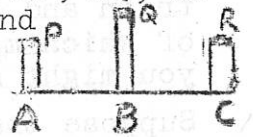


1. At the beginning of a power cut three different candles AP, BQ, CR were placed on a horizontal table and lit. $AP=CR=\frac{1}{2}BQ$ and $AB=BC$. The burning times of the candles AP, BQ, CR were 9, 6 and 18 hours respectively.

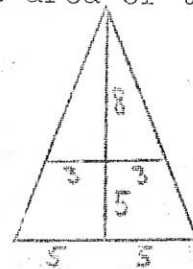
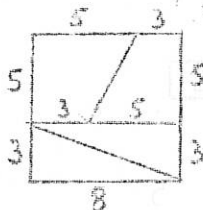


When the lights came on again it was noticed that the tops of the candles were in a straight line. How long did the power cut last?

2. (i) A melon of radius a is perfectly spherical, and the central portion containing the pips is a sphere of radius b with the same centre. The melon is cut into two unequal parts to remove the pips. Show that wherever the cut is made (provided that it is a plane section), the area of flesh exposed is the same.

- (ii) An 8×8 square is cut as in the figure, and the four pieces rearranged to form a triangle as shown.

The area of the square is 64, and yet the area of the triangle is 65. Explain.



3. (i) A is a fixed point on a circle whose centre is C. A variable circle touches the fixed circle at P and passes through C. AP meets the second circle at Q. What is the locus of Q?

- (ii) Prove that for an integer $m > 0$ the expression $\frac{m(m-1)(m-2)(3m-5)}{24}$ is an integer.

4. (i) There are n points on the circumference of a circle. A star or polygon is drawn by starting at one of them, joining to the next but one, and then to the next but one again, and so on. How many times round the circle do you have to go to complete the figure (i.e. to get back to where you began) (a) if $n = 9$ and (b) if $n = 10$?

- (ii) Repeat (i) if $n = 10$ and the same process is carried out missing out two points for each side instead of one.

- (iii) Repeat again with 10 points on the circle, missing out 3 each time.

- (iv) Find the rule giving the answer if there are n points on the circle, and $(m - 1)$ are missed out when each side is drawn. State the rule in your own words.

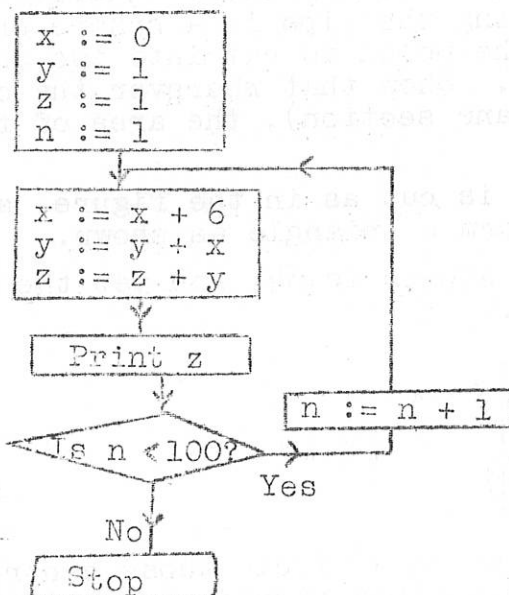
5. A billiard ball is placed at a general point A on a full-sized table 12ft by 6ft. When the ball bounces off a cushion it does so in such a way that the two lines along which it moves before and after hitting the side are equally inclined to the side. In what direction should one hit the ball placed at A so that it will reflect consecutively off each of the four sides and then pass through the point A again? Find the length of the total path of the billiard ball from the point A back to this point.

6. ABC is a triangle with B and C fixed and A variable. ABUV and ACXY are squares drawn outside ABC. Show that UX passes through a fixed point and locate this point.

7. You are crossing London by tube in order to catch an inter-city train and you have 8 minutes in hand to make two changes, each of which may take up to 7 minutes. What is the probability that you might miss the train?

Suppose that you have 8 minutes in hand, but instead you have to make three changes each of which might take up to 3 minutes. What is now the chance of missing the train?

8. What is the output of the following flow chart?



Notice that this program for computing cubes involves addition only, avoiding the use of multiplication. Explain why the program works.

Write a similar flow chart to compute x^4 by addition for integral values of x from 3 to 100.