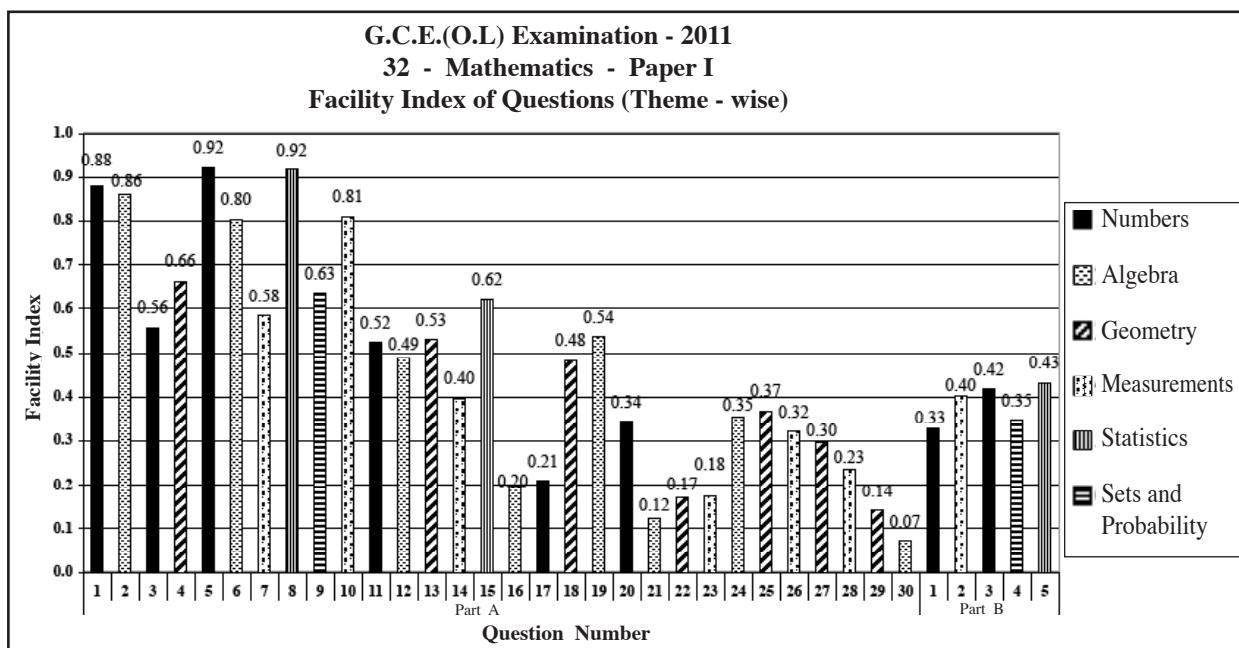## 2.1.2 Observations and conclusions (theme-wise) on the answers to Paper I
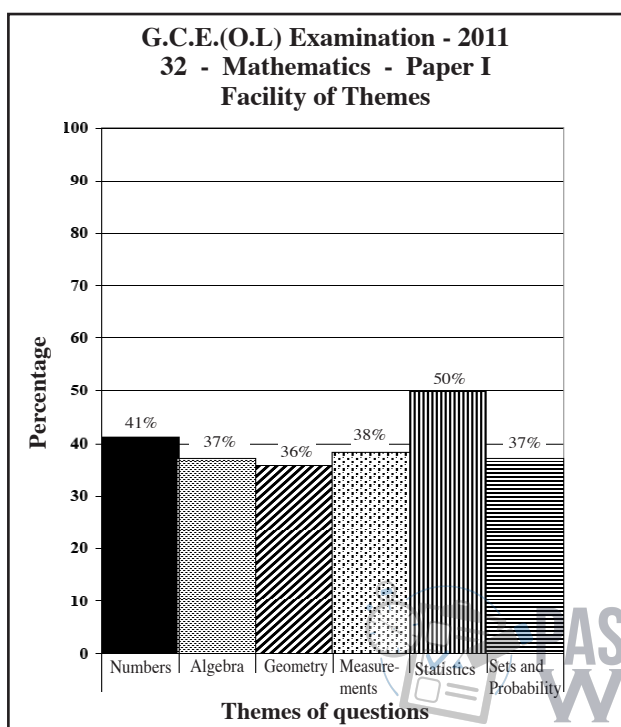

Graph 5.I

Part A

Part A consists of 30 questions on themes, 6 from Numbers, 8 from Algebra, 7 from Geometry, 6 from Measurements, 2 from Statistics and 1 from Sets and Probability. Question 5 on the theme Numbers and question 8 on the theme Statistics are the easiest questions with a facility of 92%. Question 30 which is based on the theme Algebra related to problem solving is the hardest question with a facility of 7%.

Part B

Part B consists of 5 questions, 2 from the theme Numbers and one each from the themes Measurements, Sets and Probability and Statistics. From these five questions, question 5 on the theme Statistics is the easiest with a facility of 43%, while question 1 on the theme Numbers is the hardest with a facility of 33%. All questions have facility indices of less than 50%.

Graph 5.II

According to the answers provided by the candidates for the questions in Parts A and B of this question paper, the facility of the questions on the theme Statistics is 50%. This theme has been the easiest. Geometry has been the most difficult theme. Its facility is 36%.

In this question paper, none of the themes has a facility exceeding 50%.

2.1.3 Expected answers for Paper I, marking scheme, observations and conclusions

> **The relevant percentages for the questions in Paper I are taken from Graph 5.1 found on page 13.**

Part A

Only 1 mark is allocated for each of the questions 1 - 10 since only one skill is expected for each of these questions. Here, skills on basic concepts are tested. Due to the weakness in these basic skills, most often secondary concepts too cannot be mastered. It is also expected that the satisfaction of solving some very easy problems will put the student in the correct frame of mind to solve the remaining problems.

1. If the price of 8 pens is 72 rupees, find the price of one pen.

Expected Answer   Rs. 9   **1 mark**

Observations and conclusions

This first question of Paper I of Mathematics is a very easy question where the number of 8s in 72 has to be found. 88% of the candidates have answered this question correctly. Although the question is very easy, 12% of the candidates have been unsuccessful in answering it.

The ability to perform a simple division is tested in this question. The reason why 12% of the students have been unsuccessful here may be because they are unable to divide or because they do not have a proper understanding of the correct units. Although the answer Rs. 9 can be written in various ways, just writing 9 is incorrect. Students should be encouraged to pay attention to the units.

2. If $y - 5 = 0$, find the value of y.

Expected Answer   5   **1 mark**

Observations and conclusions

86% of the candidates have correctly answered this simple question for which the answer can easily be obtained in one step.

The problem is a simple equation. Although it can easily be solved in one step, 14% of the candidates have been unsuccessful in answering it. It is important to provide students with an understanding of the application of inverse arithmetic operations which is the basic process of solving equations. It should be stressed that the accuracy of the solution can be verified by substituting the answer back into the equation.

3. Simplify : 0.1×0.1

Expected Answer   0.01   **1 mark**
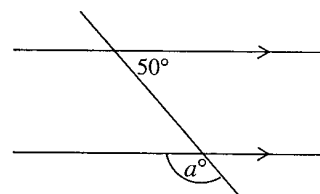
Observations and conclusions

This problem is prepared based on multiplying decimal numbers has been answered correctly by 56% of the candidates. Compared to the first and second questions, this percentage is low.

When the first 10 questions are considered, the least number of correct answers has been provided for this question. This can be simplified by acquiring the basic skill necessary to multiply decimal numbers. Placing the decimal point at the correct position is difficult for a student who mechanically simplifies expressions and hence not have a correct understanding of decimal places. By writing this as, $\frac{1}{10} \times \frac{1}{10}$ the answer $\frac{1}{100}$ can easily be converted to decimal form. Since simplifying decimals is a difficult section for them, students need to be guided to solve simple problems such as these using basic concepts.

4. Find the value of a in the figure.

Expected Answer   130   **1 mark**

Observations and conclusions

66% of the candidates have provided the correct answer to this problem which is based on angles related to parallel lines.

Although this problem is very easy, students not attempting it due to their dislike for geometry may be the reason for 44% being unsuccessful It is important to provide students with an understanding of the basic concepts in geometry. The ease with which the answer to this question can be obtained using the basic concepts should be made clear to students.

5. What is the loss that has to be borne when a chair which is bought for 450 rupees has to be sold for 425 rupees?

Expected Answer   Rs. 25   **1 mark**

Observations and conclusions

A percentage as high as 92% of the candidates have provided the correct answer to this very easy problem on money. This is one of two problems for which the greatest number of the students has provided the correct answer.

A few students did not get this correct due to not stating the units in the answer. Here the importance of paying attention to the units needs to be explained to students.

6. Simplify : $\dfrac{4}{a} - \dfrac{3}{a}$

Expected Answer $\dfrac{1}{a}$ **1 mark**

Observations and conclusions

Although this is a very easy problem of subtracting fractions with equal denominators, only 80% of the candidates have provided the correct answer.

This is not difficult for students who have correctly understood how to simplify fractions. Simplifying algebraic fractions will be easier for students after they have practiced simplifying normal fractions with equal denominators.

7. Express $2.08\,l$ in millilitres.

Expected Answer   2080 ml   **1 mark**
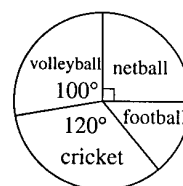
Observations and conclusions

This question for which the solution has to be obtained by converting liquid measurements has been answered correctly by 58% of the candidates.

The reason why 42% of the candidates were unable to successfully answer this question related to the conversion of units may be due to not knowing how many milliliters there are in a liter as well as due to not knowing how to multiply a decimal number by an integer. Students need to be made aware of how the decimal place changes when a decimal number is multiplied by a power of 10.

8. The pie chart represents information obtained from a group of students about their favourite sport. Which sport is the favourite of the least number of students?

Expected Answer   Football

1 mark

Observations and conclusions

This is a very easy question for which the answer can be provided directly from the pie chart. This is one of two questions in this paper for which the greatest number of students provided the correct answer.

An understanding of the information represented in a pie chart is expected from this question. 92% of the candidates have provided the correct answer to this question. A problem regarding the magnitudes of the angles does not arise here. It is very easy for a student who knows the symbol for a right angle as well as the magnitude of a right angle to find the smallest angle. The answer can also be provided by observation, instead of finding the magnitudes of the angles.

9. What is the probability of obtaining an odd number when a fair die with the numbers 1 to 6 marked on its faces is tossed up once?
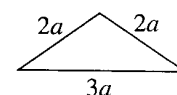
Expected Answer $\frac{3}{6}$ or $\frac{1}{2}$ **1 mark**

Observations and conclusions

This question related to probabilities has been answered correctly by 63% of the candidates.

To answer this question, an understanding of probabilities as well as odd numbers is required. The basic concepts of probabilities alone are sufficient here.

10. What is the perimeter of the triangle in the figure?

Expected Answer $7a$

1 mark

Observations and conclusions

This question for which the perimeter has to be found by adding algebraic terms has been answered correctly by 81% of the candidates.

These algebraic terms can easily be added with an understanding of like terms. The fact that 81% of the candidates answered this correctly should be appreciated.

The questions from 11 - 30 are questions for which 2 marks each are allocated. Students should be encouraged not to just write the answer to these questions. It is important to make the students understand that by writing down the necessary steps when answering the question, even if the final answer is wrong, there is a possibility of obtaining marks for the correct step. Students need also to be informed that they should write the correct units.

11. One man requires 8 days to complete a certain task. If two such men work for 2 days, what fraction of the task can they complete?

Expected Answer $\dfrac{1}{2}$ **2 marks**

$\dfrac{1}{4}$ of the task in one day by two people or $\dfrac{1}{8}$ of the task in one day by one person ——————— **1**

Observations and conclusions

This problem based on work and time has been answered correctly by 52% of the candidates.

The reason why 48% of the candidates were unable to answer this question successfully may be their lack of understanding of inverse proportions. It is necessary to provide students with an understanding of both direct and inverse proportions. Knowledge of inverse proportions, work and time as well as fractions is required here.

12. From the following expressions, select and write down all the expressions that give the answer $4y$.

$2(y+y)$ $\qquad$ $(2y+y)$ $\qquad$ $2y \times 2y$ $\qquad$ $2y+2y$ $\qquad$ $2+2y$

Expected Answer $2(y+y), 2y+2y$ **1 + 1 2 marks**

When a wrong expression has been written with the two correct answers ——————— **1**

Observations and conclusions

This question for which the answer should be obtained in terms of the product and the sum of algebraic expressions has been answered correctly by 49% of the candidates. That is, the answers of more than half the candidates were unsuccessful.

Knowledge of the product and sum of algebraic terms is expected here. Knowledge of the basic concepts of simplifying algebraic terms is sufficient to solve this problem. This basic knowledge is given in grades 7 and 8. It is important to explain to students that since 4 expressions have been given, in such instances, each of them needs be examined before the correct answers are selected.

13. Find the value of x based on the information in the figure.

Expected Answer 75 **2 marks**

$x° + 60° + 90° + 80° + 55° = 360°$ ——————— **1**
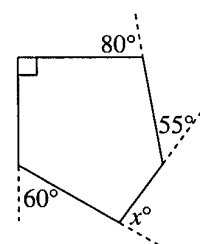
Observations and conclusions

This simple problem related to the exterior angles of a polygon, of finding the magnitude of the remaining angle when the magnitudes of four of the exterior angles of a pentagon are known has been answered correctly by 53% of the candidates.

Knowledge of the fact that the sum of the exterior angles of any polygon is 360° and the ability to find the remaining angle when the other four angles of a pentagon are given is expected here. Lack of knowledge of the fact that the sum of the exterior angles of a polygon is 360° and a general dislike for geometry have affected the success rate of this question

14. If a water pump takes 24 minutes to fill $\frac{2}{3}$ of a tank, how many minutes will it take the pump to fill half the tank?

Expected Answer   18 Minutes   **2 marks**

$24 \times \frac{3}{2}$ minutes or 36 minutes to fill the whole tank ————— **1**

Observations and conclusions

This question which is based on ratios and proportions has been answered correctly by a percentage as low as 40% of the candidates.

Basic concepts related to fractions as well as an understanding of the unitary method are required to answer this question. It is necessary to first find the time required to fill the whole tank using the unitary method. It is important to make students aware of how problems such as these which are related to fractions are solved. Here, most students were unable to find the time it takes to fill the whole tank when the time it takes to fill $\frac{2}{3}$ of the tank is given.

15. The marks obtained by 9 students who faced a certain test are given below.

2   3   5   8   4   10   4   6   7

Find
  (i)   the mode

 (ii)   the range

of these marks.

Expected Answer   (i) 4 ————— **1**
(ii) 8 ————— **1**   **2 marks**

Observations and conclusions

This is a simple question related to representative values.   62% have answered it successfully.

This is a very easy question related to representative values which can be answered by just observing the data. Even a student who has only a basic understanding of representative values can answer this question easily. 38% of the answers were unsuccessful due to the inability to correctly interpret the mode and range.

16. Factorize: $x^2 - a^2 + x + a$

Expected Answer $(x+a)(x-a+1)$ **2 marks**
$(x-a)(x+a)+x+a$ ————— **1**

Observations and conclusions

This is a problem which has to be solved using the knowledge of factors, by considering the difference of two squares, where the answer cannot be obtained directly. A very low percentage of just 20% of the candidates have been able to approach the answer successfully.

Algebra, like geometry is a difficult area for students. Factoring the difference of two squares and separating out the common factor is expected here. These are basic concepts of finding factors. Separating out common factors is a section that can easily be taught to students. Students should be guided to identify the common term when several terms have a common factor, and then to divide the terms by this common factor and write out the remaining terms.
Factoring the difference of two squares is finding the factors of the simplest type of quadratic expression. Here, students have to recognize what terms have as their squares the terms that are given.

17. A discount of 8% is given on the marked price when an item is sold. Find the marked price of an item which was sold for 368 rupees.

Expected Answer   Rs. 400   **2 marks**

$$368 \times \frac{100}{92} \quad \text{or} \quad x \times \frac{92}{100} = 368 \ \text{———} \ 1$$

Observations and conclusions

Although this is a problem which has been constructed based on the normal daily occurrence of buying a commodity from a shop, only a very few candidates have been able to answer it correctly.

Although this is not as difficult as algebra, only a low percentage of 21% of the candidates have provided the correct answer to this question. The initial difficulty may have arisen due to the fact that it is related to the inverse process. Although finding a percentage of a value or writing one value as a percentage of another are both direct processes, finding the purchase price when the profit percentage and the selling price are given is an inverse process. Here, guiding students to write sentences such as "the selling price of a Rs. 100 worth item is Rs. 108" as well as "the purchase price of an item being sold for Rs. 108 is Rs. 100" will help students solve problems such as this one. It is extremely important to guide students to logically and with understanding solve such problems by considering what the profit is for Rs. 100, when the profit is a certain amount for a certain purchase price, instead of mechanically finding the profit percentage as $\frac{\text{selling price} - \text{purchase price}}{\text{purchase price}} \times 100\%$.
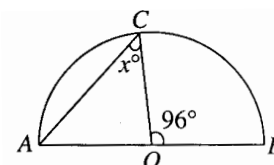
18. The figure denotes a semi-circle with centre O. If $C\hat{O}B = 96°$, find the value of x.

Expected Answer   48   **2 marks**

$$O\hat{A}C = x \quad \text{or} \quad O\hat{A}C = 48° \quad \text{or}$$
$$A\hat{O}C = 84° \quad \text{or} \quad 2x = 96° \ \text{———} \ 1$$

Observations and conclusions

This question which should be answered by thinking logically, using the theorems on the exterior angle of a triangle and the angles in an isosceles triangle has been answered correctly by 48% of the candidates.

This is an easy problem which can be solved using only the theorem on isosceles triangles and the exterior angle theorem, apart from the basic theorems on circles. The fact that *OAC* is an isosceles triangle has to be recognized first. It is encouraging that 48% have answered this correctly.

19. Make s the subject of $v^2 = u^2 + 2as$.

Expected Answer $s = \dfrac{v^2 - u^2}{2a}$ **2 marks**

$$v^2 - u^2 = 2as \quad \text{or} \quad \frac{v^2}{2a} = \frac{u^2}{2a} + s \ \text{———} \ 1$$

Observations and conclusions

This is an easy problem on making an algebraic term the subject of a formula. 54% of the candidates have answered this correctly.

It is encouraging to note that although algebraic terms had to be manipulated in this question, a fair number of candidates have answered it correctly. The reason may be because they are familiar with this formula and also because only the operations of subtraction and division had to be used. Familiarizing students with the simplification of algebraic expressions will help them solve such problem.

20. Find the value of $2 \lg 5 + \lg 8 - \lg 2$.

Expected Answer   2   **2 marks**

$$lg\left(\frac{5^2 \times 8}{2}\right) \underline{\hspace{1cm}} \text{ 1 (If at least two log rules are correct)}$$

Observations and conclusions

This is a problem for which the solution has to be obtained by using the logarithmic laws. Only 34%, a low percentage of the candidates have answered this problem correctly.

This problem which has to be simplified using the basic logarithmic laws can be answered if students are provided with the basic concepts on logarithmic laws. It has been observed that when logarithms are taught, only simplifications using the logarithmic tables are done mechanically. It is necessary to first give students a proper understanding of the logarithmic laws of simplification.
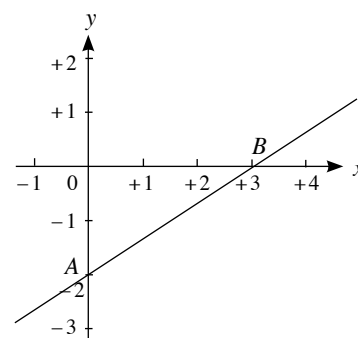
21. What is the
   (i) gradient
   (ii) equation

of the straight line through *A* and *B* given in the figure?

Expected Answer   (i) $\frac{2}{3}$ —— 1

(ii) $y = \frac{2x}{3} - 2$ —— 1   **2 marks**

Observations and conclusions

This is a problem related to straight line graphs. Only 12%, a very small percentage of the candidates have answered this question correctly. A large percentage, 88% have been unsuccessful in answering it.

This question which is based on straight line graphs had the second lowest number of correct answers. Only a very few students have understood that the gradient of the graph is the tangent of the angle that the straight line makes with the positive x-axis. The answer can also be provided by considering the coordinates of two points on the line. It is important to give a better understanding of the gradient and the intercept to students.
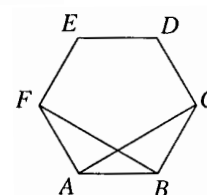
22. The figure denotes a regular hexagon *ABCDEF*. Give reasons as to why *AC = FB*.

Expected Answer   ABC Δ $\equiv$ ABF Δ (S.A.S. instance)   **2 marks**

ABC Δ $\equiv$ ABF Δ —— 1

Observations and conclusions

This is a geometry problem for which the answer has to be obtained using the congruency of triangles. Only a percentage as low as 17% of the candidates have answered this correctly.

This is a problem that can be answered with the knowledge on polygons and the congruency of triangles. This question too reflects the general weakness in geometry. This is not difficult for a student who is familiar with the properties of regular polygons. The properties of a regular polygon are sufficient to show that the triangles are congruent under the instance S.A.S.

23. Determine for which value of the radius, the numerical value of the circumference of a circle equals the numerical value of its area.

Expected Answer   r = 2   **2 marks**

$$2\pi r = \pi r^2 \text{ ———— } 1$$

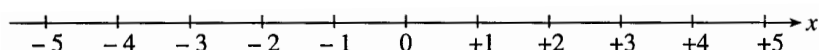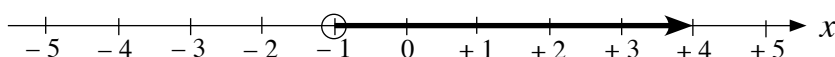**Observations and conclusions**

Only a percentage as low as 18% of the candidates have successfully answered this question which is based on the circumference and area of a circle.

This question, for which the answer can be supplied with the knowledge on the circumference and area of a circle, cannot be answered directly. The aim of the question is for connections to be made by understanding it correctly. The only expectation here is for the student to see the connection which is required to obtain a very simple equation. It is good to train students to identify simple relationships such as these. By understanding the problem correctly, such connections can easily be identified.

24. Indicate the solutions of the inequality $x - 2 > -3$ on the number line given below.

Expected Answer

2 marks

$$x > {}^-1 \text{ ———— } 1$$

Observations and conclusions

This is a problem related to work done in grades 7 and 8 on illustrating the solutions of an inequality on a number line. Only about 35% of the candidates have answered this question correctly.

The expectation of this question is for students to solve the inequality and represent the solutions on a number line. Although candidates have been able to solve the inequality, representing the solutions on a number line has been difficult. The difference in representing the solutions of an inequality which includes the case of equality and one that does not should be explained to students. It is also important to make students understand the cases when arrow heads are used and when they are not used in illustrating regions on a number line.
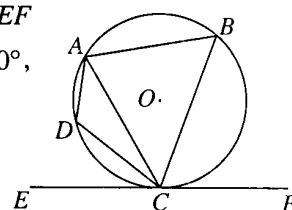
25. In the circle with centre *O* illustrated in the figure, *AC* is a chord and *EF* is a tangent through *C*. The points *D* and *B* are on the circle. If $A\hat{C}E = 60°$, find the magnitude of $A\hat{D}C$.

Expected Answer   120°   **2 marks**

$$A\hat{B}C = 60° \text{ or } A\hat{C}F = 120° \text{ ——— } 1$$

Observations and conclusions

37% of the candidates have successfully answered this question which can be solved using the theorems related to the angles in a circle. (The angles in the alternate segment, the vertically opposite angles of a cyclic quadrilateral and also adjacent angles on a straight line).

This is a problem that can be answered using the knowledge on the angles of a cyclic quadrilateral and the angles between chords and tangents. Students need to be guided to identify the relationships in a figure related to geometry. Here it is important to direct the students to clearly mark the angles or lengths that are equal on the figure. This can be achieved by guiding students to see the connections in the figures of simple exercises.

26. A map has been drawn to the scale 1 : 50 000.

  (i) What is the actual distance in metres represented by 1 cm in the map?

 (ii) By what length is an actual distance of 250 metres represented in the map?

Expected Answer   (i) 500 m ———————— **1**

      (ii) 0.5 cm or $\frac{1}{2}$ cm ———————— **1**   **2 marks**

Observations and conclusions

32% of the candidates have successfully answered this question which is based on scale lengths.

Here, it is only required to read the scale accurately. It should be explained very simply that 1 : 50 000 means that 1 cm represents 50 000 cm. Next a conversion of units, cm ⟶ m is required. This is a very basic concept of the section on scale drawings. It is necessary to give students an understanding of different scales and to train them to come up with suitable scales for various lengths.

27. In the figure, AB = 2 cm, ED = 8 cm and AD = 5 cm.
Find the length of AC.

Expected Answer   AC = 1 cm   **2 marks**

$\frac{AC}{CD} = \frac{AB}{ED}$ or an equivalent ratio
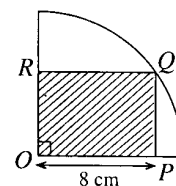
      ———————— **1**

Observations and conclusions

30% of the candidates have answered this question correctly. It is a problem on geometry which needs to be solved using the relationships between the lengths of the corresponding sides of two equiangular triangles.

In this problem which is related to the theorem, "The corresponding sides of equiangular triangles are proportional", before identifying the corresponding sides, is necessary to first realize that the two triangles are equiangular. Students need to understand that since two pairs of angles are equal in the triangles ABC and EDC, the other two angles are also equal. After that, how the corresponding sides are found can be shown. It should be explained that corresponding sides are identified as sides which are opposite equal angles, it will not be difficult for students to find the required side when the lengths of the other three sides are given.

28. The figure denotes a sector of a circle of radius 10 cm. If OP = 8 cm, find the area of the rectangle $OPQR$.

Expected Answer   48 cm^2 **2 marks**

$OP^2 + PQ^2 = OQ^2$ ———————— **1**
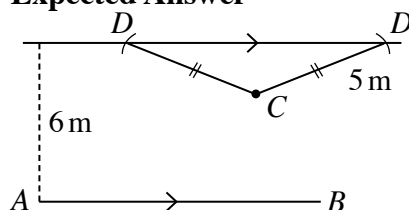
Observations and conclusions

This is a geometry problem for which the final answer has to be found using the answer obtained by first applying Pythagoras' relationship. Only 23%, which a small percentage of the candidates have answered this question correctly.

Although this is a problem related to the area of a rectangle, to find the area, the breadth of the rectangle has first to be found using Pythagoras' relationship. This is not immediately clear to students. In such an instance, finding the length of the side becomes a problem. Students need to be advised to mark the given information on the figure in such situations. Then, since the radius has been given as 10 cm, by identifying that OQ is a radius, its length can be marked as 10 cm by joining OQ. Many students had not observed this. After joining OQ, it is easy to calculate the length of PQ using the triangle OPQ. Students need to be guided to use the given data in problems such as this.

29. A straight road *AB* and the location *C* of a tree, 4 m from the straight road, both of which are located on a flat ground are given in the figure. Indicate by sketching on the figure, how the location of a point *D* which is 6 m from the road and 5 m from the tree can be found.

Expected Answer

Drawing the parallel line and the arc with centre C.

1 + 1   2 marks

Observations and conclusions

Only a very small percentage of 14% of the candidates have successfully provided the answer to this problem for which the answer has to be obtained using geometric loci.

This is a simple problem on geometric loci. Knowledge on the basic loci is sufficient to obtain the answer to this problem. Students need to be given the understanding that a constant distance from a straight line is a parallel line and at a constant distance from a fixed point is a circle.

30. Find three consecutive positive integers *a, b* and *c* such that $a + b$ is a perfect square and $b + c$ is a perfect cube.

Expected Answer $a = 12$

$b = 13$

$c = 14$ **2 or 0 marks**

Observations and conclusions

Only 7%, a very small percentage of the candidates have answered this last question of Part A of Paper I correctly. Of the 30 questions in Part A, this is the question which has been answered correctly by the least number of students.

This is a question related to problem solving. To find the answer to this problem, students should have achieved the four main aims of the mathematics curriculum, namely knowledge and skills, communication, seeing connections and reasoning. Students should be made aware that this can also be answered by understanding the problem and using the method of trial and error.

Part B

1. Mala bought a stock of mangoes. $\frac{1}{8}$ of the stock was spoilt. $\frac{1}{7}$ of the unspoilt mangoes were raw. Mala sold the remaining portion of unspoilt ripe mangoes.

(i) What fraction of the total stock of mangoes was unspoilt?

$1 - \frac{7}{8}$ —— **1** $\frac{7}{8}$ —— **1**   **2 marks**

(ii) What fraction of the total stock of mangoes was sold?

$\frac{7}{8} \times \frac{1}{7} = \frac{1}{8}$ —— **1** $1 - (\frac{1}{8} + \frac{1}{8})$ —— **1** $= \frac{3}{4}$ —— **1**   **3 marks**

(iii) There were 400 fruits in the stock that was bought. If Mala sold the unspoilt ripe mangoes at Rs 10 per fruit, how much did she earn by selling the mangoes?

Number of Mangoes sold $= 400 \times \frac{3}{4}$ —— **1**

        $= 300$ —— **1**

Amount of money made from the sale $=$ Rs. 3000   —— **1**   **3 marks**

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(iv) By selling the mangoes, Mala made 20% more than the amount she spent to buy the stock. Find the price at which she bought the stock of mangoes.

$$\text{Price bought} \quad = \quad \text{Rs. } 3000 \times \frac{100}{120} \quad \text{——— 1}$$
$$= \quad \text{Rs. } 2500 \quad \text{——— 1} \qquad \textbf{2 marks}$$

Observations and conclusions
This first question of Part B of Mathematics I is a question worth 10 marks and is based on finding the purchase price and selling price. However only a percentage as low as 33% of the candidates have answered this problem correctly.

Even though students may have the ability to manipulate operations in relation to fractions, if they do not have the ability to convert a word problem into mathematical form, they will not be able to solve such problems. This is the reason why 67% of the candidates have not been successful in answering this question. By training students to represent the information in a word problem pictorially, these types of problems can easily be understood.

2. A sketch of a rectangular shaped netball court is given in the figure.
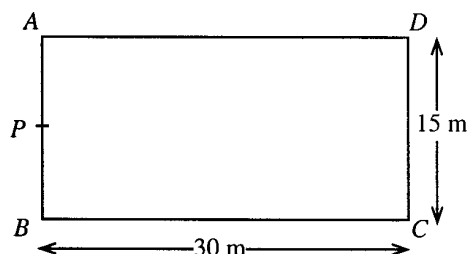

(i) Find the perimeter of the netball court.

$$\text{Perimeter} \quad = \quad 2\,(30+15)\,\text{m} \quad \text{——— 1}$$
$$= \quad 90\,\text{m} \quad \text{——— 1}$$
$$\textbf{2 marks}$$

(ii) Find its area.

$$\text{Area} \quad = \quad 30 \times 15\,\text{m}^2 \quad \text{——— 1}$$
$$= \quad 450\,\text{m}^2 \quad \text{——— 1} \qquad \textbf{2 marks}$$

(iii) It is required to draw a semi-circular goal circle inside the court. The centre P of the goal circle should be at the mid-point of AB. Further, the goal circle should meet AB at the two points which are 2.6 m from A and B respectively. Draw a sketch of such a goal circle on the above figure and note down its radius.

Drawing the goal circle ——— **1**   Diameter 9.8 m or radius 4.9 m ——— **1**
Marking radius ——— **1** **3 marks**

(iv) Two goal circles as mentioned in (iii) above are located on both sides of a netball court. If the centre player is **not allowed** to enter the goal circles, show that the area of the court in which she can move is 374.54 m². (Take $\pi = \dfrac{22}{7}$)

$$\text{Area of the goal circle} \quad = \quad \frac{22}{7} \times 4.9 \times 4.9\,\text{m}^2 \quad \text{——— 1}$$
$$= \quad 75.46\,\text{m}^2 \quad \text{——— 1}$$
$$\text{Area of the court she can move in} \quad = \quad 450 - 75.46\,\text{m}^2 \quad \text{——— 1}$$
$$= \quad 374.54\,\text{m}^2 \qquad \textbf{3 marks}$$

Observations and conclusions
40% of the candidates have successfully answered this question which is based on areas and perimeters. Here too, a greater proportion of candidates have been unsuccessful in answering the question.

In calculations related to the perimeter and area too, the ability to draw sketches based on given conditions is lacking in most students. Such situations can be avoided by engaging students in practical activities that will inculcate in them the competency of managing space in day to day life by using their knowledge on area.
The ability to successfully tackle such problems cannot be developed by doing only the exercises in the textbook. The level of achievement reveals the necessity to engage students in competency based activities.

3. (a)

> A and B started a business by investing money in the ratio 4 : 5

(i) If A invested 20 000 rupees, how much did B invest?

Amount invested by B $\quad = \quad$ Rs. $\dfrac{20000}{4} \times 5 \quad$ —— **1**

$\qquad\qquad\qquad\qquad = \quad$ Rs. 25000 $\qquad\qquad$ —— **1** $\qquad\qquad$ **2 marks**

(ii) A profit of 6 000 rupees was made by the end of the year, 10% of which was re-invested in the business. If the remaining amount was divided between the two in the ratio that they invested in the business, find separately the amounts that A and B received.

Remainder $\qquad = \quad$ Rs. $6000 \times \dfrac{90}{100} \quad$ —— **1**

$\qquad\qquad\quad = \quad$ Rs. 5400 $\qquad\qquad$ —— **1**

Amount A got $\quad = \quad$ Rs. $5400 \times \dfrac{4}{9} \quad$ —— **1**

$\qquad\qquad\quad = \quad$ Rs. 2400 $\qquad\qquad$ —— **1**

Amount B got $\quad = \quad$ Rs. 3000 $\qquad\qquad$ —— **1** $\qquad\qquad$ **5 marks**

(b) Sunil's father sent 340 Euro to Sunil who lives in Great Britain. What is its value in Sterling Pounds? (Take that 1 Euro equals 145 Sri Lankan rupees and that 1 Sterling Pound equals 170 Sri Lankan rupees.)

Euro 340 $\qquad = \quad$ Rs. $340 \times 145 \qquad\qquad$ —— **1**

$\qquad\qquad = \quad$ Sterling pounds $\dfrac{340 \times 145}{170} \quad$ —— **1**

$\qquad\qquad = \quad$ Sterling pounds 290 $\qquad$ —— **1** $\qquad\qquad$ **3 marks**

Observations and conclusions

This third question which is based on ratios has been answered successfully by only 42% of the candidates. A greater propotion of the candidates have been unsuccessful in answering this question too.

Most students have found it difficult to separate out a given percentage from a given amount and then divide the remainder in a given ratio. In the conversion of foreign currency, a reason for the poor performance has been the fact that there were two conversion steps. Another reason for a greater percentage being unsuccessful is the lack of experience in manipulating percentages

4. (a) In a single player computer game, the player has to drive a motor car two rounds. In any round, either the player wins the round or loses it. The probability that a novice wins the first round is $\dfrac{1}{5}$.

(i) An **incomplete** tree diagram to represent this information is given below. Write down the corresponding probabilities on the branches.

—— **1** $\qquad$ **1 mark**

—— **1**

—— **1** $\qquad$ **2 marks**

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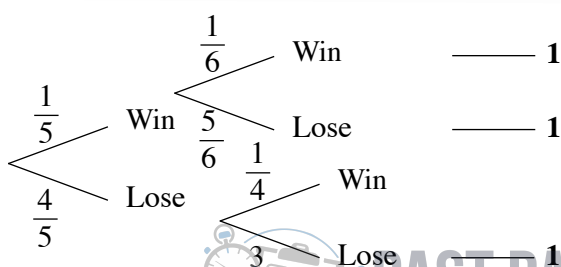
(ii) If the novice wins the first round, the probability that he will win the second round is $\frac{1}{6}$, and if he loses the first round, the probability that he will win the second round is $\frac{1}{4}$. Extend the above tree diagram to include the probabilities of win/lose of the second round and write down the corresponding probabilities on the branches.

Find the probability that a novice

(iii) loses **both** rounds.

$$\frac{4}{5} \times \frac{3}{4} \qquad \text{——— } \textbf{1}$$

$$\frac{12}{20} \quad \text{or} \quad \frac{3}{5} \quad \text{——— } \textbf{1} \qquad\qquad \textbf{2 marks}$$

(iv) wins exactly **one** round.

$$\left(\frac{1}{5} \times \frac{5}{6}\right) + \left(\frac{4}{5} \times \frac{1}{4}\right) \quad \text{——— } \textbf{1}$$

$$= \frac{11}{30} \qquad \text{——— } \textbf{1} \qquad\qquad \textbf{2 marks}$$

(b) If
$$\varepsilon = \{1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 7,\ 8,\ 9\}$$
$$A = \{\text{Multiples of two less than 10}\}$$
$$B = \{\text{Prime numbers less than 10}\},$$
write down the set $(A \cup B)'$ by listing its elements.

$$A = \{2,4,6,8\}$$
$$B = \{2,3,5,7\} \qquad \text{——— } \textbf{1}$$
$$A \cup B = \{2,3,4,5,6,7,8\} \quad \text{——— } \textbf{1}$$
$$(A \cup B)' = \{1,9\} \qquad \text{——— } \textbf{1} \qquad\qquad \textbf{3 marks}$$

Observations and conclusions

The fourth question which is based on sets and probability has been answered successfully by 35% of the candidates. More candidates have been unsuccessful in answering this question than in answering questions 2 or 3.

To answer a probability problem successfully, it is essential to not only know the concepts but also to have the ability to think about the phenomenon logically. By observation it is clear that there is a large group of students who do not have the ability to construct the tree diagram by reasoning out the phenomenon logically. Not having the ability to reason out is why students have found this problem harder than the other problems. Students need to be provided with the experience to successfully face such problems, by giving them the opportunity to construct tree diagrams for various phenomena

5. The rainfall values in millimetres at a certain location, collected during 30 days by the meteorological department are given below.

10	34	45	23	32	24
22	37	34	35	47	32
25	12	60	46	53	33
39	29	47	29	43	55
37	35	38	41	37	35

(i) What is the minimum and the maximum rainfall received during the 30 days?

Minimum $= 10\,\text{mm}$ ——— **1**

Maximum $= 60\,\text{mm}$ ——— **1** **2 marks**

(iii) Add a cumulative frequency column to the above frequency table and complete it.

Class Interval (Rainfall mm)	Tally mark	Frequency (Number of days)	Cumulative frequency		
10 - 20	//	2	2	Correct tally column	——— **1**
20 - 30	++++ /	6	8	Frequency column	——— **1**
30 - 40	++++ ++++ ///	13	21		
40 - 50	++++ /	6	27		
50 - 60	///	3	30		**2 marks**

(iii) Add a cumulative frequency column to the above frequency table and complete it.

Cumulative frequency column ——— **2**
(Neglect one error) **2 marks**

(iv) Using the information in the frequency table, draw the cumulative frequency curve on the following coordinate plane.
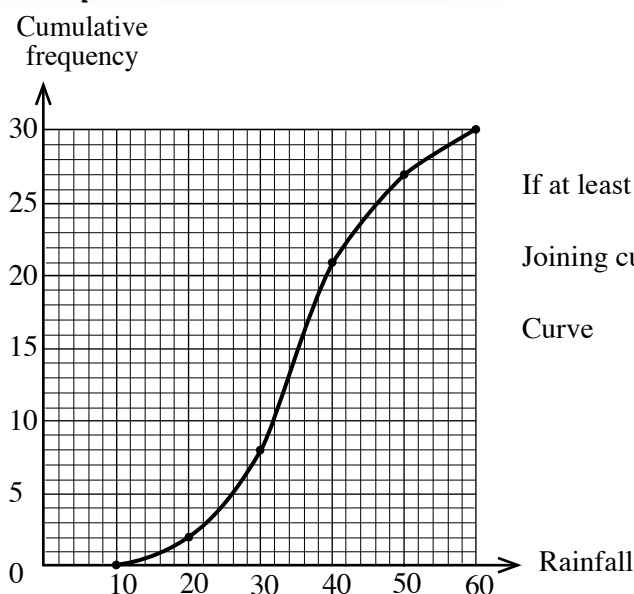
If at least three points are correct ——— **1**

Joining curve to (10,0) ——— **1**

Curve ——— **1**

3 marks

(v) Find the median rainfall during the period, according to the cumulative frequency curve.

Median $= 36 (\pm 1)$ ——— **1** **1 mark**

Observations and conclusions
Even though this is an easy problem on data representation, only 43% of the candidates have answered it successfully. Although this is the question from the five questions in Part B that has been answered successfully by the most number of students, this percentage too is less than 50%.

The following abilities are tested here; the ability to identify the least and greatest values of a given set of data, the ability to group a given set of data, the ability to represent the number of occurrences in an interval using tally marks and thereby to obtain the cumulative frequencies, and the ability to draw the cumulative frequency curve and through it to obtain the median. It is clear through observation that 57% of the candidates do not have sufficient experience regarding data representation and representative values. The knowledge that students have gained on various occasions from grade 6 to grade 11 is tested through this question. Those who depend only on the knowledge gained in the grades close to the examination grade will not be able to answer such a question successfully. Students' attention should be drawn to the fact that the experience gained from the whole syllabus is necessary to successfully answer the statistics problem.

2.2   Paper II

2.2.1 Structure of the Paper

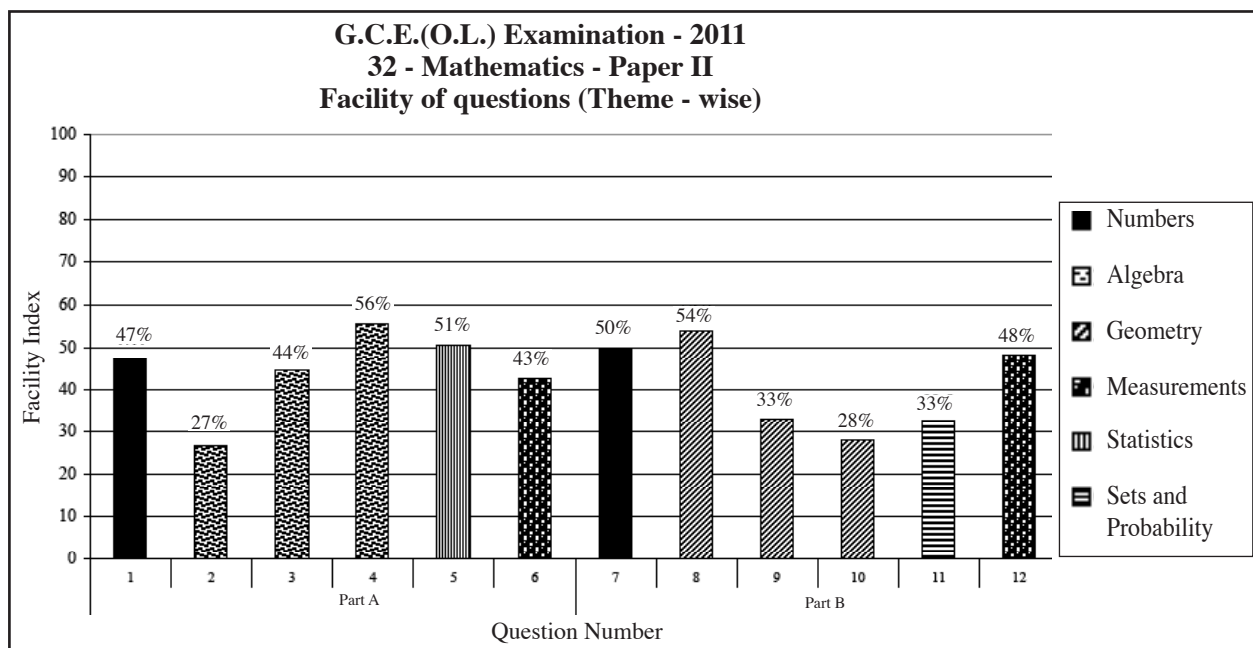Time allocated is $2\frac{1}{2}$ hours. A total of 50 marks.

This question paper consists of 12 structured essay type questions based on the themes Numbers, Measurements, Algebra, Geometry, Statistics, Sets and Probability. This question paper consists of two parts, Part A and Part B. It is expected that answers will be provided for 5 of the 6 questions in Part A and 5 of the 6 questions in Part B, totaling 10 questions.

10 marks are allocated for each question totaling 100 marks.

$$\text{Final mark for Part II} \quad = \quad \frac{100}{2}$$

$$= \quad 50$$

2.2.2. Observations and conclusions (theme - wise) on the answers to Paper II

G.C.E.(O.L.) Examination - 2011
32 - Mathematics - Paper II
Facility of questions (Theme - wise)

Graph 6.I

Paper II

This paper contains two questions from the theme Numbers, three questions from Algebra, three questions from Geometry, three questions from Measurements and one question each from the themes Statistics and Sets and Probability.

When the questions are classified according to the theme, question 4 which is based on the theme Algebra is the easiest with a facility of 56%. The hardest is question 2 which is also from the theme Algebra. It has a facility of 27%.

G.C.E.(O.L.) Examination - 2011
32 - Mathematics - Paper II
Facility of Themes
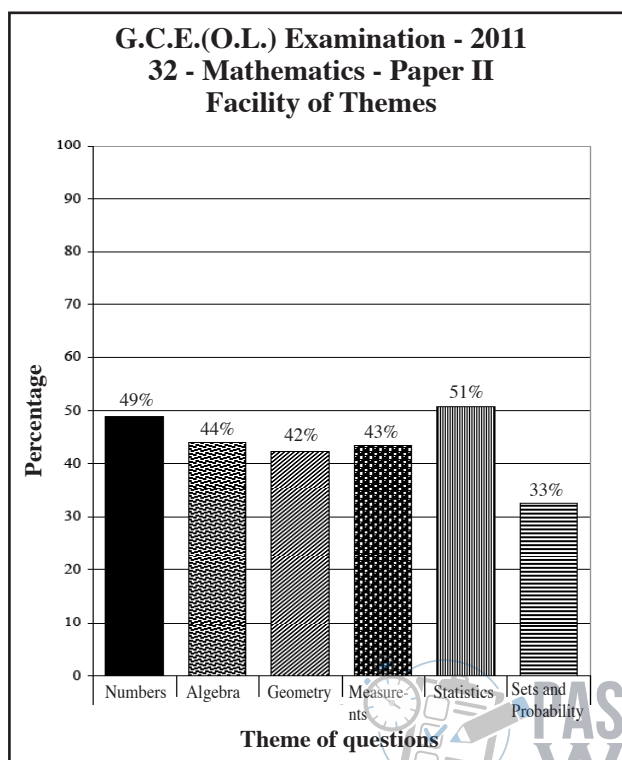
Graph 6.II

When all the questions in the question paper are considered theme-wise, the easiest theme has been Statistics, with a facility of 51%. The most difficult theme has been Sets and Probability with a facility of 33%.

2.2.3 Expected answers for Paper II, marking scheme, observations and conclusions

> Observations on the answers to Paper II are based on Graphs 2, 3, 4.I and 4.II. The part of the graph relevant to the question is provided with the observations and conclusions of each question.

Part A

> **Objectives of Question 1**
>
> Carries out transactions successfully in the modern world using percentages.
> (a) When the nominal value and the market value of a share of a company, the amount invested to buy shares, the annual interest rate, the annual interest rate paid by a bank for a fixed deposit and the amount deposited are given,
>   (i) calculates the number of shares that are bought.
>   (ii) calculates the income received thereby for a year.
>   (iii) calculates the total amount in the fixed deposit at the end of the first year.
>   (iv) determines from which investment a greater gain is made at the end of the year, and calculates the extra amount gained.
>
> (b) Calculates the annual assessed value of a property when the rates paid for a quarter and the annual rates percentage charged by a certain urban council are given.

Question 1

1. (*a*)

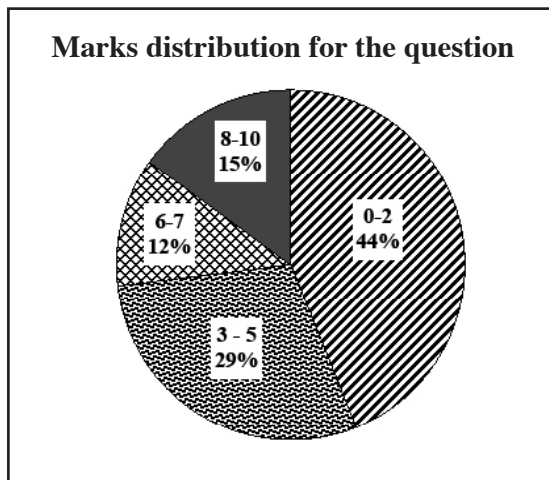| The annual interest rate paid by a company in which Rs 10 shares can be bought for Rs 12 is 11%.	The annual interest rate for fixed deposits in a bank is 9%.

Anula invested Rs 60 000 to buy shares in the above company while **Nimala** opened a fixed deposit for the same amount in the above bank.
  (i) How many shares did Anula buy?
  (ii) What is Anula's annual income from this?
 (iii) What is the total amount in Nimala's account at the end of the first year?
 (iv) Who had gained more by the end of the first year? How much was the gain?

(*b*) The annual rates percentage charged by a certain urban council is 12%. If 1 500 rupees is paid as rates for a quarter for a certain house, find the assessed annual value of the house.

Question Number			Answer	Marks				Other
1	(a)	(i)	Number of Shares $= 5000$	1	①			Multiplying by 10 or $\frac{11}{100}$
		(ii)	Income $= 5000 \times 10 \times \frac{11}{100}$	1				
			$= $ Rs. 5500	1	②			
		(iii)	Interest Receives Nimala					
			$= $ Rs. $60000 \times \frac{9}{100}$	1				or Rs. $60000 \times \frac{109}{100}$
			$= $ Rs. 5400					
			Amount in the deposit					
			$= $ Rs. 65400	1	②			
		(iv)	Amount gain for	1				
			Anula Gain $= $ Rs. 100	1	②	⑦		

Question Number			Answer		Marks		Other
1	(b)		Rates for a year $=$ Rs. 1500×4		1		
			Assessed value $=$ Rs. $1500 \times 4 \times \frac{100}{12}$		1	③ △3	
			$=$ Rs. 50000		1	**10**	

Overall observations and conclusions regarding the answers

Marks distribution for the question

8-10 15%
6-7 12%
0-2 44%
3 - 5 29%

98% of the candidates have selected this first question from Part A of Mathematics II.
Of these candidates,
about 44% have obtained marks in the range 0 - 2,
about 29% have obtained marks in the range 3 - 5,
about 12% have obtained marks in the range 6 -7,
and about 15% have obtained marks in the range 8 -10.

The percentage of candidates that obtained marks in the range 0 - 2 is 44%. The percentage of candidates that obtained marks in the range 8 - 10 is 15%.

Facility of the parts and sub-parts of the question

Percentage

70%
52%
63%
34%
36%

(i) (ii) (iii) (iv) b
a
Parts and sub parts of Question 1
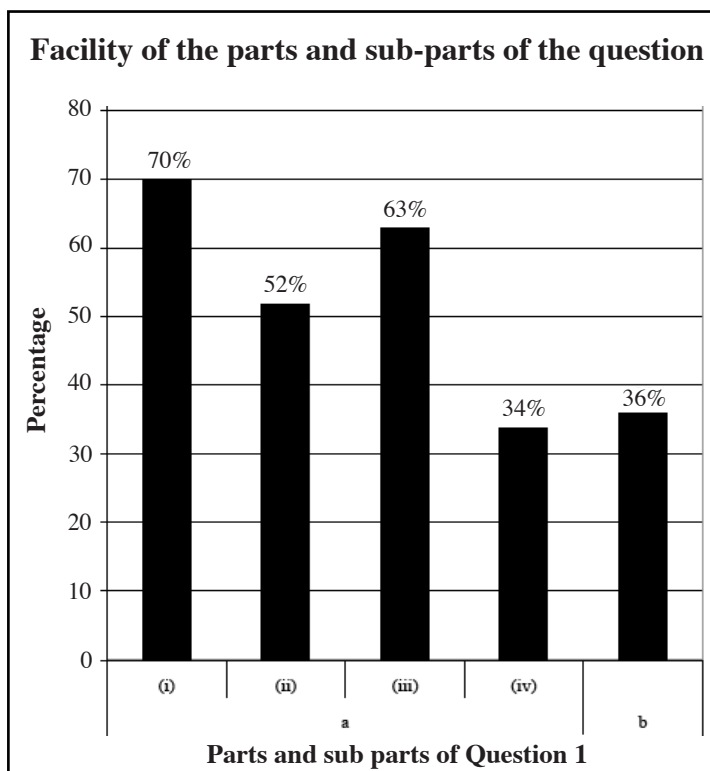
* This question contains 5 sub-parts. The facility of each of the parts (a)(i), (a)(ii) and (a)(iii) is greater than 50%, while the facility of each part (a)(iv) and (b) is less than 40%.

* (a)(i) is the easiest part, with a facility of 70%, while (a)(iv) is the hardest part with a facility of 34%.

What is mainly expected from part (a) of this question is the knowledge on percentages. Although the same ability is tested in parts (ii) and (iii), fewer correct answers had been provided for part (ii) than for part (iii). The reason for this is that, for part (iii), the percentage had to be directly calculated for a given amount while for part (ii), the nominal value had to be first calculated and then a percentage of this amount found. It is necessary to explain the difference between the market value and the nominal value of a share to students and also that the interest needs to be calculated for the nominal value. Although 52% of the candidates have provided the correct answer for part (ii), a lesser percentage had got part (iv), in which the two incomes had to be compared and the difference found, correct. The reason for this may be a lack of understanding of how amounts are compared as well as not understanding the meaning of the word 'gain'. It is necessary to train students to compare incomes and find the greater gain. Since such comparisons have to be made and decisions taken on them in day to day life, it is important to direct students to make such comparisons.

Although part (b) is a familiar question, students have not had an understanding of what a quarter is, and they have also found it difficult to apply the inverse process of finding a percentage of an amount. It may be easier for students to solve such problems using basic concepts. To find the amount when 12% of the amount is given, it is easier to base this on the fact that 12 rupees is for 100 rupees and then to solve the problem. The problem can also be solved by taking the amount as x and constructing a simple equation.

Objectives of Question 2

Easily communicates the mutual relationship between two variables by exploring various methods.

(a) When the graph of a quadratic function drawn on a specific interval of values is given, using the graph
   (i) writes down the value of the function for a given value of x.
   (ii) writes down the coordinates of the minimum point of the graph.
   (iii) writes the interval of values of x for which the function is decreasing negatively.
   (iv) writes down the values of a and b when the quadratic function of the graph is given as $y = (x - a)(x - b)$.

(b) (i) Writes down the quadratic function when the roots of the quadratic equation and the coefficient of x^2 are given.
   (ii) Re-organizes a quadratic function to take the form $y = (x - k)^2 + h$ and writes down the minimum value of the function.

Question 2

2. (a) The graph of a quadratic function drawn on the interval $-2 \le x \le 4$ is given in the figure.

   Using the graph, write down

   (i) the value of the function when $x = 2$.

   (ii) the coordinates of the minimum point of the graph.

   (iii) the interval of values of x on which the function is negative and decreasing.

   (iv) the values of a and b, if this quadratic function is $y = (x - a) (x - b)$.

   (b) (i) Write down the quadratic function y, of which the coefficient of x^2 is equal to 1, and the roots of $y = 0$ are 0 and 4.

   (ii) Write down the minimum value of the function after re-organizing the equation in (b) (i) above in the form $y = (x-k)^2 + h$.
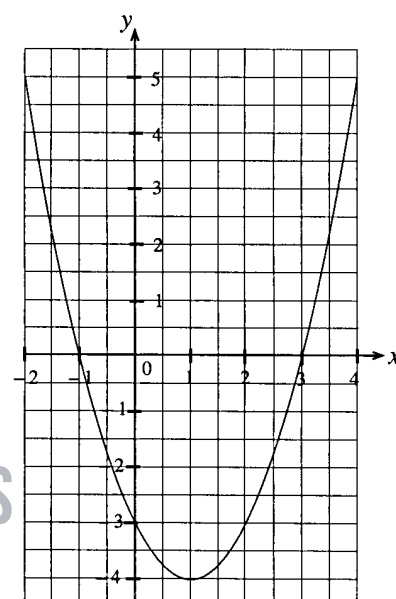
Question Number			Answer	Marks			Other
2	(a)	(i)	-3	1	①		
		(ii)	$(1, -4)$	2	②		
		(iii)	$-1 < x < 1$	2	②	or	between -1 or $+3$
		(iv)	-1 and $+3$	$1+1$	②	△7	
	(b)	(i)	$(x-0)(x-4) = 0$ or $y = x(x-4)$	1	①		
		(ii)	$y = (x-2)^2 - 4$ minimum value $= -4$	1 1	②	△3	
						10	

Overall observations and conclusions regarding the answers

Marks distribution for the question

- 8-10: 2%
- 6-7: 4%
- 3-5: 29%
- 0-2: 65%
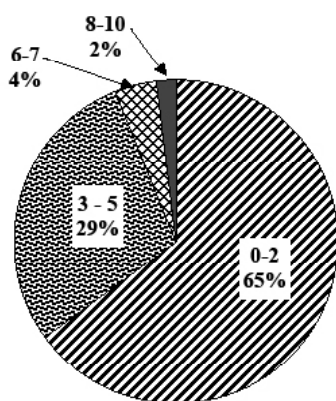
72% of the candidates have selected this question. Of these candidates
about 65% have obtained marks in the range 0 - 2,
about 29% have obtained marks in the range 3 - 5,
about 4% have obtained marks in the range 6 -7
and about 2% have obtained marks in the range 8 -10.

The percentage of candidates that obtained 2 marks or less is 65%. The percentage of candidates that obtained 8 marks or more is 2%. This is the instance where the percentage of candidates that obtained 8 or more marks is the least for **this paper**.

Facility of the parts and sub-parts of the question

- (i) a: 50%
- (ii) a: 46%
- (iii) a: 22%
- (iv) a: 17%
- (i) b: 6%
- (ii) b: 10%

Parts and sub parts of Question 2
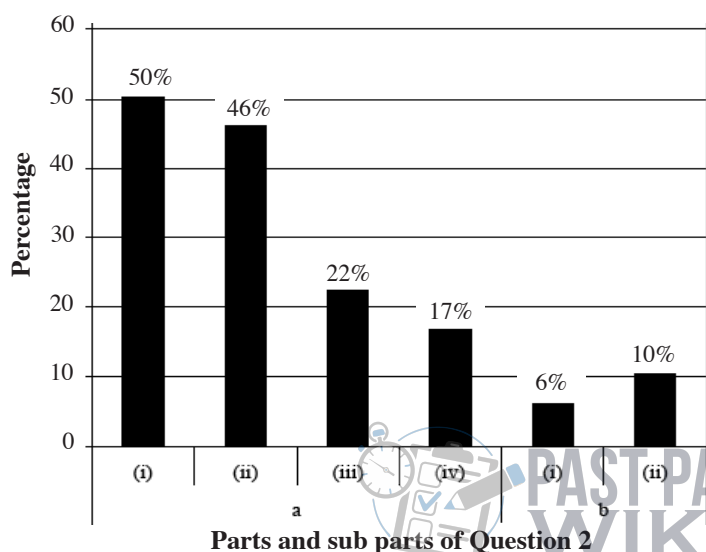
* This question contains 6 sub-parts. The facility of part (a)(i) is 50% while the facility of each of the other sub-parts is less than 50%.

* (b)(i) is the hardest part with a facility as low as 6%. The facility of (b)(ii) is also as low as 10%.

In part (i), where the student needs to find the value of the function when $x = 2$, the ability to directly find the coordinates of a point on a coordinate plane is tested. This is a very simple skill. Not only the ability of marking a point on a coordinate plane but the ability to locate a given point on a coordinate plane should also be developed in students. Parts (ii) and (iii) both expect an analysis of the graph. The difference between the coordinates of the minimum point and the minimum value of the function should be explained to students. **The minimum value** is a single value whereas when writing the **minimum point**, it is necessary to give its coordinates. Writing the relevant interval of values of x corresponding to a part of the function is expected from part (iii). It should be explained to students that, when considering that the function is less or greater than a certain value, the function doesn't take that particular value. It is important to explain separately to students 'greater than', 'less than' and 'equal to' in inequalities. It is necessary to explain the different methods of writing the relevant interval as $-1 < x < +1$ with inequality signs, or as 'greater than -1 and less than $+1$' or as 'between -1 and $+1$'. The main expectation of part (iv) is the ability to write the equation when the roots are given.

In part (b), the ability to predict the equation of a function, the graph of which satisfies certain requirements is expected by observing the given graph. This will be easier for students if they are taught to understand the properties of a given graph. The ability to organize a given quadratic function in different ways, based on certain requirements is tested in part (b)(ii). The ability to express the properties of a graph without drawing it can be developed in students by training them to examine the equation of the function and compare it with the behavior of the relevant graph. Students need to be made to understand that it is more important for them to understand the properties of the graph and to describe them than to draw the graph.

Objectives of Question 3

Manipulates the methods of solving equations to fulfill the needs of day to day life.
(a) Solves an equation involving algebraic fractions.
(b) When the breadth of a rectangular metal sheet is given in terms of x and a relationship between its length and breadth is also given.
  (i) expresses the length of the sheet in terms of x.
  (ii) and when a numerical value is given for the area, shows that x satisfies a quadratic equation of the form $ax^2 + bx + c = 0$.
  (iii) solves a quadratic equation of the form $ax^2 + bx + c = 0$ by completing the square or by some other method.

Question 3

3. (a) Solve: $\dfrac{2x+3}{2(2x+1)} - \dfrac{x+1}{2x+1} = \dfrac{1}{6}$

  (b) The breadth of a thin rectangular metal sheet is $(x + 2)$ units. Its length is twice its breadth.
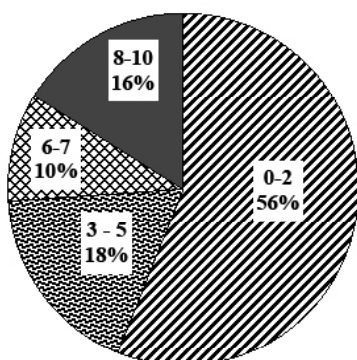
    (i) Express the length of the sheet in terms of x.

    (ii) If the area of the sheet is 12 square units, show that x satisfies the quadratic equation $x^2 + 4x - 2 = 0$.

    (iii) Solve the above equation by completing the square or by any other method.
      (Take $\sqrt{6} = 2.45$.)

Question Number			Answer	Marks			Other
3	(a)		$\dfrac{2x+3-2(x+1)}{2(2x+1)} = \dfrac{1}{6}$	1			or $3(2x+3)-6(x+1)$ $= 2x+1$
			$4x+2 = 6$ $x = 1$	1 1	③	or $\triangle 3$	$-2x = -1$ $x = 1$
							$2x+4$
	(b)	(i)	$2(x+2)$	1	①		
		(ii)	$2(x+2)(x+2) = 12$ $2(x^2+4x+4) = 12$ $x^2+4x-2 = 0$	1 1	②		$2x^2+8x+8 = 12$
		(iii)	$x^2+4x+4) = 2+4$ $(x-2)^2 = 6$ $x = 0.45$ or $x = -4.45$	1 1 1+1	④	$\triangle 7$ **10**	

Overall observations and conclusions regarding the answers

Marks distribution for the question

8–10 16%
6–7 10%
3 - 5 18%
0–2 56%

71% of the candidates have selected this question. Of these candidates
about 56% have obtained marks in the range 0 - 2,
about 18% have obtained marks in the range 3 - 5,
about 10% have obtained marks in the range 6 -7
and about 16% have obtained marks in the range 8 -10.

The percentage of candidates that obtained marks in the range 0- 2 for this question is 56%. The percentage of candidates that obtained marks in the range 8 - 10 is 16%.

Facility of the parts and sub-parts of the question

Parts and sub parts of Question 3
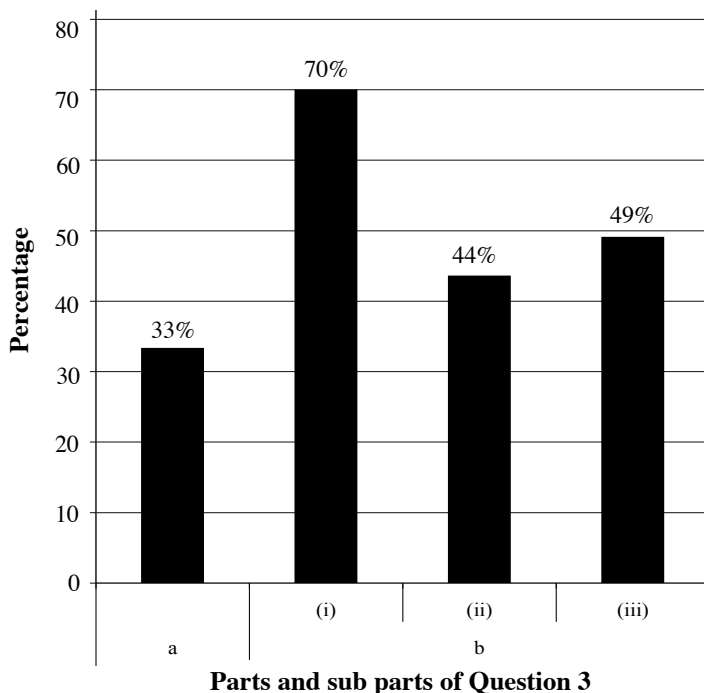
* Part (b)(i) is the easiest part of this question. Its facility is 70%. However the facility of each of the other parts is less than 50%.

* (a) is the hardest part with a facility of 33%.

(a) The aim of this question is to test the ability of students to solve an equation with algebraic fractions in the easiest possible way. It should be explained to students that when finding the common denominator, the most appropriate method is not just multiplying the given denominators. Because students have not seen the relationship between the denominators in this problem, they have missed out on getting a simple equation. A weakness in finding the least common multiple of two algebraic expressions was observed. Students need to be made to practice this. Also, by giving students a proper understanding of equivalent fractions they can easily find the numerator corresponding to the denominator they obtain. A weakness in solving equations was observed to due to the above reasons.

(b) Writing an algebraic expression based on information that is given and solving a quadratic equation by completing the square or by some other method is expected here. Although many were able to express the length of the metal sheet in terms of x, the ability to derive the quadratic equation was poor. The ability to multiply algebraic expressions has to be improved in students. Students were unable to derive the quadratic equation due to their inability to multiply the two algebraic expressions and to equate it to the given area. The number who solved the equation was greater than the number who derived the equation. Students need to be taught to complete the square. Also, students need to be made to understand the importance of using the information that is provided. In this problem, a value for $\sqrt{6}$ has been given to be used. A weakness in transforming $\sqrt{24}$ which is obtained when solving the equation using the formula, to $2\sqrt{6}$ was observed. Therefore, an unnecessary amount of time has been spent on finding the value of $\sqrt{24}$ using logarithms. It is important to make students realize that a hint like this is given in a problem to make it easier for them to solve it by using the hint. The fact that more students had answered part (iv) than part (iii) indicates that a group who were unable to derive the equation were however able to solve it. This is a satisfactory trend. Students should be encouraged to try the latter parts if they are independent of the initial parts, when the initial parts are difficult.

Objectives of Question 4

Easily communicates the mutual relationships that exist between two variables by exploring various methods.

(a)   When a relationship between the prices of two types of fruits is given,
   (i)   constructs a pair of simultaneous equations using this information.
   (ii)   solves the pair of simultaneous equations and finds the price of each type of fruit.
   (iii) finds the number of fruits of each type that can be bought for a certain amount of money without a balance.

(b)   When a matrix A of order 2×3 and a matrix B of order 2×3 having two unknown elements and the matrix $2A - B$ are given, finds the two elements represented by the unknowns by considering the relationship between the matrices.

Question 4

4. (a) It costs 65 rupees to buy one mandarin and 3 guavas. 4 guavas can be bought for the price of 3 mandarins.

   (i)   Construct a pair of simultaneous equations to represent the above information by taking the price of a mandarin as Rs x and the price of a guava as Rs y.

   (ii) By solving the above simultaneous equations, find the price of a mandarin and the price of a guava.

   (iii) Find the number of mandarins and gauvas that can be bought for Rs 50 without a balance.

   (b) If $\mathbf{A} = \begin{pmatrix} 3 & 2 & 4 \\ 0 & 1 & 5 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} x & 4 & 8 \\ 0 & 3 & y \end{pmatrix}$ and $2\mathbf{A} - \mathbf{B} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \end{pmatrix}$, find x and y.

Question Number			Answer	Marks			Other
4	(a)	(i)	$x + 3y = 65$ $3x = 4y$	1 1	②		
		(ii)	$13y = 195$ $y = 15$ $x = 20$	1 1 1	③	or	$13x = 260$ $x = 20$ $y = 15$
		(iii)	1 mandarin, 2 guavas	1	①	△6	
	(b)		$2A = \begin{pmatrix} 6 & 4 & 8 \\ 0 & 2 & 10 \end{pmatrix}$	1			
			$2A - B = \begin{pmatrix} 6-x & 0 & 0 \\ 0 & -1 & 10-y \end{pmatrix}$	1		or	$(2 \times 3) - x = 1 - 1$ $(2 \times 5) - y = 0 - 1$
			$x = 5, \ y = 10$	1+1	④	△4 **10**	

Overall observations and conclusions regarding the answers

**Marks distribution for the question**
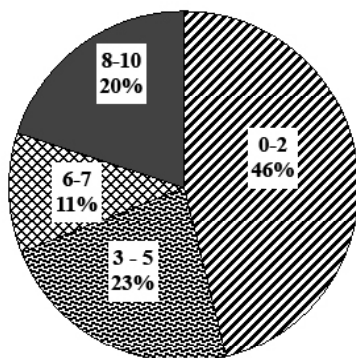
87% of the candidates have selected this question which has an allocation of 10 marks.
Of these candidates
about 46% have obtained marks in the range 0 - 2,
about 23% have obtained marks in the range 3 - 5,
about 11% have obtained marks in the range 6 -7
and about 20% have obtained marks in the range 8 -10.
46% of the candidates obtained marks in the range 0 - 2 for this question and 20% of the candidates obtained marks in the range 8 - 10.

Facility of the parts and sub-parts of the question

Parts and sub parts of Question 4
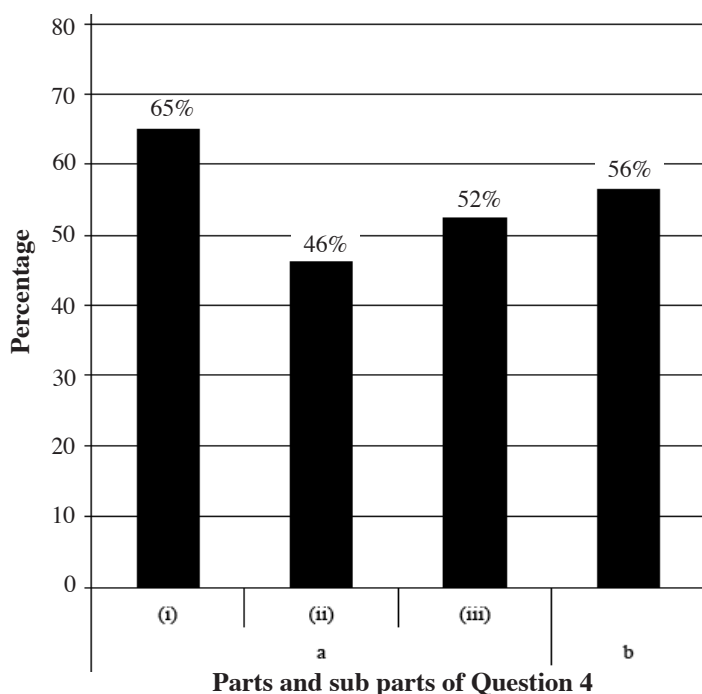
*   This question has four sub-parts. The facility of three of them is more than 50% while the facility of one part is less than 50% at 46%.

*   The easiest part is part (a)(i). Its facility is 65%.

(a)   The aims of parts (i) and (ii) of this question are for students to construct a pair of simulteneous equations based on the given information and to solve it. The ability to construct the equations is seen in 65% of the candidates. Students should be taught to read a sentence and to construct an expression based on it. Starting from simple situations, the ability to construct equations for more complex situations too should be gradually developed in students. When solving simultaneous equations, equating the coefficients of the unknown term as well as the method of substitution can be used. Here, the equation $3x = 4y$ can be reorganized as $3x - 4y = 0$ and then the equations can be solved by equating the coefficients or they can be solved by substituting $x = \frac{4}{3}y$. In part (iii), the question of how money can be spent such that a certain condition is satisfied is asked. The reason why more have been able to answer this question than to solve the equations may be because this can be solved using the method of trial and error too. Since this is also a method that can be used to solve problems, students should be familiarized with it too.

(b)   The ability to multiply a matrix by a constant as well as subtract one matrix from another is expected here. Although the ability to multiply a matrix by a constant is there to a certain extent, students have found subtracting one matrix from another difficult. A comparison of the two matrices is also expected. It should be explained here that it is easier to compare the corresponding elements separately. The values of x and y can be found by doing this. Since only a very little content on matrices is taught at this level, by getting the students to do many exercises they will be able to practice this section easily. The teacher should prepare different types of problems on matrices and guide the students to solve them.

Objectives of Question 5

Analyses data by various methods and makes predictions to facilitate daily work.

When information on the telecasting times of a certain number of advertisements shown during a television programme are given in a table with class intervals of size 4,

(i)   writes down the modal class.

(ii)   finds the mean telecasting time of an advertisement using a suitable method.

(iii)   and when the number of advertisements shown during a programme is given, calculates the expected telecasting time of the advertisements to the nearest minute using the mean telecasting time.

(iv)   calculates the expected profit when the cost to produce the programme and the charge per minute for an advertisement are given.

Question 5

5.   Information on the telecasting times of 40 advertisements shown during a certain television programme is given in the following table.
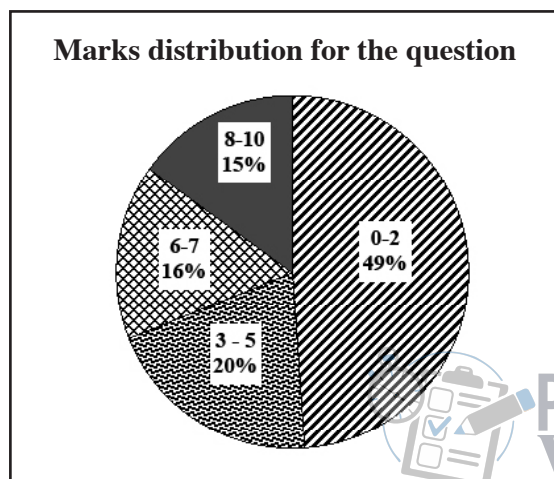
Telecasting time (seconds)	10 - 14	14 - 18	18 - 22	22 - 26	26 - 30	30 - 34	34 - 38
Number of advertisements	04	06	08	10	05	04	03

(i)   Which telecasting time interval does the most number of advertisements fall into?

(ii)   Find the mean telecasting time in seconds of an advertisement.

(iii)   Accordingly, if 100 advertisements are to be telecast during such a television programme, calculate the expected telecasting time of the advertisements to the nearest minute.

(iv)   Rs 600 000 is spent for the production of the television programme in (iii) above and Rs 20 000 is charged per minute to telecast an advertisement. How much profit can the television station be expected to make from the above programme?

Question Number			Answer				Marks			Other
5				Telecasting Time (sec.)	Number of advertisments f	Mid value x	fx			
				10 - 14	4	12	48			
				14 - 18	6	16	96			
				18 - 22	8	20	160			
				22 - 26	10	24	240			
				26 - 30	5	28	140			
				30 - 34	4	32	128			
				34 - 38	3	36	108			
							920			
	(i)		22 – 26					1	①	
	(ii)		Mid value column					1		ignore one mistake.
			Column fx					1		
			$\sum fx \quad = \quad 920$					1		
			mean $\quad = \quad \dfrac{920}{40}$					1	⑤	dividing by 40
			$\quad = \quad 23$ seconds					1		
	(iii)		Telecasting time $\quad = \quad \dfrac{23 \times 100}{60}$					1		multiplying by 100 and dividing by 60
			$\quad = \quad 38$ minutes					1	②	
	(iv)		Cost for advertisements							
			$\quad = \quad$ Rs. $20\,000 \times 38$					1		
			$\quad = \quad$ Rs. $760\,000$							
			Profit $\quad = \quad$ Rs. $160\,000$					1	② △10	
									10	

Overall observations and conclusions regarding the answers

Marks distribution for the question

94% of the candidates have selected this question. Of these candidates
about 49% have obtained marks in the range 0 - 2,
about 20% have obtained marks in the range 3 - 5,
about 16% have obtained marks in the range 6 -7
and about 15% have obtained marks in the range 8 -10.

The percentage of candidates that obtained marks in the range 0 - 2 is 49% while the percentage that obtained marks in the range 8 - 10 is 15%.
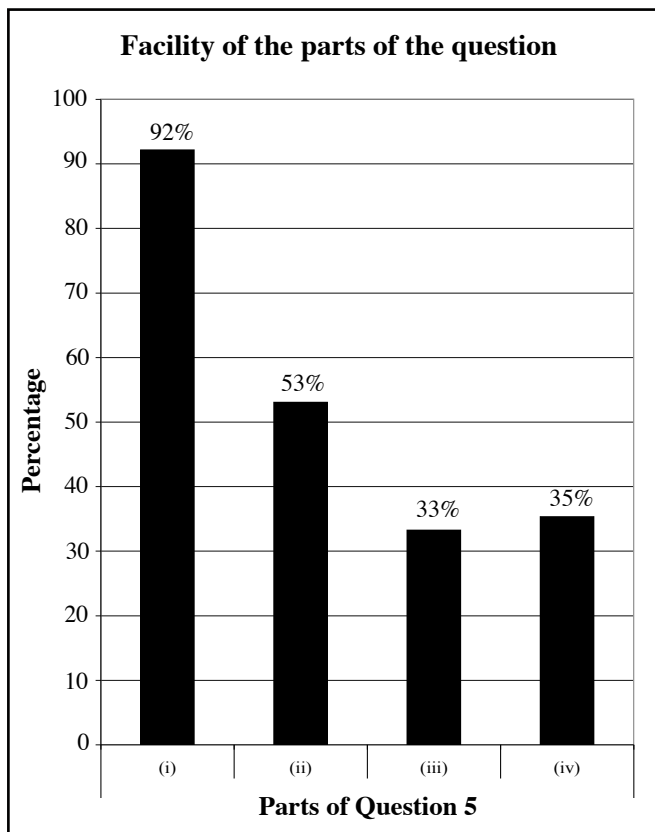
Facility of the parts of the question

* This question has four parts. The facility of two of them is more than 50% while the facility of the other two is less than 40%.

* The easiest part is (i) with a facility as high as 92%. The most difficult part is (iii) with a facility of 33%.

Determining the mode and mean of a frequency distribution with class intervals and making certain predictions based on the mean is expected from this question. It hasn't been difficult for the students to observe the mode by investigating the data. However only 53% have correctly found the mean. For this distribution, it is not necessary to use an assumed mean and find the deviations to calculate the mean. This is a fact that should be made very clear to students. If it is easy to multiply the mid-values of the class intervals by the relevant frequencies, then it is not necessary to find the deviations from the assumed mean. It is necessary to establish among students the idea that an assumed mean and deviations are used only to facilitate simplification and to avoid the difficulty of multiplying large numbers together. In solving this problem many students have made the problem harder by using deviations. Parts (iii) and (iv) may have been difficult because of students' inability to use the mean and make predications. The aim of learning statistics is to develop the ability to analyze the present situation and use the information obtained from it in future activities, as well as to be make predictions. Therefore it is necessary to organize the learning teaching process to develop these abilities. It is not sufficient to only teach students to mechanically fill in the table and find the mean.

Uses scale drawings in practical situations by exploring various methods.

(a) When it is given that one end of a wire is fixed to the top of a vertical tower located on the flat ground, while the other end is stretched and fixed to the ground, and when the length of the wire and the angle of elevation of the top of the tower from a certain location away from the tower are given,
   (i) marks the given information on a sketch.
   (ii) finds the height of the tower using trigonometric ratios.
   (iii) calculates the angle of elevation of the top of the tower from the point on the ground at which the wire is fixed.

(b) Represents the information on the location of three cities A, B and C on a horizontal plane by a sketch, when the distance between A and B and the bearing of B from A and the distance between B and C and the bearing of C from B is given. Calculates the distance AC using Pythagoras' relationship and writes it in surd form.
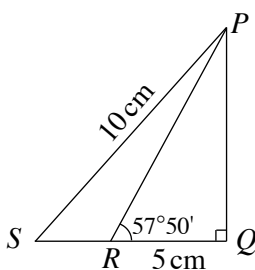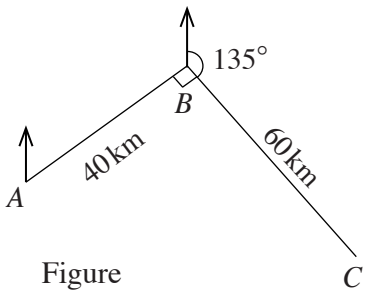
Question 6

6. (*a*) One end of a wire of length 10 m is tied to the top P of the tower PQ shown in the figure, and the other end is tied to a point S on the ground. The point R lies on the straight line QS, 5 m from Q. The angle of elevation of P from R is $57°\ 50'$.
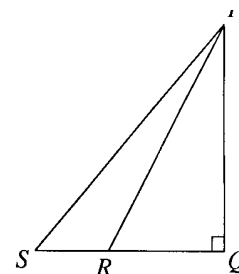
   (i) Copy the figure and include the given information in it.
   (ii) Find the height of the tower.
   (iii) Find the angle of elevation of P from S.

(*b*) Three cities A, B and C are situated such that B lies 40 km from A on a bearing of 045° from A and C lies 60 km from B on a bearing of 135° from B. Draw a sketch of the positions of the three cities and show that the distance between the cities A and C is $20\sqrt{13}$ km.

Question Number		Answer	Marks		Other
6	(a)				
	(i)	Figure	1	①	Marking one length and 57°50'
	(ii)	$\tan 57°50' = \dfrac{PQ}{5}$	1		
		$1.5900 = \dfrac{PQ}{5}$	1		
		$\therefore PQ = 7.95\,\text{cm}$	1	③	
	(iii)	$\sin P\hat{S}Q = \dfrac{7.95}{10}$	1		
		$\therefore P\hat{S}Q = 52°39'$	1	②	

6	(b)				

Figure

		1

$$\hat{ABC} = 90°$$
$$AC^2 = 40^2 + 60^2$$
$$\therefore \quad AC = \sqrt{5200} \text{ km}$$
$$= 20\sqrt{13} \text{ km}$$

1
1
1

(4)

10

an angle and a length is sufficient

Overall observations and conclusions regarding the answers

Marks distribution for the question
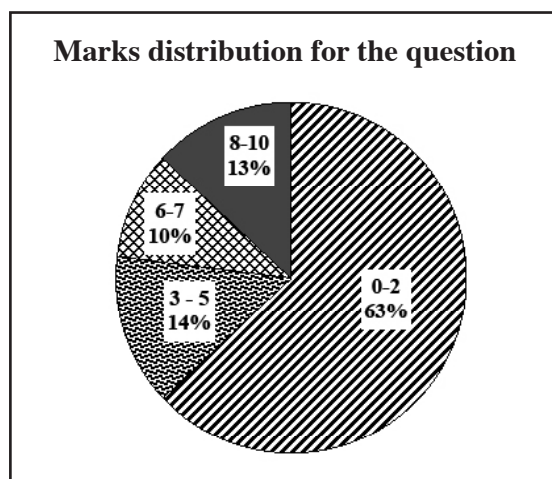
About 65% of the candidates have selected this question.
Of these candidates
about 63% have obtained marks in the range 0 - 2,
about 14% have obtained marks in the range 3 - 5,
about 10% have obtained marks in the range 6 -7
and about 13% have obtained marks in the range 8 -10.

The percentage of candidates that obtained marks in the range 0 - 2 is 63% while the percentage that obtained marks in the range 8 - 10 is about 13%.

Facility of the parts and sub-parts of the question

Parts and sub parts of Question 6
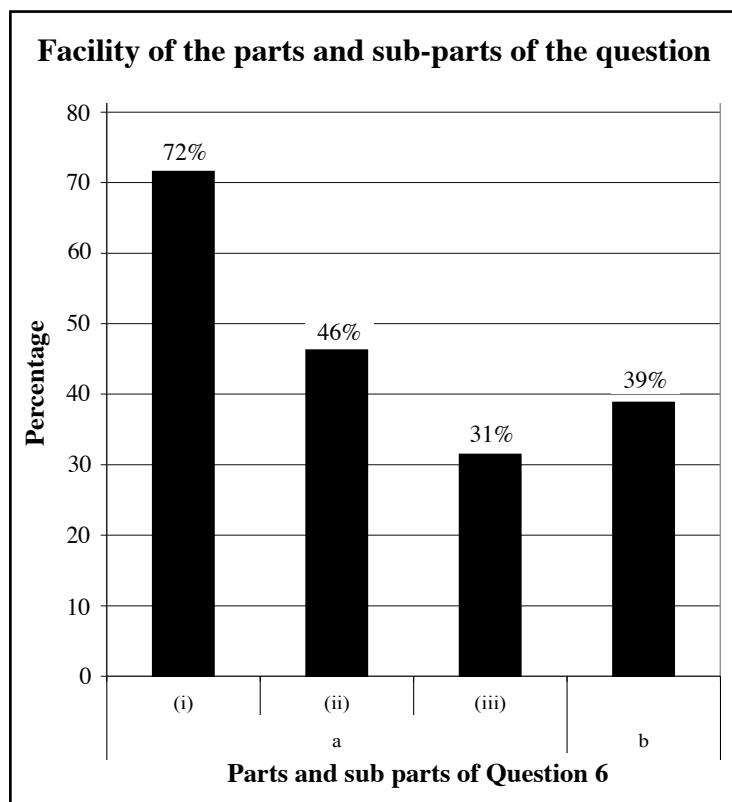
* This question has four sub-parts. Only the facility of part (a)(i) is more than 50% while the facility of each of the other three parts is less than 50%.

* The easiest part is (a)(i) with a facility of 72%. The most difficult part is (a)(iii) with a facility of 31%.

(a) It can be seen that most students have the ability to enter information in a figure. Accordingly, they also have the ability to recognize the angle of elevation. This is a satisfactory situation. However it is seen that the knowledge on trigonometric ratios is poor and that the ability to use the trigonometric tables is weak. Day to day simple situations should be used as examples to give students an understanding of trigonometric ratios. It is easy to give students an understanding of this section by engaging them in practical activities. Students can establish the accuracy of the solution to a practical problem obtained by using trigonometric ratios, by measuring the values. This will give them satisfaction.

(b) The aim of this problem is to test the students' ability to draw a rough sketch based on bearings and to calculate a length using Pythagoras' theorem. Only 39% of the students have an understanding of bearings and the ability to draw the relevant sketch. As mentioned in part (a), it is advisable to get students to draw sketches to represent locations related to practical problems. Students can use the protractor to measure angles and the measuring tape to measure lengths to draw these sketches. It is good to develop the ability to square numbers and find the square roots of numbers too.

Part B

Objectives of Question 7

Makes decisions for future requirements by investigating the various relationships in number patterns.

(a) When the seats in a theatre are arranged according to an arithmetic progression and when the number of seats in the first row and the difference between the number of seats in two consecutive rows are given, using the knowledge on progressions,

    (i) finds the number of seats in a given row.

    (ii) finds the total number of seats in a given number of rows.

    (iii) writes with reasons the truth or falsehood of a statement made regarding the number who could be seated in a certain number of rows.

(b) Calculates using the knowledge of progressions, the area to which a certain type of germ which doubles daily spreads by the end of a certain day, when the area to which it has spread by the end of the first day is given.
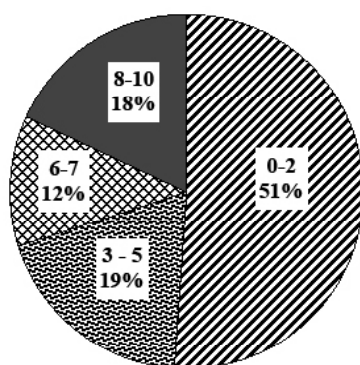
Question 7

7. (*a*) There are 12 seats in the first row of a certain theatre. The remaining rows are arranged so that each row contains 5 seats more than the preceeding row.

    (i) How many seats are there in the fifth row?

    (ii) How many seats are there in total in the first 20 rows?

    (iii) This theatre has exactly 21 rows arranged in the above manner. The manager claims that if an audience of 1300 take their seats, then all the seats will be occupied. Is this true/false? Give reasons for your answer.

(*b*) It is observed that a certain type of germ on a glass slide spreads and occupies at the end of each day, an area which is twice the area it occupied at the end of the previous day. If, at the end of the first day, the germ occupied an area of 3 mm^2 on the slide, find the area to which the germ had spread by the end of the sixth day.

Question Number			Answer	Marks			Other
7	(a)	(i)	$T_n = a + (n-1)d$	1			
			$T_5 = 32$	1	②		
		(ii)	$S_n = \dfrac{n}{2}\{2a + (n-1)d\}$	1			
			$S_{20} = \dfrac{20}{2}\{2\times 12 + (19\times 5)\}$	1			
			$= 1190$	1	③		
		(iii)	$S_{21} = 1302$	1			Getting T_{21} and adding
			Two seats left.	1			
			false claim	1	③	△8	
	(b)		$T_n = ar^{(n-1)}$	1			
			area $= 96\,\text{mm}^2$	1	②	△2	
						10	

- 45-

Overall observations and conclusions regarding the answers

Marks distribution for the question

8–10
18%

6–7
12%

3 - 5
19%

0–2
51%

92% of the candidates have selected this question. Of these candidates
about 51% have obtained marks in the range 0 - 2,
about 19% have obtained marks in the range 3 - 5,
about 12% have obtained marks in the range 6 -7
and about 18% have obtained marks in the range 8 -10.

The percentage of candidates that obtained marks in the range 0 - 2 is 51% while the percentage that obtained marks in the range 8 - 10 is 18%.

Facility of the parts and sub-parts of the question
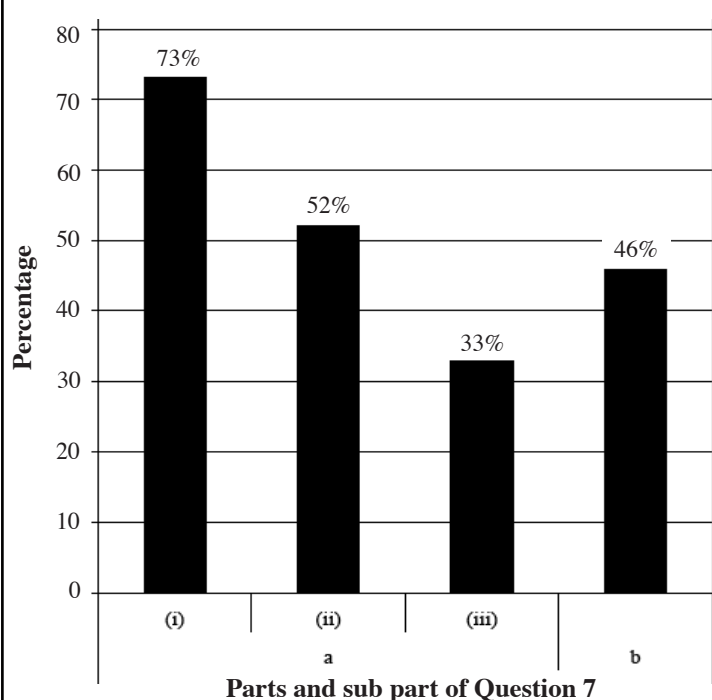
73%

52%

33%

46%

Percentage

(i)   (ii)   (iii)   b

a

Parts and sub part of Question 7

* This question has four sub-parts. The facility of two of them is more than 50% while the facility of each of the other two is less than 50%.

* The easiest part is part (a)(i). It has a facility of 73%. The most difficult part is (a)(iii). It has a facility of 33%.

(a) The aim of this problem is to test the ability of students to investigate the relationships in number patterns and make certain decisions. Most students like this problem. It is seen that many students had the ability to find a term of the progression. Here, not only was the formula used, but the relevant term was also found by writing out the terms. Knowledge of the common difference is necessary to write out a certain number of terms. It is seen in part (ii) that about 52% had the ability to find the sum of a certain number of terms. Some students have had difficulty writing the formula. It will be easy for students to remember the formulae used in progression problems if they are displayed in a prominent place. Apart from this, by getting students to practice several exercises too, they will become familiar with the use of formulae. In part (iii), many students didn't have the ability to present the correct reason for the truth or falsehood of the given statement. This question covers the four aims, knowledge, application, seeing connections and reasoning. The aim here is for students to obtain certain information by applying the formula, to relate this information to a practical life situation and provide reasons for making a decision based on it. These abilities need to be developed in students using simple examples, by getting them to provide reasons.

In part (b), the conversion of an event in day to day life into mathematical language and the performance of a calculation is expected. Here the importance of focusing on developing the students' ability to apply the formulae is seen.

Question 8

8. Using only a straight edge with a cm/mm scale and a pair of compasses and showing the construction lines clearly,

(i) construct a line segment AB such that $AB = 9.0$ cm, and the angle BAP such that $B\hat{A}P = 60°$ and $AP = 8$ cm.

(ii) bisect $B\hat{A}P$. Construct the circle that touches the lines AB and AP and has its centre at the point O lying 4.5 cm from A. Measure its radius and write it down.

(iii) construct another tangent to this circle from the point B, and produce it to meet AP at the point C.

(iv) What is the above circle with respect to the triangle ABC?

Question Number			Answer	Marks				Other
8	(i)		Drawing AB or AP	1				
			angle 60°	1	②			
	(ii)		angle bisector	2				
			Obtaining O	1				
			Drawing perp. to AB from O and constructing	2				
			radius 2.2 cm (±0.1)	1	⑥			Obtaining target point, copying the angle. Drawing the tangent from the external point.
	(iii)		Drawing tangents	1	①			
	(iv)		innercircle	1	①	**10**		
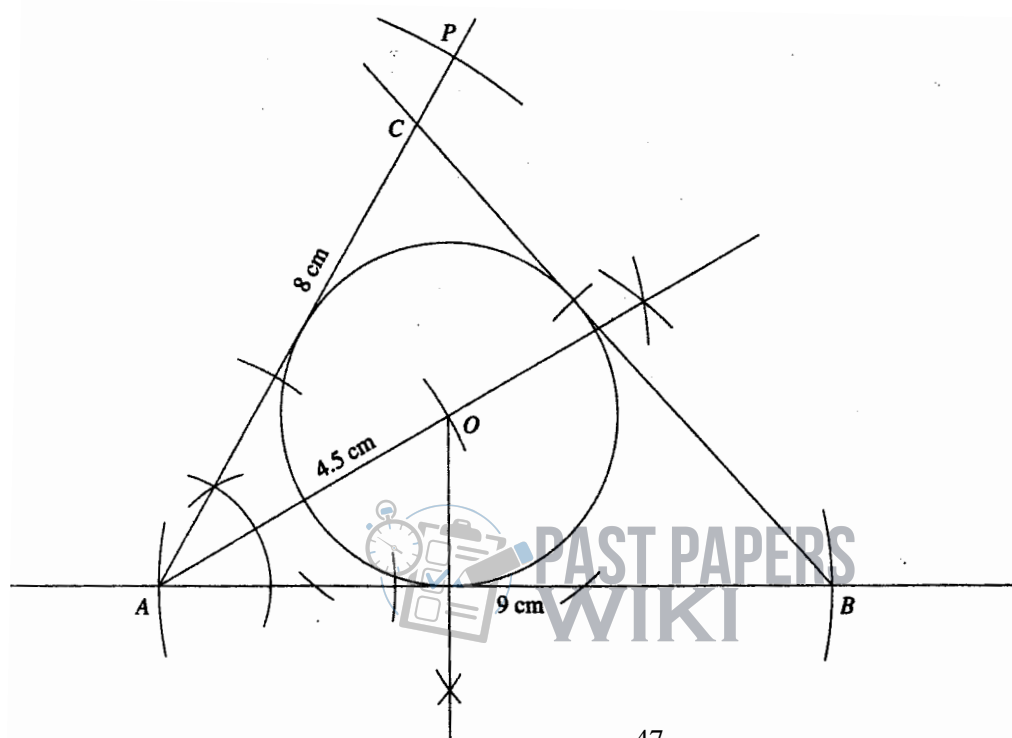
**Overall observations and conclusions regarding the answers**

Marks distribution for the question
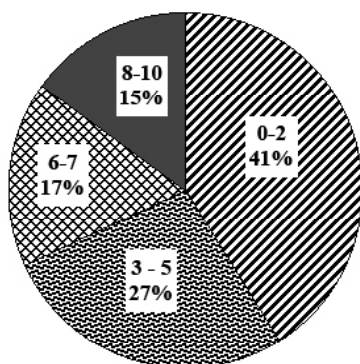
89% of the candidates have selected this question. Of these candidates
about 41% have obtained marks in the range 0 - 2,
about 27% have obtained marks in the range 3 - 5,
about 17% have obtained marks in the range 6 -7
and about 15% have obtained marks in the range 8 -10.

The percentage of candidates that have obtained marks in the range 0 - 2 is 41%. The percentage of candidates that have obtained marks in the range 8 - 10 is 15%.

Facility of the parts of the question
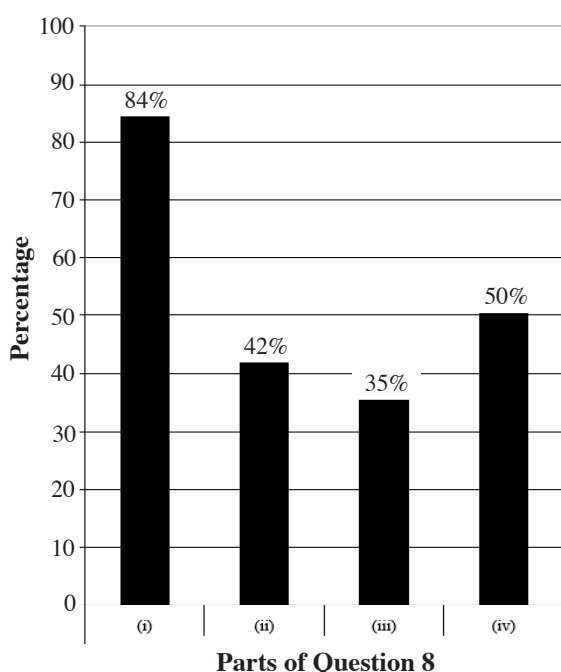
* This question has four parts. The facility of two of them is 50% or more while the facility of each of the other two is less than 50%.

* The easiest part is part (i) with a facility of 84%. The most difficult part is part (iii) with a facility of 35%.

This problem tests the ability of students to do the basic constructions in geometry as well as the understanding of students regarding the basic loci. Even the students who generally dislike geometry most often attempt this problem. About 84% of the students had accurately constructed the angle in part (i) according to the given data. However it can be seen that about half this number do not have knowledge on loci. The selection of a point which satisfies two conditions was expected. This ability should be developed in students by engaging them in various constructions. After finding the center, students need to be guided to find the radius by constructing a perpendicular from the centre to a side of the triangle, instead of trying to find it by trial and error. From part (iii) it is clear that students don't have knowledge of the methods of constructing a tangent from an external point. Students can be given this knowledge by showing them through various exercises that tangents can be constructed using various methods by applying their understanding of tangents. In part (iv), their knowledge of the relationship between the circle and the triangle is tested. Most students have found this part difficult. It can be seen that students need to be made aware of the in-circle, circum-circle and escribed-circle which are related to a given triangle.

Question 9

9. *E* is the mid-point of *AC* and *D* is the mid-point of *BC* of the traingle *ABC* in the figure. Further, *F* is the mid-point of *AD*.

(i)   Copy the figure and produce *BF* and *DE* to meet at the point *G*.

(ii) Write down the theorem that asserts that *BA//DE*.

(iii) Show that $\triangle ABF \equiv \triangle DGF$.

(iv) Show that *ABDG* is a parallelogram.

(v)   Prove that *DE = EG*.

(vi) Show that the areas of the triangles *AGB* and *ADC* are equal.

| Question Number			Answer	Marks		Other
9						
	(i)		Correct Figure	1	①	
	(ii)		The segment joining the midpoints of two sides of a trangle is paralled to the third side and half as long as the third side.	2	②	mid point theorem - 1
	(iii)		for ABF Δ and DFG Δ AF = FD (midpoint AD is F) A$\hat{B}$F = D$\hat{G}$F (alternating angles) B$\hat{A}$F = F$\hat{D}$G (alternating angles) } any 2 A$\hat{F}$B = D$\hat{F}$G (opposite angles) ∴ ABF Δ ≡ DGF Δ (AAS)	2	②	2 reasons - 1 3 reasons - 2

9	(iv)	AF = FD (given)
		BF = FG (Δ congruent traingles)
		∴ ABDG is a parallelogram
		(since diagnals bisect)
		
		or
		
		AB // DG (given)
		AB = DG (Δ trianvles are ungruent)
		∴ ABDG is a parallelogram
		(one pair of opposite sides are
		equal and parallel)
			2
			
			or
			
			2
				②	2 or 0
					
					2 or 0

	(v)	in ADC Δ, FE // DC (F, E midpoints) ∴ FE // BD in Δ BGD F is the midpoint of BG ∴ E is the midpoint of DG (converse of midpoint theorem) ∴ DE = EG	1	①	
	(vi)	AGB Δ = ABD Δ (Same base and between same parallled lines) AGB Δ = ADC Δ (BD = DC and common apex) ∴ area AGB Δ = area ADC Δ	1 1	② **10**	

Overall observations and conclusions regarding the answers

Marks distribution for the question

8–10
5%

6–7
6%

3 – 5
15%

0–2
74%
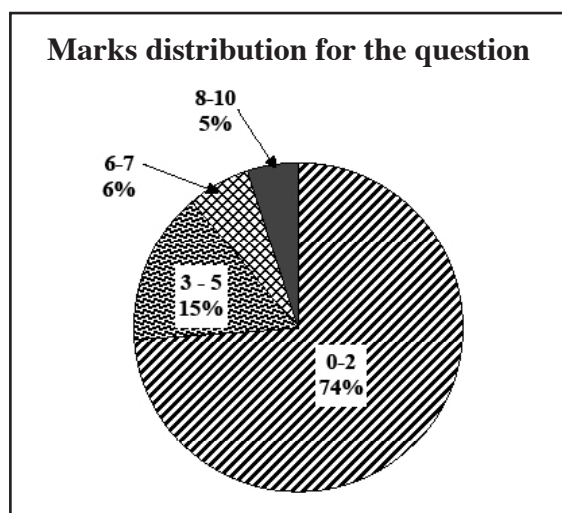
69% of the candidates have selected this question. Of these candidates
about 74% have obtained marks in the range 0 - 2,
about 15% have obtained marks in the range 3 - 5,
about 6% have obtained marks in the range 6 -7
and about 5% have obtained marks in the range 8 -10.

The percentage of candidates that have obtained marks in the range 0 - 2 is as high as 74%. The percentage of candidates that have obtained marks in the range 8 - 10 is as low as 5%.

Facility of the parts of the question
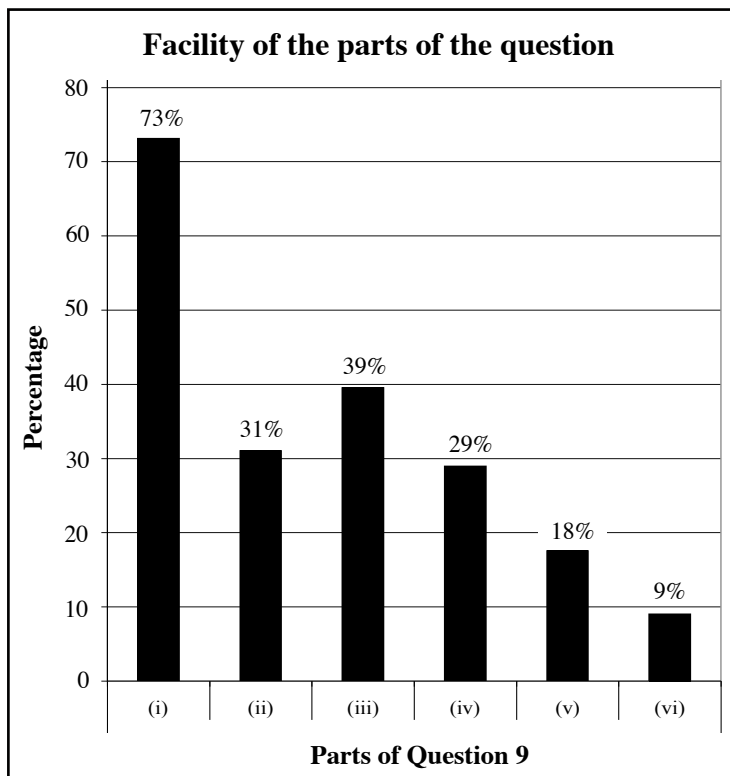
* This question has six parts of which only part (i) has a facility of more than 50%. Each of the other five parts has a facility of less than 40%.

* The easiest part is part (i) with a facility of 73%. The most difficult part is part (vi) with a facility as low as 9%.

This problem tests the geometrical knowledge on rectilinear plane figures. Many students usually do not attempt this problem. Of the students who attempted this problem, 73% have been able to copy the figure and develop it further. Although the aim of part (ii) is for a theorem to be written, many students have found this part difficult. Students need to be able to write down the Mid-point Theorem which is one of the few theorems of which the proof should be known. The reason why students in general dislike geometry may be due to its abstractness. Therefore, for students to develop a good understanding of geometrical concepts, it is advisable to first provide concrete examples, and after they have gained an understanding to proceed to abstract concepts. When doing exercises too, it is better to first present the numerical exercises, and after the students familiarize themselves with the theorems, to provide the proofs and problems requiring proofs. From the fact that more students have answered part (iii) correctly than part (ii), it is clear that they find congruency relatively easy. In problems which require proofs, it is necessary to provide reasons in the relevant steps. When students do exercises, it is necessary to get them to draw conclusions through reasoning while providing the appropriate reasons.

Objectives of Question 10

Thinks logically when making decisions based on geometrical concepts related to circles. When a figure is given of two intersecting circles such that two chords of the larger circle intersect at a point on the smaller circle,

(i) if an angle has been marked as x, writes down several given angles in terms of x.

(ii) shows that the two radii named are perpendicular to each other.

Question 10

10. Two circles with centres P and Q intersect at the points C and D as shown in the figure. AB is a diameter of the larger circle. AC and BD produced meet at E on the smaller circle.
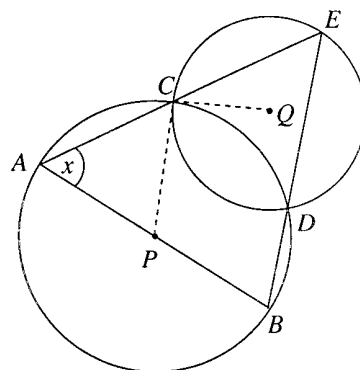
(a) Let $P\hat{A}C = x$. Providing reasons, write the following angles in terms of x.

(i) $A\hat{C}P$

(ii) $C\hat{D}E$

(iii) $C\hat{Q}E$

(iv) $E\hat{C}Q$

(b) Show that the radii CP and CQ are perpendicular to each other.

Question Number			Answer	Marks			Other
10	(a)	(i)	$A\hat{C}P = x$ (since $PA = PC$)	1+1	②	or	PA and PC are radii.
		(ii)	$C\hat{D}E = x$ (in cycle quadrilateral, Exterior angle = interior opposite angle)	1+1	②		
		(iii)	$C\hat{Q}E = 2x$ (angle at the centre is twice the angle at the circle subtended by the minor arc CE)	1+1	②		
		(iv)	$E\hat{C}Q = 90° - x$ (Sum of the angles of a triangle is 80° and ECQ is a isoslese Δ)	1+1	②	△8	
	(b)		$P\hat{C}A + P\hat{C}Q + Q\hat{C}E = 180°$ (ACE is a straight line)				
			$x + P\hat{C}Q + (90° - x) = 180°$	1			
			$P\hat{C}Q = 90°$				
			$CP \perp CQ$	1	②	△2	
						10	

Overall observations and conclusions regarding the answers

Marks distribution for the question
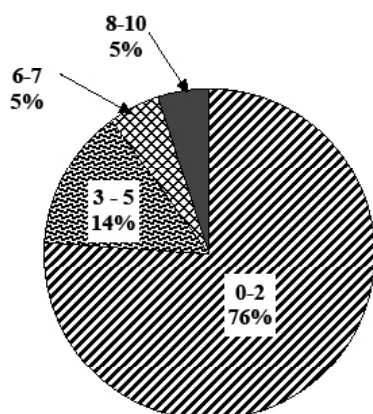
38% of the candidates have selected this question. This is the question which the least number of candidates have selected from Mathematics Paper II.
Of these candidates
about 76% have obtained marks in the range 0 - 2,
about 14% have obtained marks in the range 3 - 5,
about 5% have obtained marks in the range 6 -7
and about 5% have obtained marks in the range 8 -10.

The percentage of candidates that have obtained marks in the range 0 - 2 is as high as 76% while the percentage that has obtained marks in the range 8 - 10 is as low as 5%

Facility of the parts and sub-parts of the question

Parts and sub part of Question 10
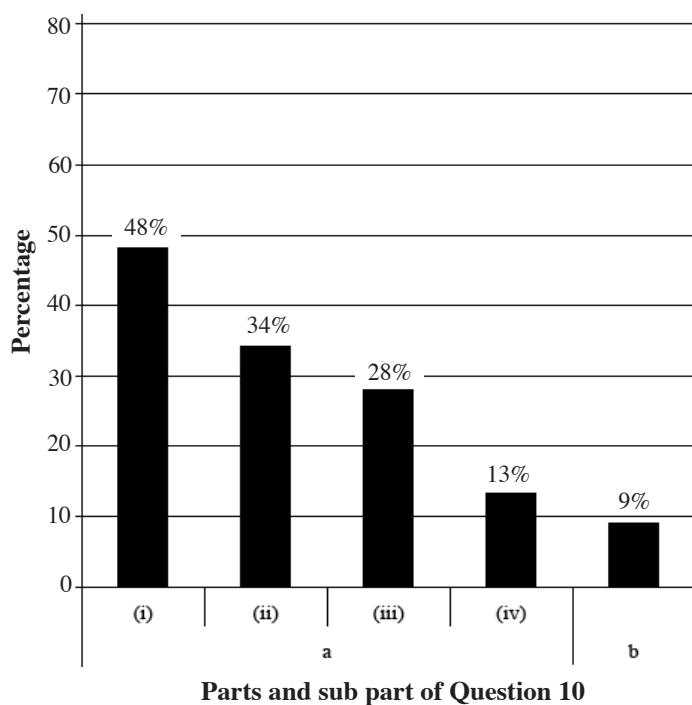
* This question has five sub-parts, each of which has a facility of less than 50%.

* The easiest part is part (a)(i) with a facility of 48%. The most difficult part is part (b) with a facility of 9%. The facility has gradually decreased from the first sub-part to the final sub-part.

The aim of this problem is to test students' abilities in relation to geometric concepts and theorems on circles. The reason for the lowest number of students selecting this problem may be the general dislike that students show towards geometry. Although 48% of the students who had selected this problem answered part (i) correctly, only a very few students had answered the remaining parts correctly. As mentioned before, the reason may be the dislike among students for geometry. It is easier to explain the theorems on circles as concrete concepts. All the theorems on circles can be explained to students using a drawing pin board and paper. After the theorems are understood, getting students to practice many related numerical problems will make proving the theorems and doing problems with proofs easier.

Objectives of Question 11

Manipulates the principles related to sets to facilitate daily activities.

When an incomplete Venn diagram of the number of students in a certain grade of a school and the number of these students engaged in two sports are given,

(i) shades a given region in the Venn diagram.

(ii) calculates the number of elements in one region when the number of elements in another region is given.

(iii) calculates the number of elements in a set which do not belong to either of two sub-sets which are named.

(iv) writes an equation in terms of x to represent the number of elements in the whole set, when the number of elements in a region of the set is given as x.

(v) by solving the above equation, writes down the number of elements in another region of the set.

Question 11

11. There are 210 grade ten students in a mixed school, 90 of whom are female. Of the female students, 20 are swimmers and 28 are athletes. An incomplete Venn diagram to represent information on the students in this grade is shown here.
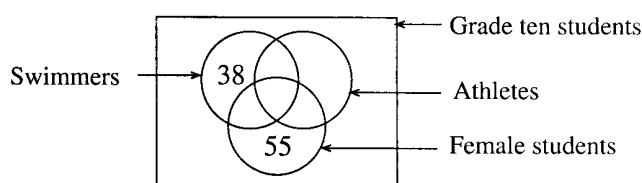

(i) Copy the given Venn diagram and shade the region denoting the male athletes.

(ii) If there are 70 athletes in this grade, how many male athletes are there?

(iii) How many male students are **neither** athletes **nor** swimmers?

(iv) By taking the number of female students who are only athletes as x, construct an equation for the total number of female students in grade ten and find x by solving it.

(v) Find how many female students are swimmers as well as athletes.

Question Number			Answer	Marks		Other
11						
	(i)		Shaded in the figure	2	②	
	(ii)		$70 - 28$ $= 42$	1 1	②	
	(iii)		$210 - (90 + 38 + 42)$ $= 40$	1 1	②	
	(iv)		$x + 20 + 55 = 90$ $x = 15$	1 1	②	
	(v)		$28 - 15$ $= 13$	1 1	② **10**	

Overall observations and conclusions regarding the answer

Marks distribution for the question

- 8–10 6%
- 6–7 6%
- 3 – 5 15%
- 0–2 73%
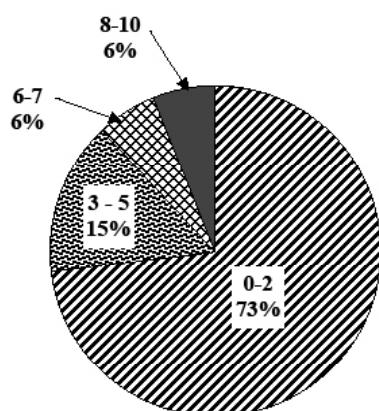
90% of the candidates have selected this question. For this question which carries 10 marks, from these candidates
about 73% have obtained marks in the range 0 - 2,
about 15% have obtained marks in the range 3 - 5,
about 6% have obtained marks in the range 6 -7
and about 6% have obtained marks in the range 8 -10.

The percentage of candidates that have obtained marks in the range 0 - 2 is 73% while the percentage of candidates that have obtained marks in the range 8 - 10 is 6%

Facility of the parts of the question

Percentage

- (i) 35%
- (ii) 57%
- (iii) 23%
- (iv) 22%
- (v) 21%

Parts of Question 11
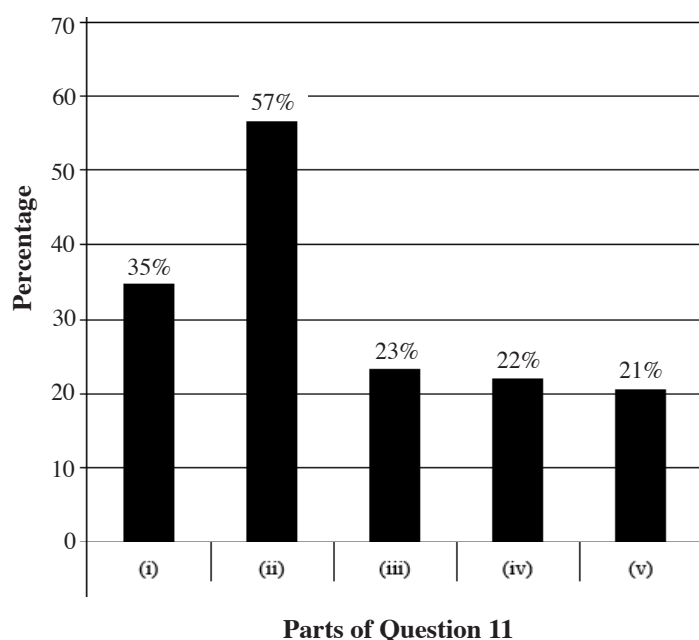
* This question has five parts, of which one part has a facility of more than 50% while each of the other parts has a facility of less than 40%.

* The easiest part is part (ii) with a facility of 57%. The most difficult part is part (v) with a facility of 21%.

The aim of this question is to test the ability of students to apply the principles related to sets to solve a real life problem. In part (i) students are expected to shade a given region. It is clear that only 35% have this ability. It is important to develop in students the ability to describe various regions related to three sets, by drawing them intersecting in various ways and getting them to describe different regions. It is better to start with two sets and then go on to more complex situations. Students should be trained not only to describe a given region using words but also to represent it using set symbols for sets and their operations. The reason for the poor response to this problem may be the difficulty that students face in reading and understanding such questions. Therefore there is a need for a programme to improve students' language skills too.

Objectives of Question 12

Gets the maximum out of space by working critically with respect to volume.

(a)   For a metal cone of base radius *a* and height 3*a*,
    (i)   shows that the volume is πa^3.
    (ii)   calculates the number of spheres of given radius that can be made with the metal that is obtained by melting the cone, such that there is no waste.
    (iii)   Writes down the volume of one such sphere in terms of *a*.

(b)   Calculates using the logarithmic tables, the value of an expression of the form $\dfrac{a \times \sqrt{b}}{c^2}$ where *a*, *b*, *c* are real numbers between 0 and 1000.

Question 12

12. (*a*) The height of a solid right circular metal cone of base radius *a* is 3*a*.

    (i) Show that the volume of the cone is πa^3.

    (ii) Find how many solid spheres of radius $\dfrac{a}{2}$ can be made without waste from the metal obtained by melting the cone.
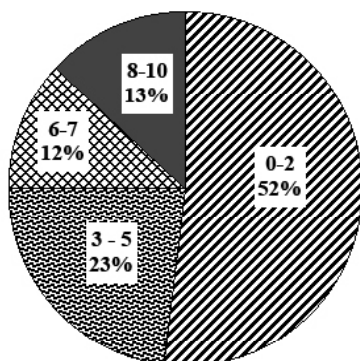
    (iii) Find the volume of one such metal sphere in terms of *a*.

(*b*) Simplify by using the logarithm tables: $\dfrac{0.523 \times \sqrt{763.5}}{(1.35)^2}$

Question Number			Answer	Marks			Other
12	(a)	(i)	Volume of cone $= \dfrac{1}{3}\pi r^2 h$ $= \dfrac{1}{3}\pi \times a^2 \times 3a$ $= \pi a^3$	1	①		
		(ii)	Volume of sphere $= \dfrac{4}{3}\pi a^3$				
			Volume of sphere of radius $\dfrac{a}{2}$	1			
			$= \dfrac{4}{3}\times\pi\times\left(\dfrac{a}{2}\right)^3$	1		or	$\pi a^3 \div \dfrac{\pi a^3}{6}$
			$k\left[\dfrac{4}{3}\times\pi\times\left(\dfrac{a}{2}\right)^3\right] = \pi a^3$	1	③		
			Volume of sphere K = 6	1	①	or	$\dfrac{\pi a^3}{6}$
		(iii)	Volume of sphere $= \dfrac{11 a^3}{21}$			⑤	
	(b)		$x = \dfrac{0.523 \times \sqrt{763.5}}{(1.35)^2}$	1			
			$lg\, x = lg\, 0.523 + \dfrac{1}{2}\,lg\,763.5 - 2\,lg\,1.35$	1			
			$= \overline{1}.7185 + \dfrac{1}{2}\times 2.8828 - 2\times 0.1303$	1			
				1			
			$= \overline{1}.7185 + 1.4414 - 0.2606$	1	⑤	⑤	
			$= 0.8993$			**10**	
			$x = 7.93$				

## Overall observations and conclusions regarding the answers

Marks distribution for the question

55% of the candidates have selected this question. Of these candidates
about 52% have obtained marks in the range 0 - 2,
about 23% have obtained marks in the range 3 - 5,
about 12% have obtained marks in the range 6 - 7
and about 13% have obtained marks in the range 8 -10.

The percentage of candidates that have obtained marks in the range 0 - 2 is 52% while the percentage of candidates that have obtained marks in the range 8 - 10 is 13%.

Facility of the parts and sub-parts of the question

Parts and sub part of Question 12
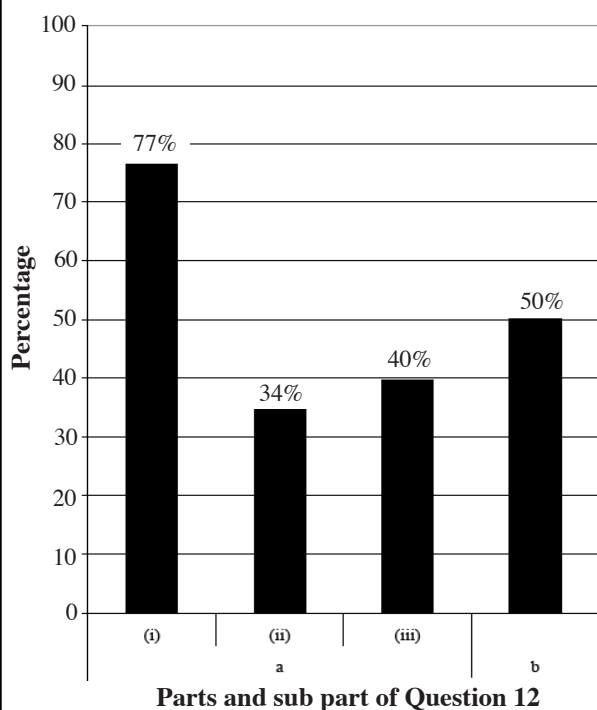
* This question has four sub-parts, of which two parts have facilities of 50% and more than 50% while the other two have facilities of 40% and less than 40%.

* The easiest part is part (a)(i) with a facility as high as 77%. The most difficult part is part (a)(ii) with a facility of 34%.

The aims of this problem are to test the students' ability to see the connections between the volumes of solid objects and to simplify numbers using the logarithmic tables. In part (i) the students are expected to find the volume of a cone. Since the required formula is given, only correct substitution of values and simplification is expected. About 77% of the candidates have provided the correct answer to this very easy part. Only the height of the cone had to be substituted here. Only 34% have answered part (ii) correctly. Although the only requirement here is to divide the volume obtained in part (i) by the volume of a sphere, many students may have not attempted this due to the dimensions not being numerical values. Students will be able to do such problems easily if they are encouraged to simplify algebraic expressions. About 50% of the students have correctly answered part (iii) which involves simplification using the logarithmic tables. By familiarizing students with reading the logarithmic tables accurately and finding the square roots and squares of numbers, they will find this question much easier to answer.

Part III

3. Factors to be considered when answering questions and suggestions:

3.1 Factors to be considered when answering questions.

* The general instructions in the question paper should be read and understood well. That is, students should pay attention to the following: How many questions should be answered from each part? Which questions are compulsory? How much time is available? How many marks are allocated?
  Students should also read the questions carefully and clearly understand what is expected before selecting the questions.

* The answers to the questions in Paper I should be written on the question paper itself.

* When answering the questions in Paper II, each main question should be started on a new page.

* Answers should be written clearly and legibly.

* The candidate's index number should be written on every page in the space provided for it.

* The question numbers and their parts should be written accurately.

* When short answers are required, long steps should not be included and when answers with steps are required short answers should not be provided.

* For problems which require sentences to be written, the relevant steps should be clearly stated.

* Depending on how the question is asked, facts should be presented in a logical and analytical way.

Special Instructions

* When figures have to be drawn, they should be presented very clearly.

* When performing calculations, each step should be written clearly.

* When required, the correct units should be used.

* The final answer should be written clearly and according to what has been asked.

* The units relevant to the final answer should be in standard form.

* Candidates should pay attention to their handwriting and write all numbers and symbols clearly and accurately.

* Candidates should note that, considering the simplification required for a mathematical problem as rough work and not presenting it in the solution results in the candidate not receiving the marks assigned for the relevant step.

* All the known steps should be written down.

* When answering the problems on geometry, the necessary steps should be written down logically with the appropriate reasons.

* It should be mentioned that for problems on geometry, including the given data and also data derived from it in the relevant figure will facilitate solving the problem.

* Attention should be paid to write any final solution which is either a fraction or a ratio in its simplest form.

* Since some of the parts that come later in a question may be easier as well as independent of the earlier parts, it is important not to give up on a question if the initial parts are difficult, but to pay attention to all the parts.

3.2 Comments and suggestions regarding the teaching learning process

* It is important for teachers as well as students to be aware of the resources such as the syllabus, teachers' instructional manual, textbooks and other external resources that are available to them and to make use of them.

* Students should be informed of what they will be learning during a lesson.

* More attention needs to be paid to the multiplication tables since students lose a lot of marks due to the mistakes they make in multiplications and divisions.

* Students need to also pay attention and correctly manipulate the mathematical operations with respect to fractions and decimals. It is productive to conduct a programme on manipulating the basic mathematical operations.

* It is also productive to use learning aids and practical activities in the teaching learning process to inculcate the correct mathematical concepts in even the weaker students.

* Subject content such as Geometry which is considered difficult should be first introduced using simple numerical exercises and gradually developed towards abstract concepts. The teacher should use different techniques in this effort.

* To overcome the weaknesses with respect to basic algebraic concepts developed during the lower classes, the teacher should pay greater attention to confirm these concepts.

* To be successful in problem solving which is one of the special aims of learning mathematics, it is necessary for the other skills too to be simultaneously developed and for challenging problem which stimulate the mind to be gradually introduced.

* Students should be given the confidence that they can do mathematics. For this, the teacher should use various methods. Short methods, games, fun activities, memory games, quizzes are some examples.

* The teacher should make an effort to inform students that mathematics which is an important and compulsory subject in the curriculum is necessary for higher education as well as for future jobs and that it has a close relationship with normal day to day life.

* Teachers who continuously work to advance and update their knowledge are skilled and creative people who are a great gift to students.

* A programme should be initiated to minimize the effects of poor literacy skills which affect students' understanding of questions as well as their communication skills.