RADLEY

Scholarship Examination

MATHEMATICS II

2023

Time allowed – 1 hour

Show all working

Calculators may be used

1. a. On December 1st the cost of a basket of groceries is £85. On January 1st it rises by 4%, and on February 1st it rises by another 5%. What is the cost on February 1st?

   b. In a sale the cost of a coat is reduced by 20% on January 1st. That sale price is reduced by a further 10% on February 1st. The cost on February 1st is £138.24. What was the cost of the coat before the sale?

   c. A vintage car is worth £20000 on January 1st 2023. It appreciates in value by 15% each year, valuations being taken on January 1st each year. In which year will its value first exceed £100000?

2.
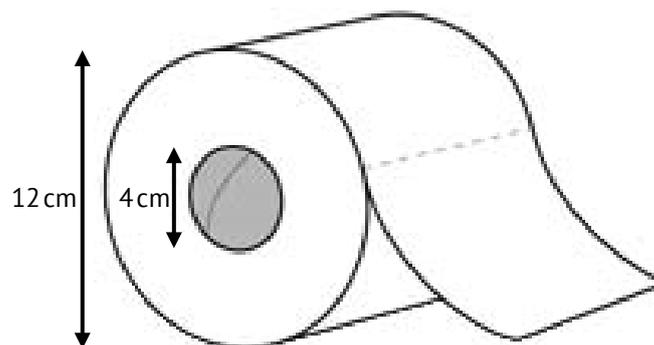
The diagram shows a roll of toilet paper. The inner tube has a diameter of 4 cm, and the whole roll has a diameter of 12 cm. The roll contains 150 sheets.

A jumbo roll has the same inner tube, but the whole roll has a diameter of 20 cm. Estimate the number of sheets in a jumbo roll.

3. A man completes a hike of 43 km. He walks the first 22 km at a speed of v kmh^{-1}, and then jogs the remaining hike at a speed that is 4 kmh^{-1} faster than his walking speed. The hike takes 7½ hours.

    a. Write down an expression in terms of v for the time he spends walking

    b. Write down an expression in terms of v for the time he spends jogging

    c. Write down an equation for v

    d. Solve your equation to find the value of v

Hint: 22 x 8 = 176

4. a. Solve the simultaneous equations

$$\left. \begin{array}{r} 4x + 5y = 48 \\ 10x - 7y = -36 \end{array} \right\}$$

    b. Using your answer to part a. solve the simultaneous equations

$$\left. \begin{array}{r} \dfrac{4}{x} + \dfrac{5}{y} = 48 \\[2mm] \dfrac{10}{x} - \dfrac{7}{y} = -36 \end{array} \right\}$$
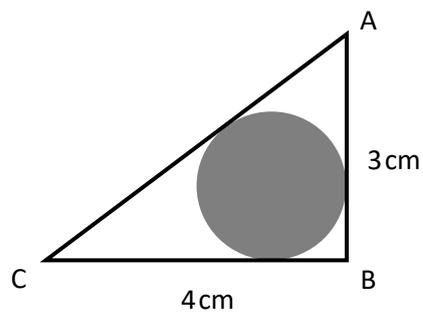
    c. Using your answer to part a. solve the simultaneous equations

$$\left. \begin{array}{r} 4x^2 + 5y^2 - 4x - 10y = 48 \\ 10x^2 - 7y^2 - 10x + 14y = -36 \end{array} \right\}$$

5. The triangle ABC has a right angle at B. AB=3cm and BC=4cm.

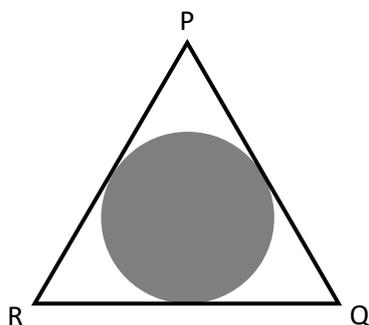a. Find the area of the largest square that can fit inside triangle ABC.

A

3cm

C

B

4cm
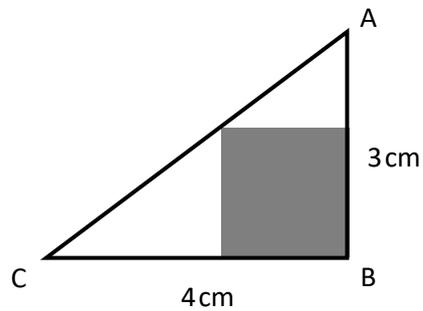
b. Find the area of the largest circle that can fit inside triangle ABC.

A

3cm

C

B

4cm

The triangle PQR in part c is equilateral with sides of length 4cm

c. Find the area of the largest circle that can fit inside triangle PQR.

P

R

Q

6.

A basic padlock has a simple two-digit code. So any two-digit number between 00 and 99 inclusive can be that code. In the diagram above the code is 26.

a. How many codes are possible?

b. How many codes are possible if no digit can be repeated?

A more advanced padlock has a three-digit code

c. How many codes are possible?

d. How many codes are possible if no digit can appear more than once?

e. How many codes are possible if no digit can appear more than twice?

f. How many codes are possible if the first two digits cannot be consecutive numbers?