(32) Mathematics

Structure of the Question Paper

- The question paper consists of two papers, namely Paper I and Paper II.

Paper I
- The duration is two hours.
- Two parts named Part A and Part B.
- **Both Part A and Part B are based on "Essential Mathematical Learning Concepts".**

The percentages of the "Aims of Mathematics" which are required to be covered in Paper I are as follows.

Knowledge and Skills	50%
Communication	30%
Connections	20%

Part A
- 25 short questions worth two marks each.   (02 × 25 = 50 marks)
- These 25 questions will come under the 6 mathematics subject themes as follows.

Numbers	04
Measurements	04
Algebra	06
Geometry	08
Sets and Probability	02
Statistics	01
Total number of questions	**25**

Part B
- Five structured questions worth 10 marks each.   (10 × 5 = 50 marks)
- Questions on the themes algebra and geometry are **not included.**
- At least three parts and at most five parts will be used to structure each question.

                                        Total marks for Paper I = 100

Paper II
- **The duration is three hours.**
- Two parts named Part A and Part B.

Part A
- Six questions worth 10 marks each. **Only five questions** should be answered.

                                        (10 × 5 = 50 marks)

- Questions on the theme Geometry are **not included** in Part A.
- Three questions under the theme Algebra and three questions from three themes selected from the themes Numbers, Measurements, Statistics and Sets and Probability are included.
- Four of the questions are such that each question has at least 3 parts and at most 5 parts. The other two questions are unstructured and test higher order skills. One of these two questions will be under the theme Algebra.

Part B

- Six questions worth 10 marks each. **Only five questions** should be answered.

$(10 \times 5 = 50 \text{ marks})$

- Questions on the theme Algebra are **not included** in Part B.
- Three questions under the theme Geometry and three questions from three themes selected from the themes Numbers, Measurements, Statistics and Sets and Probability are included.
- Four of the questions are such that each question has at least 3 parts and at most 5 parts. The other two questions are unstructured and test higher order skills. One of these two questions will be under the theme Geometry.

Total marks for Paper II = 100

- The percentages of the Subject Themes and the Aims of Mathematics included in the Mathematics question paper are as follows.

| Subject Theme	Percentage	Aim of Mathematics	Percentage
Numbers	23%	Knowledge and Skills	40%
Measurements	15%	Communication	20%
Algebra	20%	Connections	20%
Geometry	22%	Reasoning	10%
Sets and Probability	10%	Problem Solving	10%
Statistics	10%		

Paper I
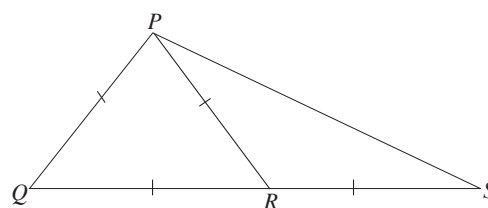
Part A

Answer **all** questions on this paper itself.

1. The value of a television set is Rs 35 000. If the import duty percentage charged on this item is 6%, how much is the import duty?

2. What is the name of the solid that can be constructed using the net shown here?
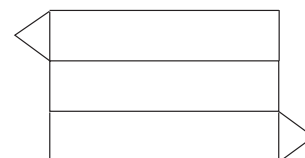
3. Simplify : $\dfrac{6}{xy} \times \dfrac{y}{3}$; here $x, y \neq 0$.

4. Find the magnitude of $Q\hat{P}S$ based on the information marked on the given figure.

5. Between which two consecutive whole numbers does $\sqrt{15}$ lie?

6. In a box, there are 2 blue pens, 5 black pens and 3 red pens which are identical. What is the probability of a pen taken randomly from this box being a red pen?

7. Find the least common multiple of the algebraic terms x^2, $2x$, $6y$.

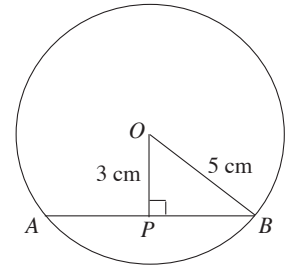8. The centre of the given circle is O. Find the value of x.
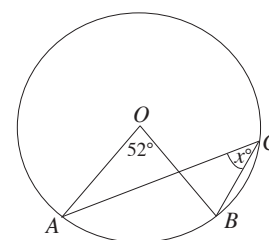
9. $P = \{ x : x \text{ is a square number and } x \leq 16\}$

Write down the set P in terms of its elements.
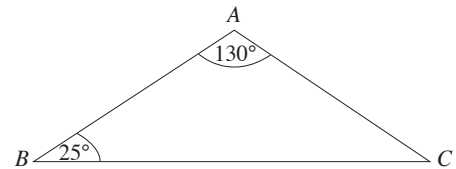
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10.   Write down $7^2 = 49$ in logarithm form.

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11.   The centre of the given circle is O. Find the length of the chord AB.

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12.   The radius of a right circular cylinder is 7 cm and its altitude is 20 cm. Find the area of its curved surface. (Take $\pi = \frac{22}{7}$)

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13.   Find the common ratio of the geometric progression given below.

   1, 3, 9, 27, · · ·

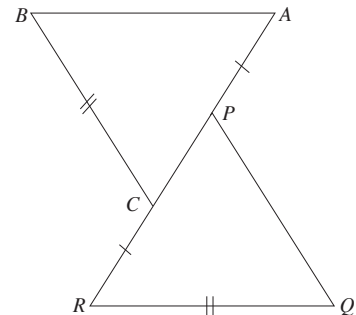**14.**   If AB = 10 cm in the given figure, find the length of AC.

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15.   Write down the equation of the straight line that passes through the point (0, 2) and has a gradient of 3.

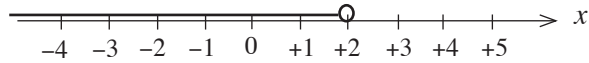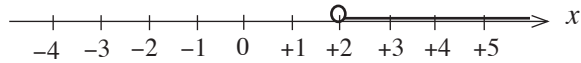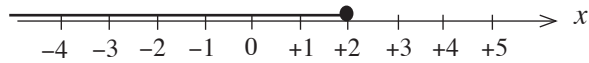**16.**   In the given figure, $AP = CR$ and $BC = QR$.

$\triangle\, ABC$ and $\triangle\, PQR$ are congruent.

(i) What is the side that is equal in length to AB?

(ii) What is the angle which is equal in magnitude to $B\hat{A}C$?

17. Select the number line on which the solution set of the inequality $2x - 1 < 3$ has been represented accurately and underline it.
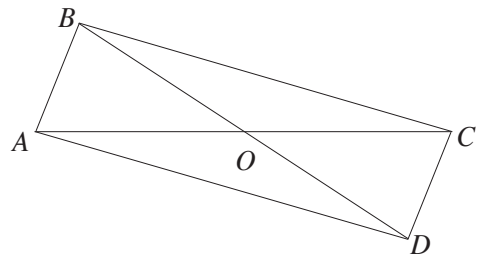

18. A distance time graph drawn by considering the motion of a vehicle travelling at a uniform speed is shown in the figure. Find the speed of the vehicle.
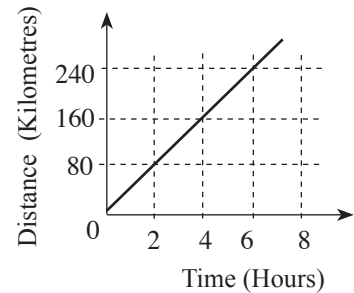
19. Solve : $\dfrac{4}{x} + \dfrac{3}{x} = 14$
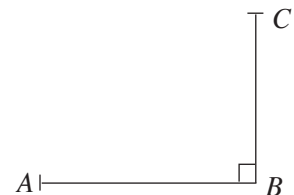
20. Write down the condition that needs to be satisfied by the diagonals for quadrilateral *ABCD* to be a parallelogram.
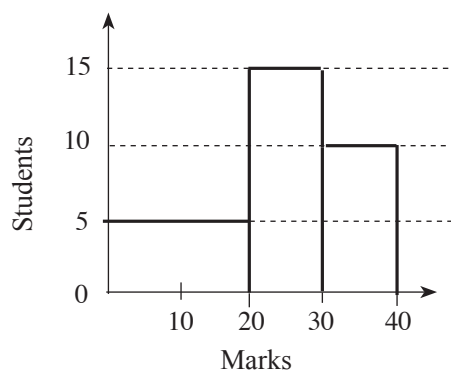

21. The angle of elevation of the top *C* of a flag pole *BC*, when observed from the point *A* on the ground is 40°. Mark this on the given figure.

22. Find *a* and *b* such that $x^2 + 8x + 7 = (x + a)(x + b)$ for all real values of *x*.

23. This histogram illustrates how a group of students in a class obtained marks for a question paper worth 40 marks in total. How many students faced this question paper?

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24. In the given rhombus *ABCD*, $\stackrel{\wedge}{ABD} = 50°$. Find the magnitude of $\stackrel{\wedge}{BCD}$.

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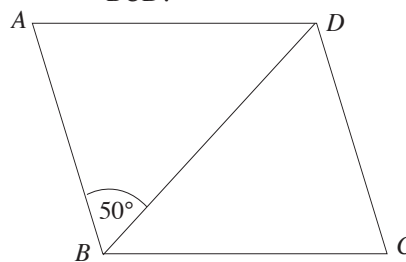
25. A portion of a sketch drawn by a student to obtain the location of a point *P* which lies at a distance of 3cm from the given straight line *AB* and 5cm from the point *A*, is shown in the figure. Complete the sketch and mark the location of the point *P*.

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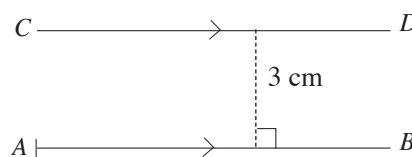
Paper I
Part B
Answer **all** questions on this paper itself.

1.

> From the total distance a man needed to travel, he travelled $\frac{3}{5}$ by train, $\frac{2}{3}$ of the remaining portion by bus, and the rest of the distance he walked.

(i) What fraction of the total distance remained after he had travelled by train?

(ii) What fraction of the total distance did he travel by bus?

(iii) Write down in the simplest from the ratio of the distance he travelled by train to the distance he walked.

(iv) The total distance of the journey was 30 kilometres. The time travelled by train was 20 minutes. Find the average speed of the train in kilometres per hour.

2. The figure depicts a semi-circular plot of land of diameter 14 metres. Sand has been spread on a rectangular portion of this land, of length 7 metres and breadth 3 metres. Grass is grown on the remaining portion. (Take $\pi = \frac{22}{7}$)
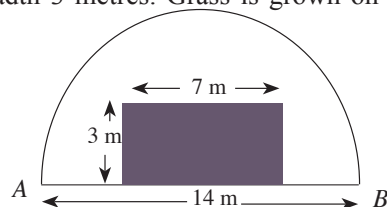
(i) What is the perimeter of the semi-circular plot of land?

(ii) What is the area of the portion of land on which grass is grown?

(iii) Find the ratio of the land on which grass is grown to the area of the land in which sand is spread.

(iv) It is required to join to this plot of land, a rectangular plot of land of area equal to the area on which grass is grown. Illustrate by drawing on the given figure, a sketch of this with the measurements marked on it, such that it lies outside the semi-circular plot and has *AB* as one of its boundaries.

3.(a) A financial institution provides loans at a simple interest rate of 12% per annum. Sumith obtains a loan of Rs 80 000 from this institution with the intention of settling the loan at the end of 3 years.

(i) Find the interest that has to be paid for a year.

(ii) Find the total amount that has to be paid to settle the loan at the end of three years.

(iii) Instead of obtaining the loan from this institution, if a loan is obtained from another institution for the same amount, to be settled in full in four years, an interest of Rs. 32 000 has to be paid. What is the simple interest rate per annum charged by this institution?

(b) 12 men are needed to construct a wall in 10 days. However, only 6 men worked during the first 10 days. It is required to complete the wall in another 4 days. How many more men should be engaged during these four days to achieve this?

4. Three out of seven identical vessels contain red rice while the remaining vessels contain white rice.

(i) Nimal randomly selects one of these vessels and takes a handful of rice. An incomplete tree diagram of the relevant outcomes is shown below. Complete it.

Nimal's selection

- - - → vessel with red rice

$\frac{4}{7}$ - - -
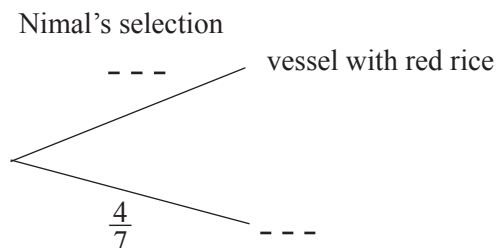
(ii) After Nimal, Kamala also randomly selects a vessel from the above mantioned vessels and takes a handful of rice. Extend the above tree diagram by including the relevant outcomes for this occasion too.

(iii) Find the probability of Nimal selecting a vessel with white rice and Kamala one with red rice.

(iv) The sample space related to Nimal and Kamala randomly selecting a vessel containing rice is shown on the grid. On this grid, mark the event of both of them selecting the same vessel.

(v) Using the grid, find the probability of both of them selecting the same vessel.
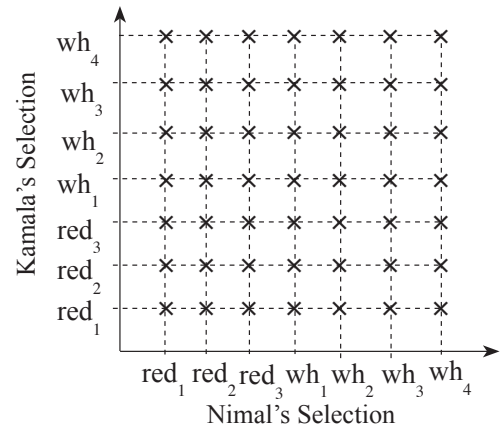
5. The incomplete pie chart in the figure shows how the students in a certain class have been divided into groups for the aesthetic subjects, art, dancing, music, drama and literature.
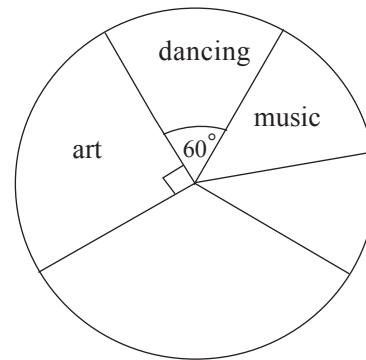
(i) The number of students who selected music is exactly half the number of students who selected art. What is the angle at the centre of the sector that represents those who selected music?

(ii) The angle at the centre of the sector that represents those who selected drama is $120°$. Find the magnitude of the angle at the centre of the sector that represents those who selected literature and mark it in the relevant region.

(iii) If 8 students have selected dancing, how many students are there in the class?

(iv) The number of students who have selected two of these subjects is equal to the number of students who have selected the other three subjects. What are these **two** subjects?

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Paper II
Part A
Answer only **five** questions.

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1. **(a)** The assessed value of a house is 48 000 rupees. 5% is charged annually as rates for this house. Find the amount that needs to be paid as rates for a quarter.

   (b) (i) Sunil can deposit 60 000 rupees in an institution that pays an annual compound interest rate of 8%. Find the total amount he will receive after 2 years if he deposits the money.

   (ii) The amount that he intended to deposit in the institution can be invested for two years to buy shares of market value 15 rupees per share, in a company that pays an annual dividend of 1.50 rupees per share. Show with reasons whether it is more advantageous for him to deposit the money at the compound interest rate or to invest in the company.

   (iii) What annual dividend should the company pay for him to receive an income of 30% by investing in the above company for two years?

2. A table containing the y values corresponding to several x values of the function $y = x^2 - 4x - 3$ is given below.

 | x | −1 | 0 | 1 | 2 | 3 | 4 | 5 |
   |---|---|---|---|---|---|---|---|
   | y | 2 | −3 | −6 | −7 | −6 | −3 | 2 |

   (i) Draw the graph of the function $y = x^2 - 4x - 3$ by selecting a suitable scale.

   Using the graph you drew,

   (ii) write down the minimum value of the function.

   (iii) write down the interval of values of x for which the function is increasing in the interval $-6 < y < 0$.

   (iv) find the roots of the equation $x^2 - 4x - 3 = 0$ and hence obtain the value of $\sqrt{7}$ to the nearest first decimal place.

   (v) by drawing a suitable straight line, write down the coordinates of a point on the graph of which the x coordinate is twice the y coordinate.

3. **(a)** Solve the following pair of simultaneous equations.

   $$2x - 5y = -4$$
   $$3x + y = 11$$

   (b) The price of a tub of ice cream and a tub of yoghurt respectively at store A and store B are given below.

   Store A : 40 rupees, 30 rupees
   Store B : 38 rupees, 35 rupees

   (i) Represent the above information in a matrix of order 2 × 2, such that the columns denote the stores.

   (ii) 20 tubs of ice cream and 30 tubs of yoghurt are required for a certain function. Represent these amounts by a matrix of order 1 × 2 and obtain the product of the two matrices.

   (iii) By considering this product, write down with reasons, the store from which it is more advantageous to buy 20 tubs of ice cream and 30 tubs of yoghurt.

4. In the figure, H denotes a harbour and L denotes a lighthouse. At a certain instant, Ship A, Ship B and the harbour lie along a straight line. At that instant, Ship A lies on a bearing of $040°$ from the harbour H, at a distance of 4.5 km from H, and the lighthouse L lies on a bearing of $110°$ from Ship A, at a distance of 3 km from A. Furthermore, $A\hat{B}L = 90°$ at this instant.
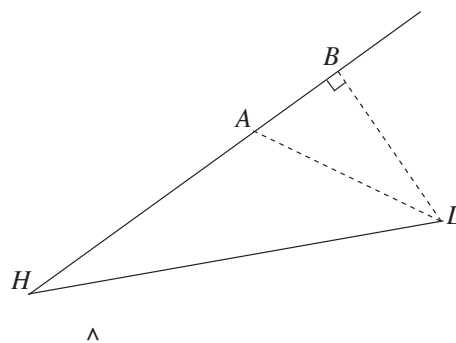

    (i)   Copy the figure and include the above information in it.

    (ii) Using the trigonometric tables, find the magnitude of $B\hat{H}L$.

5. The information obtained during a 30 day month, on the number of passengers who travelled each day from city A to city B on a certain bus is given below.

Class Interval (Number of passengers)	Frequency (Number of days)
5 – 9	2
10 – 14	5
15 – 19	4
20– 24	6
25 – 29	8
30 – 34	3
35 – 39	2

    (i)   According to the given information, what is the maximum number of passengers that can be expected to have travelled from A to B on a particular day.

    (ii)   Calculate the mean of the number of passengers that travelled from A to B each day.

    (iii) During a period of 3 such months, exactly $\frac{3}{5}$ of the passengers were those who travelled from A to B. How many passengers travelled on this bus during these three months?

    (iv) The bus trip costs Rs. 30 for a person who travels from A to B, while it costs Rs. 15 for each of the other passengers. Show that the income received during the three months from those travelling from A to B is three times the income received from the other passengers.

6.
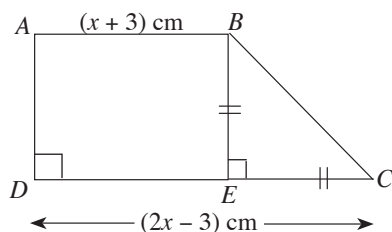
In the trapezium $ABCD$ shown in the figure, $AB = (x + 3)$ cm, $DC = (2x – 3)$ cm and $BE = EC$. If the area of the trapezium is 15 cm², find the length of DC to the nearest first decimal place.
(Take $\sqrt{19} = 4.36$)

Part B

Answer only **five** questions.

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7. Sumana cuts pieces of ribbon for a decoration according to a pattern, such that the first piece is 20 cm long, the second piece is 25 cm long and the third piece is 30 cm long. The longest piece of ribbon she requires for the decoration is of length 95 cm.

 (i) Show with reasons that a roll of ribbon of length 10 m is sufficient for this decoration.

(ii) For another decoration, the length of the longest piece of ribbon cut as above, is twice the length of the above longest piece. Show by computing, whether two rolls of ribbon of length 10 m each are sufficient for this.

8. Use only a straight edge with a cm/mm scale and a pair of compasses to do the following constructions. Draw your construction lines clearly.

 (i) Construct the triangle *ABC* according to the measurements shown in the given sketch.

(ii) Construct a perpendicular from *A* to *BC* and name the point it meets *BC* as *D*.

(iii) Construct the circle that passes through the points *A, C* and *D*.

(iv) Construct the tangent to this circle at the point *C*, and name the point at which it meets *AD* produced as *X*.

 (v) Show that $A\hat{X}C = A\hat{C}B$.
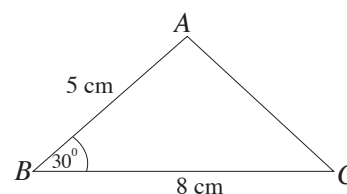
9. In the given figure, $B\hat{A}P = C\hat{A}P$. The tangent drawn to the circle at *B*, meets *AP* produced at *Q* . Furthermore, *BQ = QC*.

 (i) If $Q\hat{B}P = a$, write down the magnitude of $B\hat{A}C$ in terms of *a*.

(ii) Show that $B\hat{C}Q = B\hat{A}Q$.

(iii) Show that *ABQC* is a cyclic quadrilateral.

(iv) Show that *BPD* is an isosceles triangle.
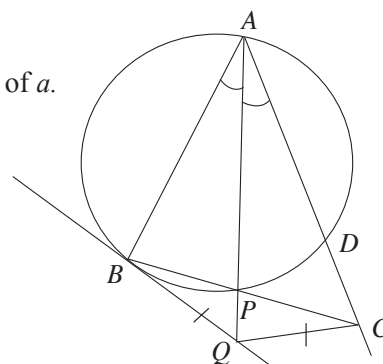
10. The midpoints of the sides *AB* and *AC* of the triangle *ABC* are *P* and *Q* respectively. *BQ* produced and the straight line through *A* drawn parallel to *PQ* meet at *R*. Draw a figure with this information marked on it and prove that, area of *ABCR* = 8 × area of *APQ*.

11. The height of a solid right circular cylindrical metal block of radius 10.5 cm is 20 cm. When this cylinder was heated and 25 identical solid metal spheres were made, 230 cm³ of metal was left over.

(i)   Taking $\pi = \frac{22}{7}$, calculate the volume of the cylindrical metal block.

(ii) What is the volume of one of the spheres that was made?

(iii) If the radius of one of the spheres that was made is denoted by r, by assuming that $\pi = 3.14$ and using the logarithms table, find the value of r^3 to the nearest whole number.

(iv) By using the value obtained above for r^3, find the radius of the sphere.

12. Information on the job types of 250 account holders of a certain bank are given in the following Venn diagram.
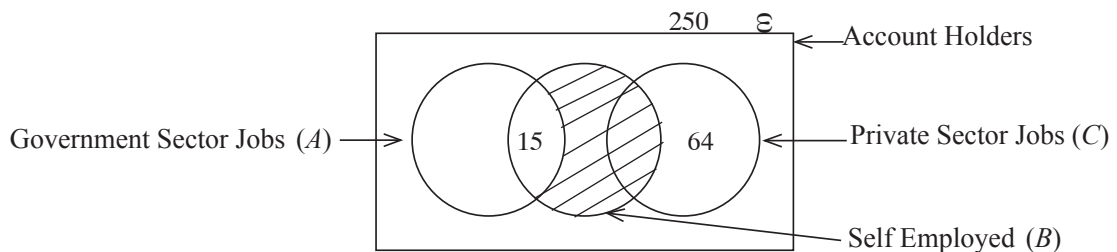
There are 73 persons working in the private sector, 120 persons working in the government sector and 63 persons who are self employed.

(i)   How many persons work only in the government sector?

(ii) The bank has decided to give loans at a low interest rate to those who are only self employed. How many persons can apply for this loan?

(iii) Describe in words the job types of those represented by the shaded region. Express this region using set notation too in terms of *A, B* and *C*.

(iv) Find the number of persons who do not engage in a job of any one of the above three types and show that this number is twice the number of persons who while working in the private sector are also self employed.

(v) Show with the relevant numerical information included in the diagram, how the above Venn diagram changes, if the persons who while working in the private sector are also self employed, give up being self employed.

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