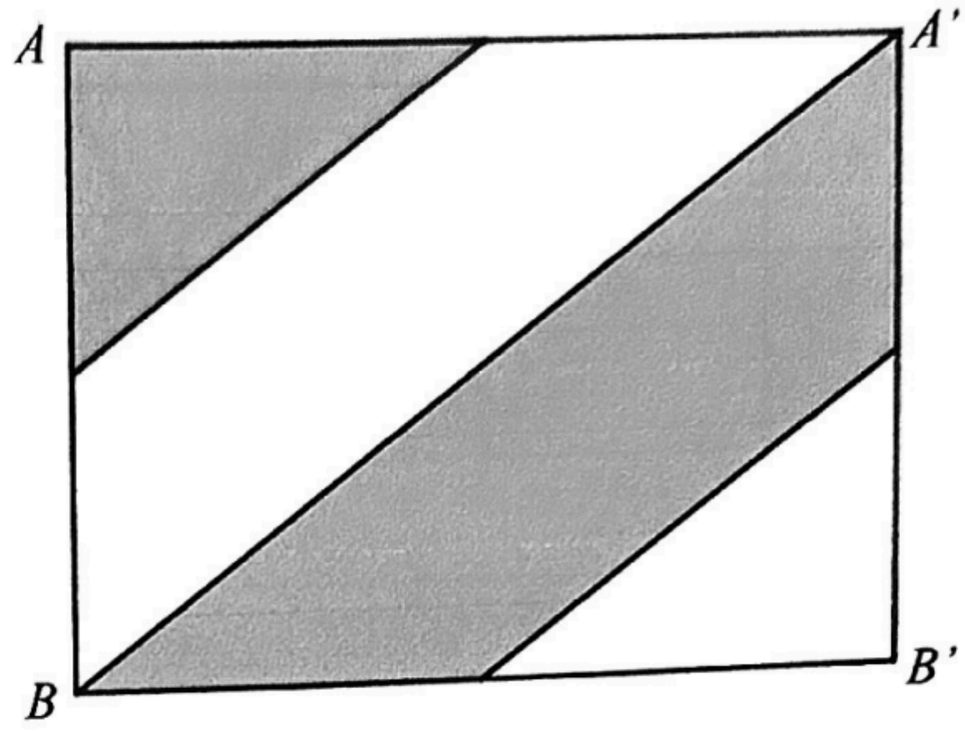


Figure (2)

(a) Find the length of AB.

(3 marks)

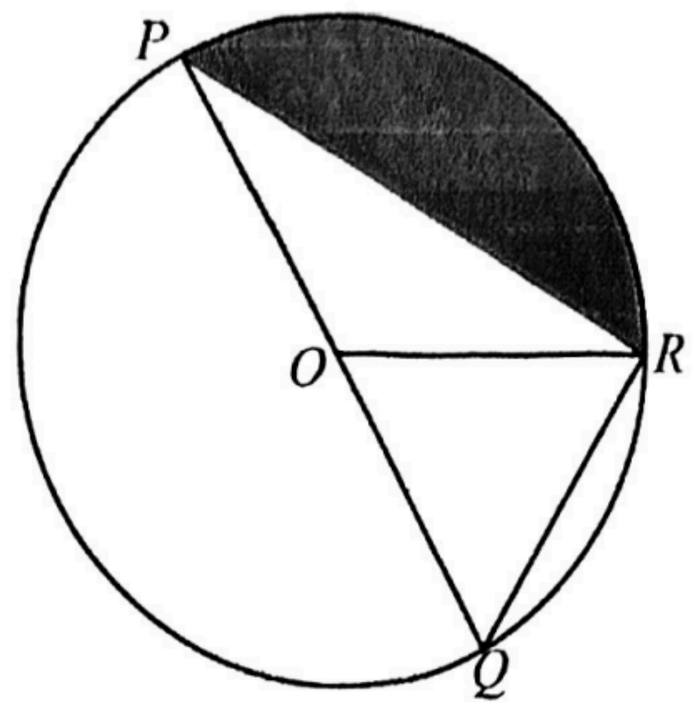
(b) Find the volume of the hollow cylinder correct to the nearest cm^3.

(4 marks)

(c) Suppose the rectangle is now rolled in another way to form a cylinder by joining A with B and joining A' with B'. Is the volume of this new cylinder larger or smaller than the original cylinder? By how many percent? (Correct your answer to the nearest %.)

(4 marks)

4. The figure shows a circle centred at O. POQ is a diameter of the circle. R is a point on the circumference of the circle.



(a) Use deductive geometry to prove that ΔPQR is right-angled at R.

[Hint: Consider the radii OP, OQ and OR.]

(3 marks)

(b) It is given that $PR = 35$ and $\angle PQR = 65°$.

(i) Using the result of (a), find the length of the radius of the circle.

(ii) Hence, or otherwise, find the area of sector OPR.

(iii) A student claims that the shaded area is more than half of the area of sector OPR. Is the claim correct? Explain your answer.

(Correct your answers to 3 significant figures if necessary.)

(10 marks)

5. (a) In Figure 5(a), ABC is an isosceles triangle with $AB = AC$. D is a point lying on BC such that $AD \perp BC$. Prove that $BD = DC$ and $\angle BAD = \angle CAD$. (3 marks)

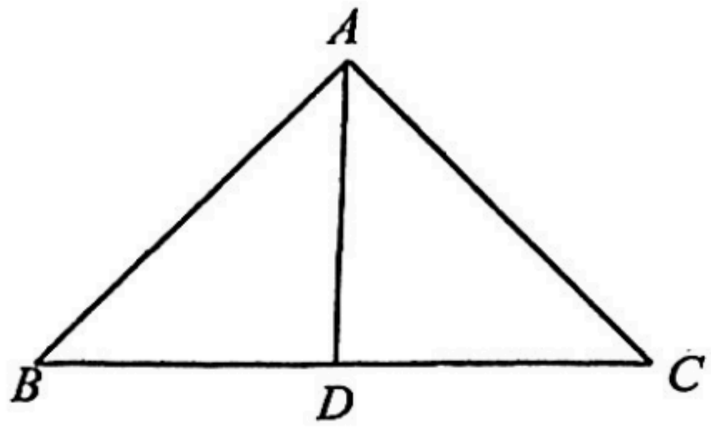


Figure 5(a)

(b) Figure 5(b) below shows a cylindrical container. It is given that the volume of the container is $1300\pi\ \text{cm}^3$ and the height of the container is 13 cm. Water is poured into the container such that the depth of water is h cm.

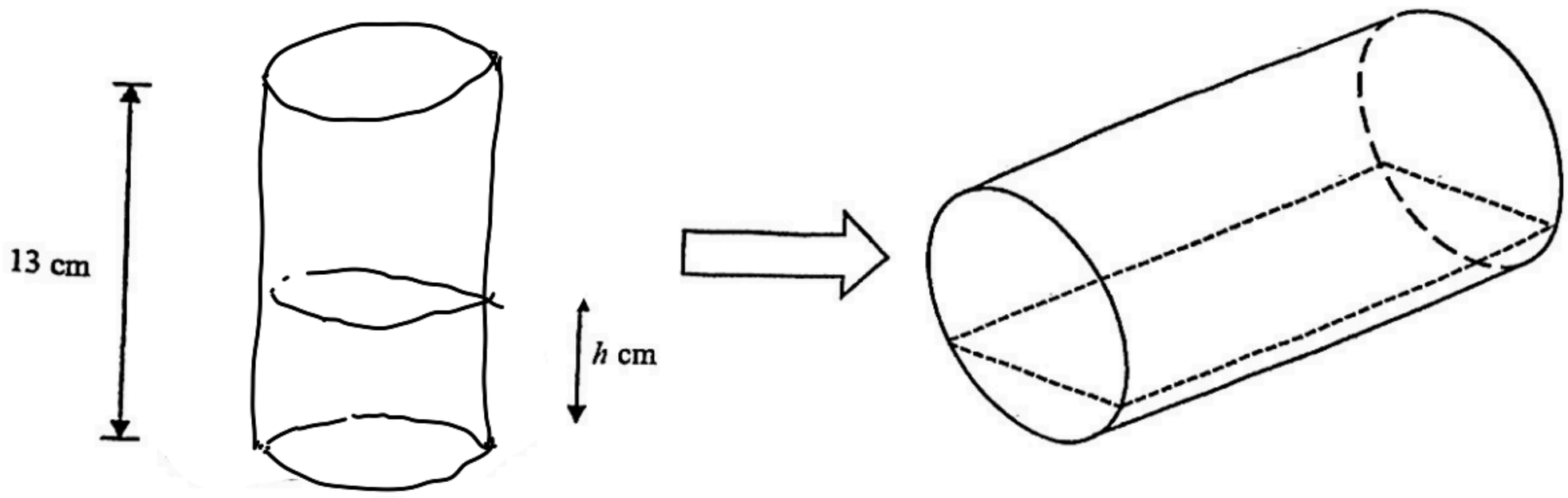


Figure 5(b)

Figure 5(c)

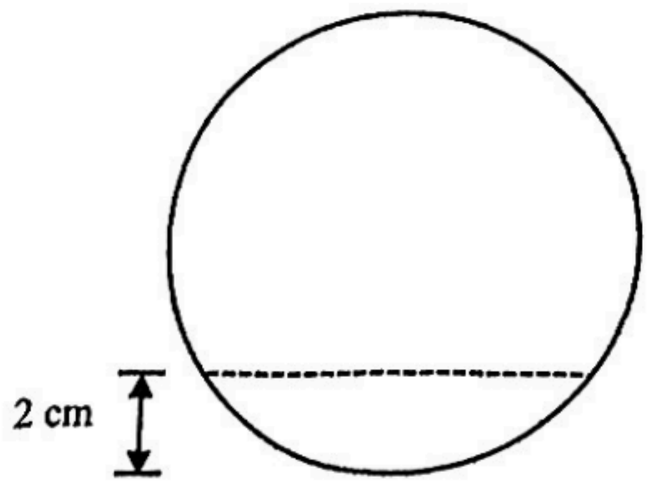


Figure 5(d)

(i) Find the base radius of the container.

(ii) The container is then sealed and toppled as shown in Figure 5(c). Figure 5(d) shows the cross-section of the base after the container is toppled. If the new depth of water is 2 cm, find the value of h. (8 marks)

1. In Figure 1, $ABCDEF$ is a regular hexagon. G is a point on BF such that $AG \perp BF$.

(a) Find the size of each interior angle of $ABCDEF$. (2 marks)

(b) Find $\angle AFB$. (2 marks)

(c) If $CD = 2$, find the length of EG. (3 marks)

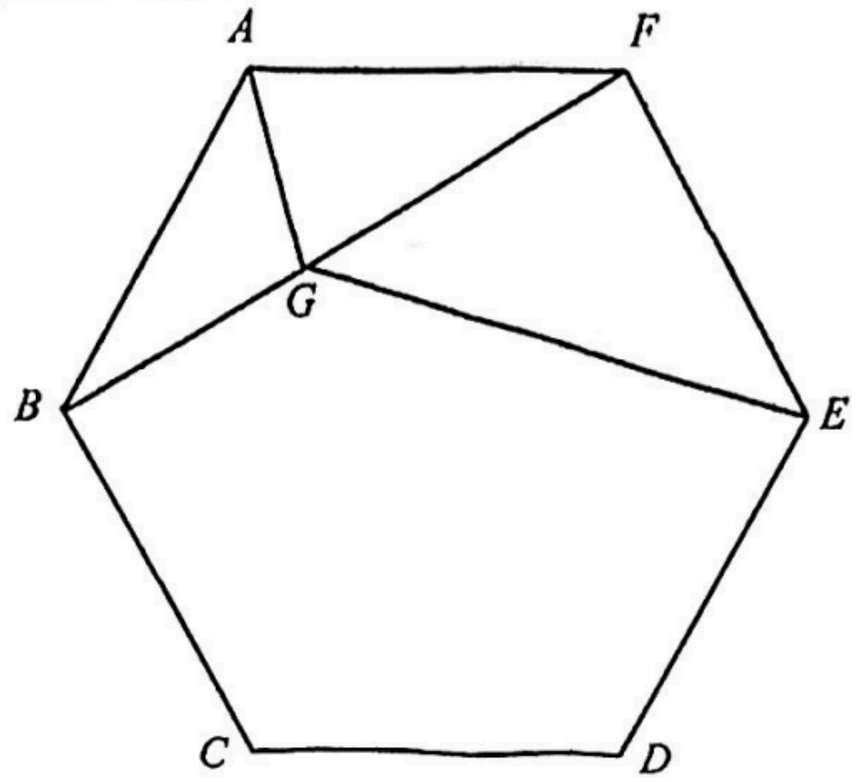


Figure 1

2. In Figure 2, ABC is an equilateral triangle. It is given that $\angle ACD = 72°$ and $\angle CAD = 36°$.

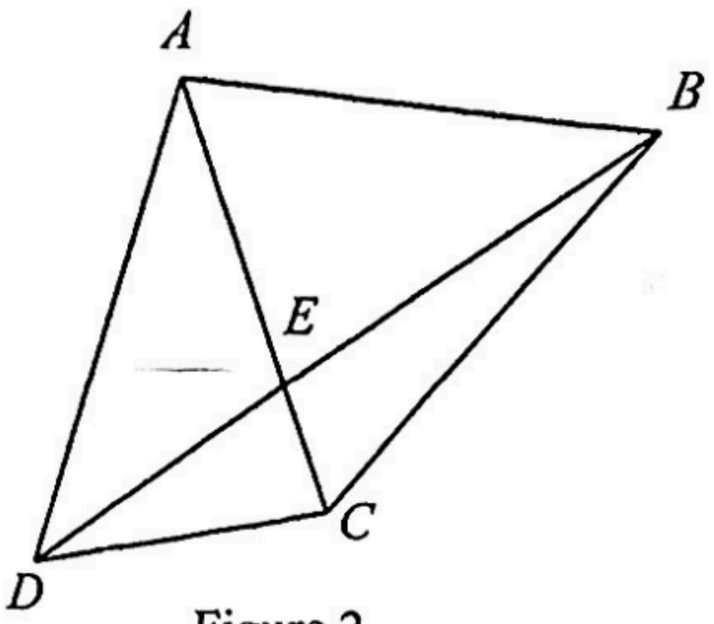


Figure 2

(a) Prove that $AD = AC$. (2 marks)

(b) Find $\angle ADB$. (2 marks)

(c) Let F be a point on AD such that $CF \perp BD$. If $CD = 2\text{cm}$, find the length of CF. (3 marks)

Figure 3 shows two perpendicular straight roads AC and BC. At 1 p.m., Alan starts walking from A to C at a constant speed of 1.2 m/s. At 1:10 p.m., Billy starts walking from B to C at a constant speed, and they arrive at C at the same time. Let D be the position of Alan at 1:10 p.m. It is given that $\angle DBC = 22°$ and $\angle ABD = 16°$.

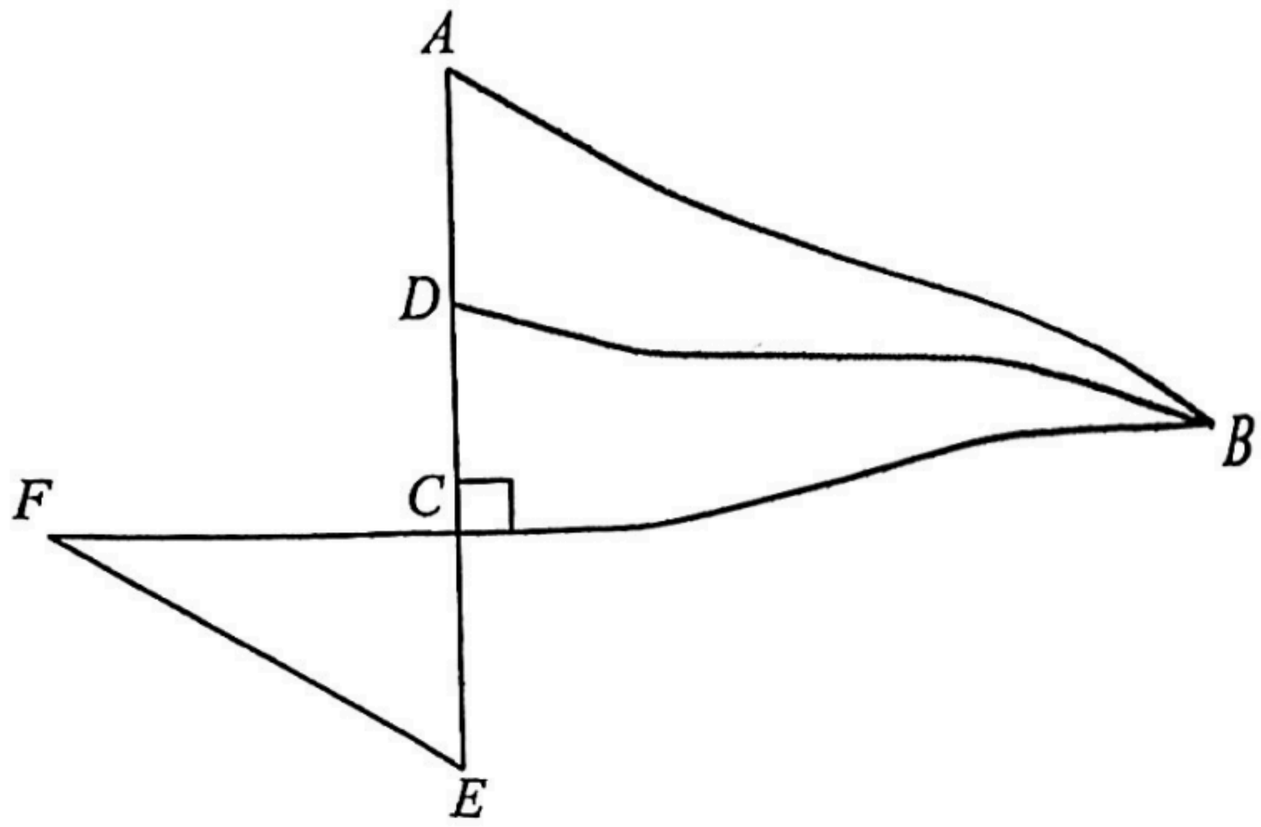


Figure 3

(a) Find the length of AD. (2 marks)

(b) (i) Let $BC = x$ m. Express the length of CD in terms of x.

(ii) Hence, find x. (3 marks)

(c) After meeting at C, they continue to walk without changing their directions and speeds. At the time when Alan arrives at E, Billy arrives at F. Someone claims that EF must be parallel to BD. Do you agree? Explain your answer. (3 marks)

(a) Solve $\begin{cases} 4k+10h=48 \\ 3k+12h=54 \end{cases}$. (3 marks)

(b) A merchant sells small packs and large packs of candies. In each small pack, the ratio of lemon candies to orange candies is $4:3$; in each large pack, the ratio of lemon candies to orange candies is $5:6$. In one small pack and two large packs, the total number of lemon candies and orange candies are 48 and 54 respectively.

(i) Find the number of lemon candies and orange candies in each small pack.

(ii) Carl bought x small packs and y large packs of candies for his students. If the ratio of lemon candies to orange candies he bought is $22:21$, find $x:y$. (4 marks)