रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(III) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **38** प्रश्न हैं ।

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें ।**

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

NOTE

(I) Please check that this question paper contains **23** printed pages.

(II) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(III) Please check that this question paper contains **38** questions.

(IV) **Please write down the Serial Number of the question in the answer-book at the given place before attempting it.**

(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

गणित (बुनियादी)
MATHEMATICS (BASIC)

निर्धारित समय : *3 घण्टे*
Time allowed : 3 hours

अधिकतम अंक : *80*
Maximum Marks : 80

• • •

सामान्य निर्देश :

निम्नलिखित निर्देशों को बहुत सावधानी से पढ़िए और उनका सख़्ती से पालन कीजिए :

(i) इस प्रश्न-पत्र में **38** प्रश्न हैं। **सभी** प्रश्न **अनिवार्य** हैं।

(ii) यह प्रश्न-पत्र **पाँच** खण्डों में विभाजित है – **क, ख, ग, घ एवं ङ।**

(iii) **खण्ड क** में प्रश्न संख्या **1** से **18** तक बहुविकल्पीय *(MCQ)* तथा प्रश्न संख्या **19** एवं **20** अभिकथन एवं तर्क आधारित **1** अंक के प्रश्न हैं।

(iv) **खण्ड ख** में प्रश्न संख्या **21** से **25** तक अति लघु-उत्तरीय *(VSA)* प्रकार के **2** अंकों के प्रश्न हैं।

(v) **खण्ड ग** में प्रश्न संख्या **26** से **31** तक लघु-उत्तरीय *(SA)* प्रकार के **3** अंकों के प्रश्न हैं।

(vi) **खण्ड घ** में प्रश्न संख्या **32** से **35** तक दीर्घ-उत्तरीय *(LA)* प्रकार के **5** अंकों के प्रश्न हैं।

(vii) **खण्ड ङ** में प्रश्न संख्या **36** से **38** तक प्रकरण अध्ययन आधारित **4** अंकों के प्रश्न हैं। प्रत्येक प्रकरण अध्ययन में आंतरिक विकल्प **2** अंकों के प्रश्न में दिया गया है।

(viii) प्रश्न-पत्र में समग्र विकल्प नहीं दिया गया है। यद्यपि, खण्ड ख के 2 प्रश्नों में, खण्ड ग के 2 प्रश्नों में, खण्ड घ के 2 प्रश्नों में तथा खण्ड ङ के 3 प्रश्नों में आंतरिक विकल्प का प्रावधान दिया गया है।

(ix) जहाँ आवश्यक हो स्वच्छ आकृतियाँ बनाइए। जहाँ आवश्यक हो $\pi = \frac{22}{7}$ लीजिए, यदि अन्यथा न दिया गया हो।

(x) कैल्कुलेटर का उपयोग **वर्जित** है।

खण्ड क

इस खण्ड में **20** बहुविकल्पीय प्रश्न *(MCQ)* हैं, जिनमें प्रत्येक प्रश्न **1** अंक का है।   *20×1=20*

1. यदि एक समांतर श्रेढ़ी का प्रथम पद 'a' तथा इसका सार्व अंतर 'b' है, तो इसका 10वाँ पद है :

(A)   a + 10b   (B)   10a + b

(C)   a + 9b   (D)   9a + b

2. यदि बिंदु $(3, \frac{3}{4})$, बिंदुओं (k, 0) तथा $(7, \frac{3}{2})$ को मिलाने वाले रेखाखण्ड का मध्य-बिंदु है, तो 'k' का मान है :

(A)   −1   (B)   1

(C) $\frac{3}{2}$ (D)   5

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) This question paper contains **38** questions. **All** questions are **compulsory**.

(ii) This question paper is divided into **five** Sections – **A, B, C, D** and **E.**

(iii) In **Section A,** Questions no. **1** to **18** are Multiple Choice Questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.

(iv) In **Section B,** Questions no. **21** to **25** are Very Short Answer (VSA) type questions, carrying **2** marks each.

(v) In **Section C,** Questions no. **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.

(vi) In **Section D,** Questions no. **32** to **35** are Long Answer (LA) type questions carrying **5** marks each.

(vii) In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.

(viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.

(ix) Draw neat diagrams wherever required. Take $\pi = \dfrac{22}{7}$ wherever required, if not stated.

(x) Use of calculator is **not** allowed.

SECTION A

*This section comprises **20** Multiple Choice Questions (MCQs) carrying **1** mark each.* $20\times1=20$

1. If the first term of an A.P. is 'a' and its common difference is 'b', then its 10th term is :

    (A)   a + 10b   (B)   10a + b

    (C)   a + 9b   (D)   9a + b

2. If the point $(3, \dfrac{3}{4})$ is the mid-point of the line segment joining the points $(k, 0)$ and $(7, \dfrac{3}{2})$, then the value of 'k' is :

    (A)   – 1   (B)   1

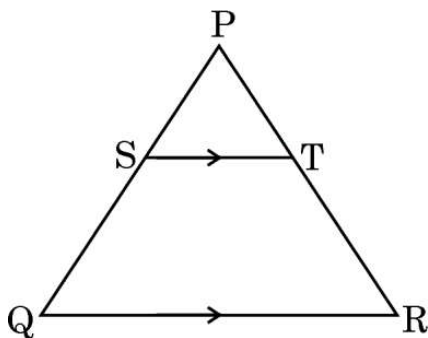   (C) $\dfrac{3}{2}$ (D)   5

. . .

3. 7 cm त्रिज्या वाले एक वृत्त के एक त्रिज्यखंड का क्षेत्रफल, जिसका कोण 60° है, है :

(A) $\dfrac{22}{3}$ sq cm

(B) $\dfrac{77}{3}$ sq cm

(C) $\dfrac{44}{7}$ sq cm

(D) $\dfrac{132}{7}$ sq cm

4. दो भिन्न सिक्कों को एक साथ उछाला गया। केवल एक पट आने की प्रायिकता है :

(A) $\dfrac{1}{4}$

(B) $\dfrac{1}{2}$

(C) $\dfrac{3}{4}$

(D) 1

5. दी गई आकृति में, $\triangle$ PQR में, ST || QR है। यदि PS = 16 mm तथा PQ = 40 mm है, तो PT : TR है :

(A) 2 : 3

(B) 3 : 2

(C) 2 : 5

(D) 5 : 2

6. निम्नलिखित में से कौन-सा कथन *असत्य* है ?

(A) दो सर्वांगसम त्रिभुज समरूप भी होते हैं।

(B) एक वर्ग तथा समचतुर्भुज समरूप नहीं होते।

(C) दो त्रिभुज समरूप होते हैं, यदि उनकी संगत भुजाएँ समानुपाती हों।

(D) दो बहुभुज समरूप होते हैं यदि और केवल यदि, उनकी संगत भुजाएँ समानुपाती हों।

7. $\dfrac{1 - \tan^2 45°}{1 + \tan^2 45°}$ का मान निम्नलिखित में से किसके मान के बराबर है ?

(A) $\tan 30°$

(B) $\tan 60°$

(C) $\tan 90°$

(D) $\tan 0°$

•••

3. The area of a sector of a circle with radius 7 cm, when the angle of the sector is 60°, is :

(A) $\dfrac{22}{3}$ sq cm   (B) $\dfrac{77}{3}$ sq cm

(C) $\dfrac{44}{7}$ sq cm   (D) $\dfrac{132}{7}$ sq cm

4. Two different coins are tossed together. The probability of getting exactly one tail is :

(A) $\dfrac{1}{4}$ (B) $\dfrac{1}{2}$

(C) $\dfrac{3}{4}$ (D)   1

5. In the given figure, in $\triangle$ PQR, ST $\parallel$ QR. If PS = 16 mm and PQ = 40 mm, then PT : TR is :
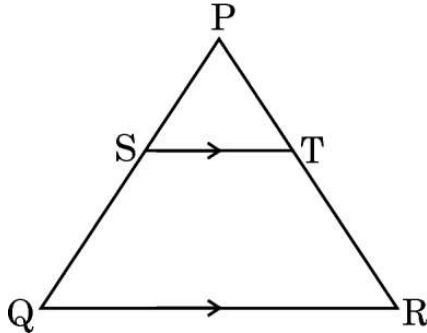
(A)   2 : 3   (B)   3 : 2

(C)   2 : 5   (D)   5 : 2

6. Which of the following is an ***incorrect*** statement ?

(A)   Two congruent triangles are also similar.

(B)   A square and a rhombus are not similar.

(C)   Two triangles are similar if their corresponding sides are proportional.

(D)   Two polygons are similar if and only if their corresponding sides are in proportion.

7. The value of $\dfrac{1 - \tan^2 45°}{1 + \tan^2 45°}$ is equal to the value of :

(A) $\tan 30°$ (B) $\tan 60°$

(C) $\tan 90°$ (D) $\tan 0°$

8. तीनों केन्द्रीय प्रवृत्ति के मापकों के बीच आनुभविक संबंध है :

   (A)   3 माध्यक = बहुलक + 2 माध्य

   (B)   3 माध्यक = बहुलक – 2 माध्य

   (C)   3 बहुलक = माध्यक + 2 माध्य

   (D)   3 माध्य = बहुलक – 2 माध्यक

9. एक निष्पक्ष पासा एक बार उछाला गया । 3 से छोटी सम संख्या प्राप्त करने की प्रायिकता है :

   (A) $\dfrac{1}{6}$ (B) $\dfrac{1}{3}$
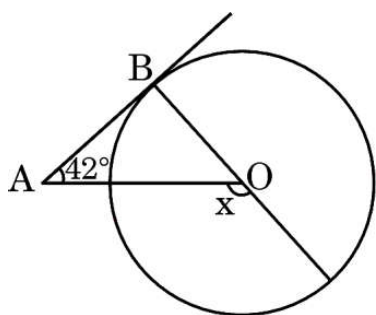
   (C) $\dfrac{1}{2}$ (D)   0

10. एक घटना के घटित होने की प्रायिकता 'p' है तथा इसी घटना के न घटित होने की प्रायिकता 'q' है । 'p' तथा 'q' के बीच संबंध है :

   (A)   p + q + 1 = 0   (B)   p = q – 1
   (C)   p + q = 1   (D)   p = 1, q = 1

11. यदि बहुपद p(x) = $2x^2 + 6x – 6$ के शून्यक α तथा β हैं, तो $\dfrac{1}{\alpha} + \dfrac{1}{\beta}$ का मान है :

   (A)   – 1   (B)   1
   (C)   – 3   (D)   3

12. दी गई आकृति में, केंद्र O वाले वृत्त की AB एक स्पर्श-रेखा है । यदि $\angle$ BAO = 42° है, तो x का मान है :

   (A)   42°   (B)   38°
   (C)   48°   (D)   132°

13. 3·5 cm त्रिज्या वाले एक वृत्त की दो समांतर स्पर्श-रेखाओं के बीच की दूरी है :

   (A)   3·5 cm   (B)   14 cm
   (C)   1·75 cm   (D)   7 cm

• • •

8. The empirical relationship between the three measures of central tendency is :

(A) 3 Median = Mode + 2 Mean

(B) 3 Median = Mode – 2 Mean

(C) 3 Mode = Median + 2 Mean

(D) 3 Mean = Mode – 2 Median

9. A fair die is thrown once. The probability of getting an even number less than 3 is :

(A) $\dfrac{1}{6}$ (B) $\dfrac{1}{3}$

(C) $\dfrac{1}{2}$ (D) 0

10. The probability of the happening of an event is 'p' and the probability of non-happening of the same event is 'q'. The relation between 'p' and 'q' is :

(A) p + q + 1 = 0 (B) p = q – 1

(C) p + q = 1 (D) p = 1, q = 1

11. If α and β are the zeroes of the polynomial p(x) = $2x^2$ + 6x – 6, then the value of $\dfrac{1}{\alpha} + \dfrac{1}{\beta}$ is equal to :

(A) – 1 (B) 1

(C) – 3 (D) 3

12. In the given figure, AB is a tangent to the circle with centre O. If $\angle$ BAO = 42°, then the value of x is :
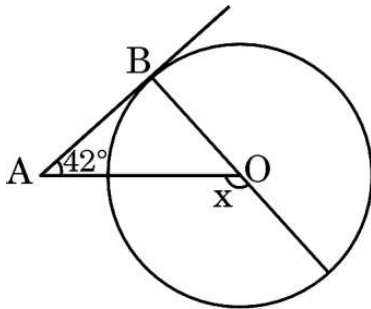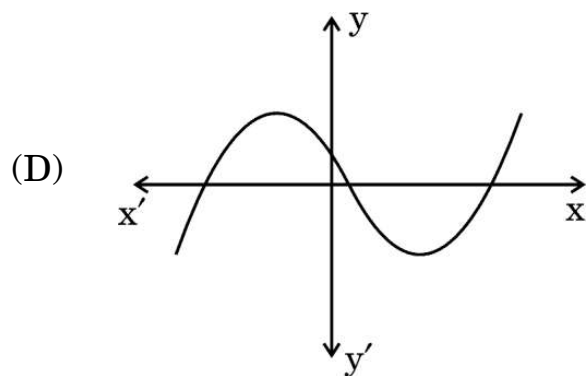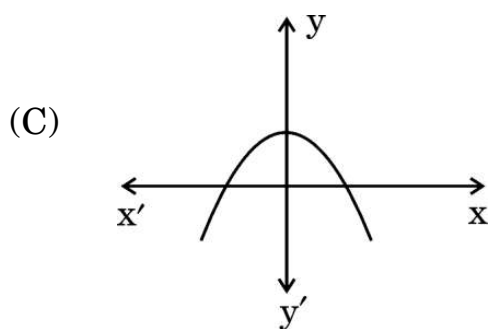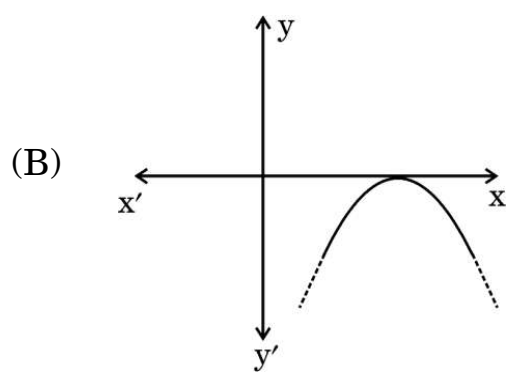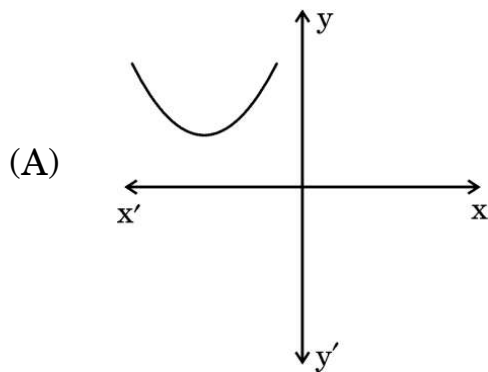

(A) 42° (B) 38°

(C) 48° (D) 132°

13. The distance between two parallel tangents to a circle of radius 3·5 cm is :

(A) 3·5 cm (B) 14 cm

(C) 1·75 cm (D) 7 cm

14. निम्नलिखित में से कौन-सा आलेख एक द्विघात बहुपद का *नहीं* है ?

(A)

(B)

(C)

(D)

15. यदि द्विघात समीकरण $ax^2 + ax + c = 0$ $(a \neq 0)$ के मूल वास्तविक तथा समान हैं, तो :

(A) $a = 4c$ (B) $4a = c$

(C) $a = -4c$ (D) $c = -4a$

16. समांतर श्रेढ़ी (A.P.) $\sqrt{5}$, $\sqrt{20}$, $\sqrt{45}$, ... का अगला पद है :

(A) $\sqrt{60}$ (B) $4\sqrt{5}$

(C) $\sqrt{75}$ (D) $\sqrt{125}$

17. रैखिक समीकरण युग्म $3x + 4y = 5$; $4x + 3y = 9$ का हल है :

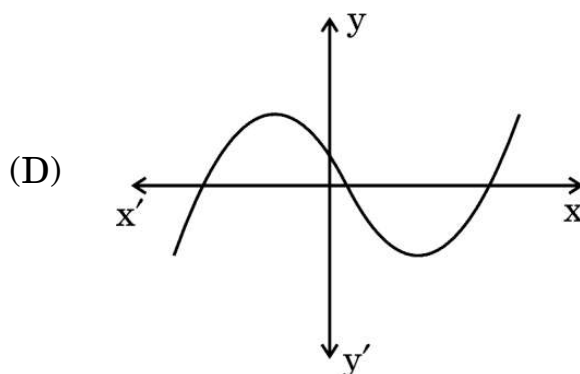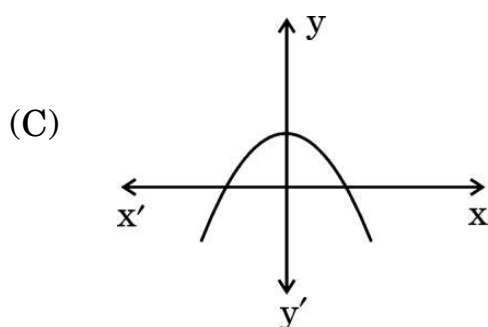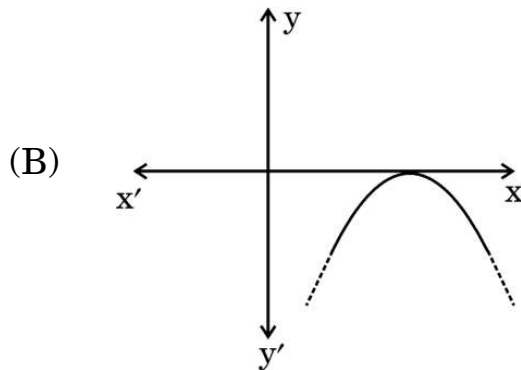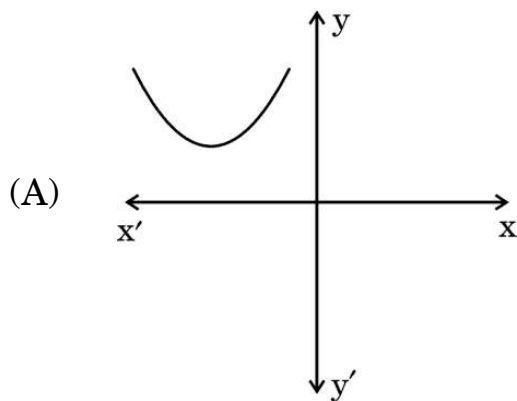(A) $x = -3, y = 1$

(B) $x = 3, y = 1$

(C) $x = 3, y = -1$

(D) $x = -3, y = -1$

• • •

14. Which of the following is ***not*** the graph of a quadratic polynomial ?

(A)

(B)

(C)

(D)

15. If the quadratic equation $ax^2 + ax + c = 0$ $(a \neq 0)$ has real and equal roots, then :

(A) $a = 4c$ (B) $4a = c$

(C) $a = -4c$ (D) $c = -4a$

16. The next term of the A.P. $\sqrt{5}$, $\sqrt{20}$, $\sqrt{45}$, ... is :

(A) $\sqrt{60}$ (B) $4\sqrt{5}$

(C) $\sqrt{75}$ (D) $\sqrt{125}$

17. The solution of the pair of linear equations $3x + 4y = 5$; $4x + 3y = 9$ is :

(A) $x = -3, y = 1$

(B) $x = 3, y = 1$

(C) $x = 3, y = -1$

(D) $x = -3, y = -1$

18. यदि x tan 45° cos 60° = $\sqrt{3}$ sin 60° cot 60° है, तो x का मान है :

    (A)   1

    (B) $\dfrac{1}{\sqrt{3}}$

    (C) $\sqrt{3}$

    (D) $\dfrac{\sqrt{3}}{2}$

प्रश्न संख्या 19 और 20 अभिकथन एवं तर्क आधारित प्रश्न हैं। दो कथन दिए गए हैं जिनमें एक को अभिकथन (A) तथा दूसरे को तर्क (R) द्वारा अंकित किया गया है। इन प्रश्नों के सही उत्तर नीचे दिए गए कोडों (A), (B), (C) और (D) में से चुनकर दीजिए।

    (A)   अभिकथन (A) और तर्क (R) दोनों सही हैं और तर्क (R), अभिकथन (A) की सही व्याख्या करता है।

    (B)   अभिकथन (A) और तर्क (R) दोनों सही हैं, परन्तु तर्क (R), अभिकथन (A) की सही व्याख्या *नहीं* करता है।

    (C)   अभिकथन (A) सही है, परन्तु तर्क (R) ग़लत है।

    (D)   अभिकथन (A) ग़लत है, परन्तु तर्क (R) सही है।

19.   *अभिकथन (A) :*   त्रिज्या r वाले वृत्त के एक त्रिज्यखंड, जिसका कोण अंशों में θ है, का क्षेत्रफल $\dfrac{\theta}{360} \times 2\pi r$ होता है।

    तर्क (R) :   एक वृत्तखंड का क्षेत्रफल = संगत त्रिज्यखंड का क्षेत्रफल – संगत त्रिभुज का क्षेत्रफल।

20.   *अभिकथन (A) :*   यदि दो त्रिभुजों के कोण परस्पर समान हों, तो त्रिभुज समरूप होते हैं।

    तर्क (R) :   यदि दो त्रिभुज समरूप हैं, तो वे सर्वांगसम होते हैं।

•••

18. If $x \tan 45° \cos 60° = \sqrt{3} \sin 60° \cot 60°,$ then the value of x is :

(A)   1

(B) $\dfrac{1}{\sqrt{3}}$

(C) $\sqrt{3}$

(D) $\dfrac{\sqrt{3}}{2}$

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

(A)   Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B)   Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of Assertion (A).

(C)   Assertion (A) is true, but Reason (R) is false.

(D)   Assertion (A) is false, but Reason (R) is true.

19.   *Assertion (A) :* Area of a sector of a circle with radius r and angle with degree measure θ is $\dfrac{\theta}{360} \times 2\pi r.$

Reason (R) :   Area of segment of a circle =
Area of the corresponding sector – Area of the corresponding triangle.

20.   *Assertion (A) :* If two triangles are equiangular, then they are similar.

Reason (R) :   If two triangles are similar, then they are congruent.

खण्ड ख

इस खण्ड में 5 अति लघु-उत्तरीय (VSA) प्रकार के प्रश्न हैं, जिनमें प्रत्येक के 2 अंक हैं।   *5×2=10*

21. एक स्कूल में कक्षा X के दो सेक्शन A और B हैं। सेक्शन A में 48 विद्यार्थी हैं तथा सेक्शन B में 36 विद्यार्थी हैं। स्कूल की कक्षा लाइब्रेरी के लिए आवश्यक पुस्तकों की वह कम-से-कम संख्या ज्ञात कीजिए ताकि प्रत्येक सेक्शन A या B में विद्यार्थियों को समान रूप में बाँटी जा सके।

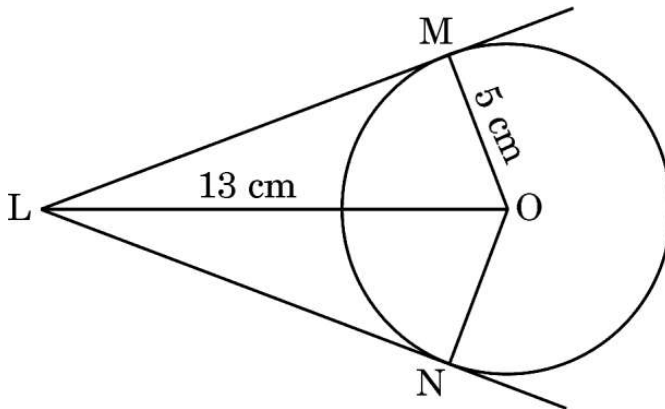22. (क) बहुपद $7y^2 - \dfrac{11}{3}y - \dfrac{2}{3}$ के शून्यक ज्ञात कीजिए।

    अथवा

    (ख) x में वह द्विघात बहुपद ज्ञात कीजिए, जिसका एक शून्यक 15 है तथा शून्यकों का योगफल 42 है।

23. (क) बिंदुओं (– 1, 7) तथा (4, – 3) को मिलाने वाले रेखाखण्ड को 2 : 3 के अनुपात में बाँटने वाले बिंदु के निर्देशांक ज्ञात कीजिए।

    अथवा

    (ख) दूरी सूत्र के प्रयोग से सिद्ध कीजिए कि बिंदु A(3, 1), B(6, 4) तथा C(8, 6) संरेख हैं।

24. दी गई आकृति में, केंद्र O तथा त्रिज्या 5 cm वाले वृत्त पर, O से 13 cm की दूरी पर स्थित बिंदु L से वृत्त पर स्पर्श-रेखाएँ LM तथा LN खींची गई हैं। चतुर्भुज LMON का परिमाप ज्ञात कीजिए।

25. यदि 3 cot A = 4 है, तो $\cos^2 A - \sin^2 A$ का मान ज्ञात कीजिए।

SECTION B

*This section comprises **5** Very Short Answer (VSA) type questions carrying **2** marks each.* 5×2=10

21. In a school, there are two Sections A and B of Class X. There are 48 students in Section A and 36 students in Section B. Determine the minimum number of books required for their class library so that they can be distributed equally among the students of Section A or that of Section B.

22. (a) Find the zeroes of the polynomial $7y^2 - \dfrac{11}{3}y - \dfrac{2}{3}$.

OR

(b) Find a quadratic polynomial in x, whose one zero is 15 and sum of the zeroes is 42.

23. (a) Find the coordinates of the point which divides the join of $(-1, 7)$ and $(4, -3)$ in the ratio 2 : 3.

OR

(b) Using distance formula, prove that the points A(3, 1), B(6, 4) and C(8, 6) are collinear.

24. In the given figure, from a point L which is at a distance of 13 cm from the centre O of a circle of radius 5 cm, the pair of tangents LM and LN are drawn to the circle. Find the perimeter of quadrilateral LMON.
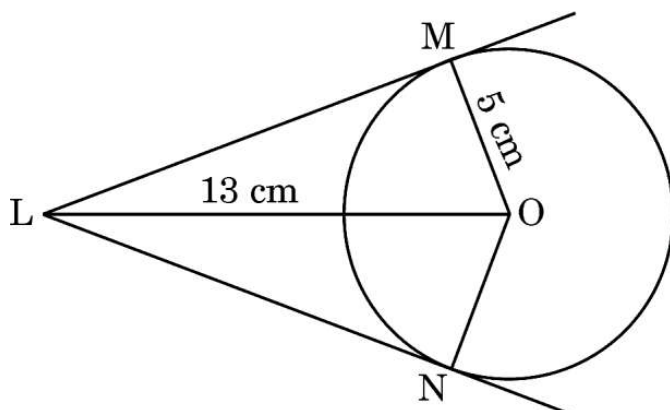
25. If $3 \cot A = 4$, then determine the value of $\cos^2 A - \sin^2 A$.

खण्ड ग

इस खण्ड में *6 लघु-उत्तरीय (SA) प्रकार के प्रश्न हैं, जिनमें प्रत्येक के 3 अंक हैं।* *6×3=18*

26. (क) निम्नलिखित रैखिक समीकरण निकाय का हल ज्ञात कीजिए :

$$\frac{x}{a} - \frac{y}{b} = 0; \quad ax + by = a^2 + b^2$$

अथवा

(ख) 'p' के किस मान के लिए निम्नलिखित रैखिक समीकरण निकाय

$$(2p - 1)x + (p - 1)y = 2p + 1$$

$$3x + y = 1$$

का कोई हल *नहीं* है ?

27. यदि बिंदु Q(0, 1), बिंदुओं P(5, – 3) तथा R(x, 6) से समदूरस्थ है, तो x का/के मान ज्ञात कीजिए। दूरी QR तथा PR भी ज्ञात कीजिए।

28. सिद्ध कीजिए कि :

$$\frac{\sin \theta - 2 \sin^3 \theta}{2 \cos^3 \theta - \cos \theta} = \tan \theta$$

29. (क) एक घड़ी की मिनट वाली सुई की लंबाई 14 cm है। इस मिनट वाली सुई द्वारा 5 मिनट में रचित क्षेत्रफल ज्ञात कीजिए।

अथवा

(ख) पानी के नीचे की चट्टानों के बारे में जहाजों को चेतावनी देने के लिए, एक लाइटहाउस 80° के केंद्रीय कोण के एक त्रिज्यखण्ड पर 16·5 km की दूरी तक लाल रंग की रोशनी डालता है। समुद्र के उस क्षेत्र का क्षेत्रफल ज्ञात कीजिए जहाँ तक जहाजों को चेतावनी दी जाती है।

30. निम्नलिखित सारणी में एक स्कूल के कक्षा X के 110 छात्रों द्वारा एक विशेष शैक्षिक सत्र में प्राप्त अंक दर्शाए गए हैं। इस बंटन का बहुलक ज्ञात कीजिए।

प्राप्तांक :	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
छात्रों की संख्या :	21	25	30	24	10

31. सिद्ध कीजिए कि किसी वृत्त के परिगत खींचा गया समांतर चतुर्भुज, एक समचतुर्भुज होता है।

SECTION C

*This section comprises **6** Short Answer (SA) type questions carrying **3** marks each.*   *6×3=18*

26. (a) Solve the following system of linear equations :

$$\frac{x}{a} - \frac{y}{b} = 0; \quad ax + by = a^2 + b^2$$

OR

(b) For what value of 'p' will the following system of linear equations have **no** solution ?

$$(2p - 1)x + (p - 1)y = 2p + 1$$

$$3x + y = 1$$

27. If the point Q(0, 1) is equidistant from points P(5, − 3) and R(x, 6), then find the value/s of x. Also, find the distance QR and PR.

28. Prove that :

$$\frac{\sin \theta - 2 \sin^3 \theta}{2 \cos^3 \theta - \cos \theta} = \tan \theta$$

29. (a) The length of the minute-hand of a clock is 14 cm. Find the area swept by this minute-hand in 5 minutes.

OR

(b) To warn ships for underwater rocks, a lighthouse throws a red coloured light over a sector of central angle 80° up to a distance of 16·5 km. Find the area of the sea over which the ships are warned.

30. The following table shows the marks obtained by 110 students of class X in a school during a particular academic session. Find the mode of the distribution.

Marks Obtained :	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
Number of Students :	21	25	30	24	10

31. Prove that the parallelogram circumscribing a circle is a rhombus.

खण्ड घ

इस खण्ड में 4 दीर्घ-उत्तरीय (LA) प्रकार के प्रश्न हैं, जिनमें प्रत्येक के 5 अंक हैं।　　　　4×5=20

32. (क) एक हवाई जहाज जब भूमि से 5000 m की ऊँचाई पर उड़ रहा है, तो वह एक अन्य हवाई जहाज के ऊपर से ऊर्ध्वाधर रूप से उस समय गुजरता है जब भूमि पर एक बिंदु से दोनों जहाजों के उन्नयन कोण क्रमश: 60° तथा 45° हैं। उस समय हवाई जहाजों के बीच की ऊर्ध्वाधर दूरी ज्ञात कीजिए। [$\sqrt{3}$ = 1·732 प्रयोग कीजिए]

अथवा

(ख) एक नहर के एक किनारे पर एक टीवी टावर सीधा खड़ा है। नहर के दूसरे किनारे के एक सम्मुख बिंदु पर इस टावर के शिखर का उन्नयन कोण 60° है। इसी किनारे पर इस बिंदु से 20 m की दूरी पर स्थित अन्य बिंदु पर टावर के शिखर का उन्नयन कोण 30° है। टावर की ऊँचाई तथा नहर की चौड़ाई ज्ञात कीजिए। [$\sqrt{3}$ = 1·73 प्रयोग कीजिए]

33. (क) एक कक्षा परीक्षा में, अनन्या द्वारा गणित तथा विज्ञान में प्राप्त अंकों का योगफल 28 है। यदि उसके गणित में 3 अंक अधिक तथा विज्ञान में 4 अंक कम आते, तो दोनों विषयों में प्राप्तांकों का गुणनफल 180 होता। उसके द्वारा दोनों विषयों में प्राप्त अंक अलग-अलग ज्ञात कीजिए।

अथवा

(ख) x के लिए हल कीजिए :

$$\frac{150}{x} + x + 18 = 10x + \frac{15}{x} ; \; x \neq 0$$

34. यदि △ ABC ~ △ PQR है तथा AD और PM क्रमश: त्रिभुजों ABC तथा PQR की माध्यिकाएँ हैं, तो सिद्ध कीजिए कि $\frac{AB}{PQ} = \frac{AD}{PM}$.

35. एक टैंट एक बेलन के आकार का है जिसके ऊपर उसी त्रिज्या का एक शंकु अध्यारोपित है। यदि बेलनाकार भाग की ऊँचाई तथा व्यास क्रमश: 2·1 m और 4 m हैं और ऊपरी भाग (शंकु) की तिर्यक ऊँचाई 2·8 m है, तो टैंट में लगने वाले कैनवास का क्षेत्रफल ज्ञात कीजिए। ₹ 500 प्रति वर्ग मीटर की दर से कैनवास का खर्च (लागत) भी ज्ञात कीजिए।

SECTION D

*This section comprises **4** Long Answer (LA) type questions carrying **5** marks each.*   *4×5=20*

32.   (a)   An aeroplane when flying at a height of 5000 m above the ground passes vertically above another aeroplane at an instant when the angles of elevation of the two planes from a point on the ground are 60° and 45° respectively. Find the vertical distance between the aeroplanes at that instant. [Use $\sqrt{3}$ = 1·732]

OR

(b)   A TV tower stands vertically on a bank of a canal. From a point on the other bank directly opposite the tower, the angle of elevation of the top of the tower is 60°. From a point 20 m away from this point on the same bank, the angle of elevation of the top of the tower is 30°. Find the height of the tower and the width of the canal. [Use $\sqrt{3}$ = 1·73]

33.   (a)   In a class test, the sum of marks obtained by Ananya in Mathematics and Science is 28. Had she got 3 marks more in Mathematics and 4 marks less in Science, the product of marks obtained in the two subjects would have been 180. Find the marks obtained in the two subjects separately.

OR

(b)   Solve for x :

$$\frac{150}{x} + x + 18 = 10x + \frac{15}{x}; \ \ x \neq 0$$

34.   If AD and PM are medians of triangles ABC and PQR respectively, where $\triangle$ ABC ~ $\triangle$ PQR, then prove that $\dfrac{AB}{PQ} = \dfrac{AD}{PM}$.

35.   A tent is in the shape of a cylinder surmounted by a conical top of same radius. If the height and diameter of the cylindrical part are 2·1 m and 4 m respectively, and the slant height of the top is 2·8 m, find the area of the canvas used for making the tent. Also, find the cost of the canvas of the tent at the rate of ₹ 500 per m².
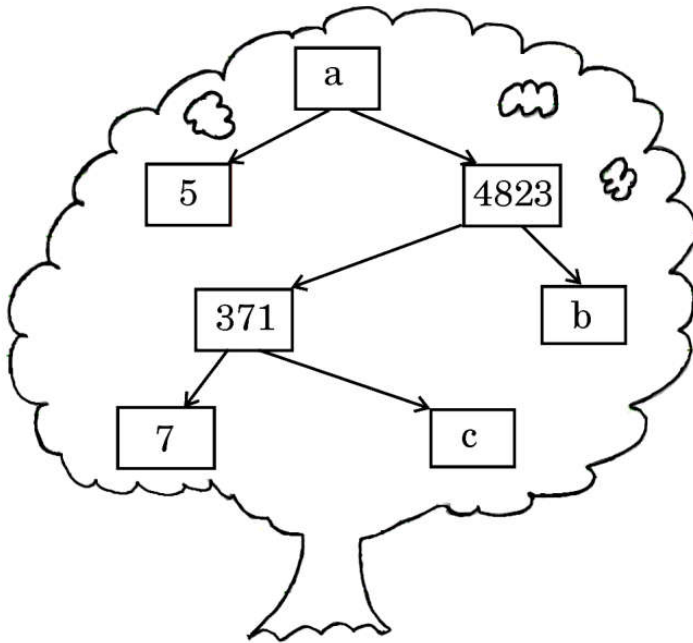
इस खण्ड में **3** प्रकरण अध्ययन आधारित प्रश्न हैं, जिनमें प्रत्येक के **4** अंक हैं। *3×4=12*

प्रकरण अध्ययन – 1

36. आपके स्कूल में एक गणित प्रदर्शनी का आयोजन किया गया है तथा आपके एक मित्र ने 'गुणनखण्ड वृक्ष' का एक मॉडल बनाया है। उसे कुछ कठिनाई आ रही है जिसके लिए उसने आपकी सहायता माँगी है, ताकि वह दर्शकों के लिए एक क्विज़ पूरा कर सके।

निम्नलिखित 'गुणनखण्ड वृक्ष' का अवलोकन कीजिए तथा निम्नलिखित प्रश्नों के उत्तर दीजिए :

|	
(i) a का मान क्या है ?	*1*
(ii) (क) b का मान क्या है ?	*2*
अथवा	
(ख) c का मान क्या है ?	*2*
(iii) 24115 का अभाज्य गुणनखण्डन लिखिए।	*1*

SECTION E

*This section comprises **3** case study based questions carrying **4** marks each.*   *3×4=12*

Case Study – 1

36.   A Mathematics exhibition is being conducted in your school and one of your friends is making a model of a 'factor tree'. He has some difficulty and asks for your help in completing a quiz for the audience.

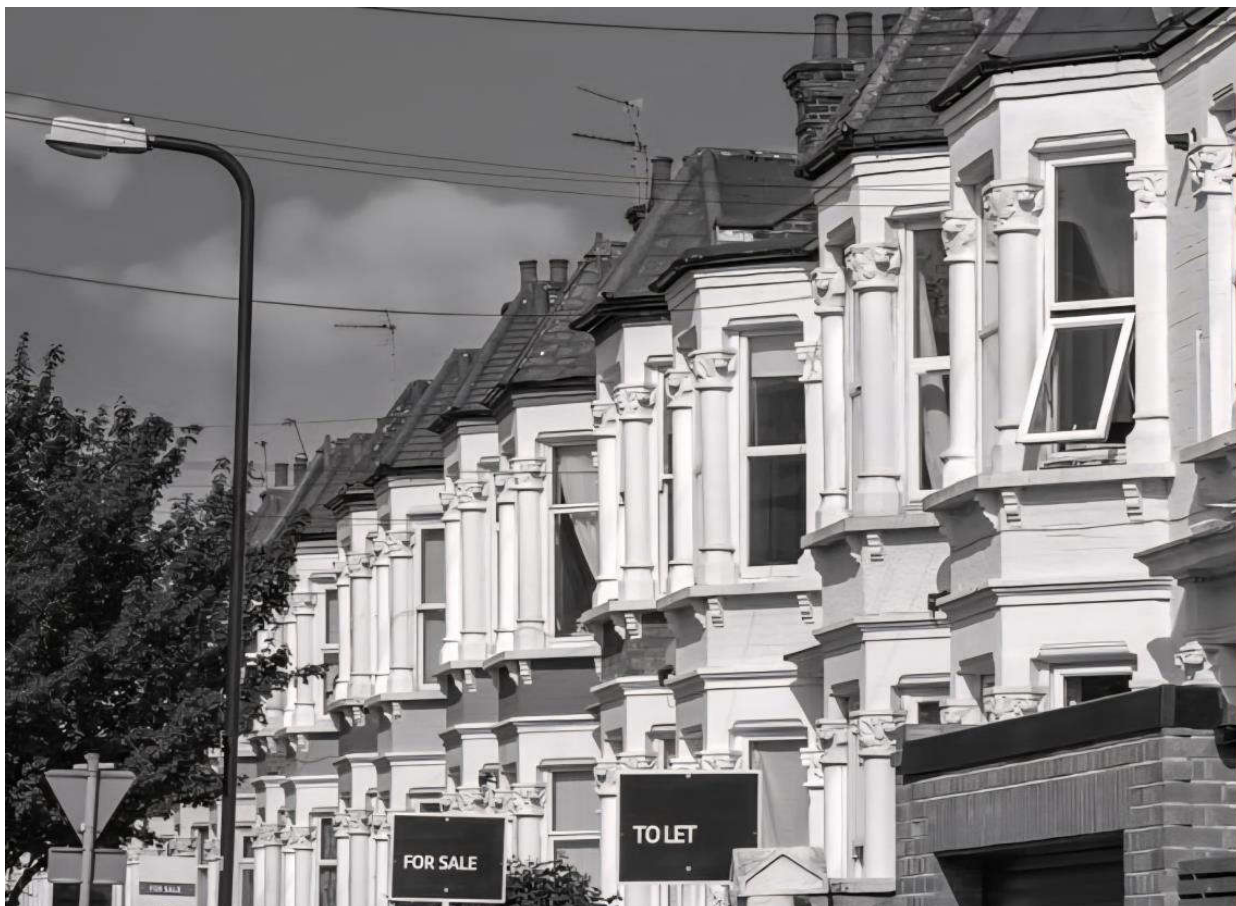Observe the following 'factor tree' and answer the following questions :

   (i)   What is the value of a ?   *1*

   (ii)   (a)   What is the value of b ?   *2*

        OR
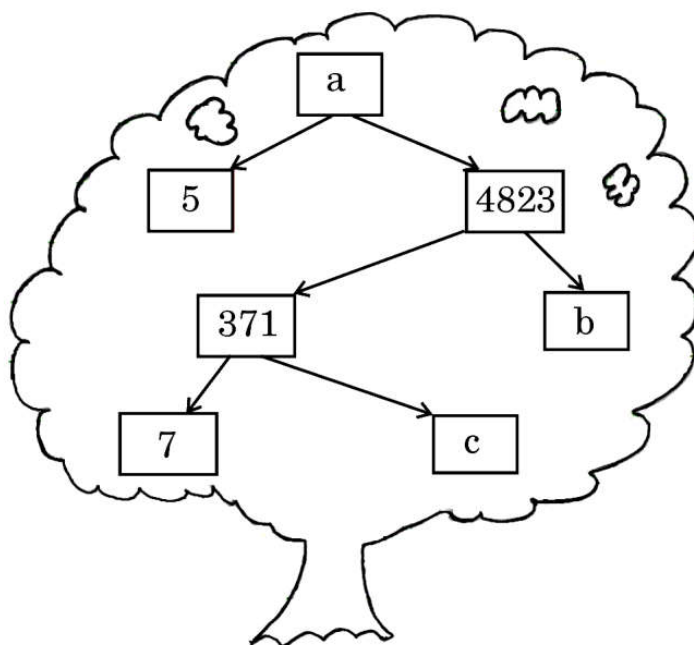
      (b)   What is the value of c ?   *2*

   (iii)   Write the prime factorisation of 24115.   *1*

37. एक आकर्षक गाँव में, 'मेपलवुड एवेन्यू' नामक एक गली है जिसमें घरों को 1 से 49 तक क्रमांकित किया गया है । एक सामुदायिक समूह ने एक हरित नवीकरण परियोजना शुरू करने का फैसला किया है, जिसमें घरों पर सौर पैनल स्थापित करने हैं ।

परियोजना शुरू करने से पहले उनके निम्नलिखित कुछ प्रश्न हैं ।

(i)   'मेपलवुड एवेन्यू' में कुल कितने घर हैं ?   *1*

(ii)   घरों के नम्बर एक समांतर श्रेढ़ी बनाते हैं । समांतर श्रेढ़ी का प्रथम पद तथा सार्व अंतर क्या है ?   *1*

(iii)   (क)   यदि यह समूह 1 से 49 वाले सभी घरों के नम्बरों का योगफल परिकलित करना चाहता है, तो वह कितना होगा ?   *2*

अथवा

(ख)   15 से 30 तक के बीच के घरों के नम्बरों का योगफल क्या है ?   *2*

Case Study – 2

37. In a charming village, there is a street called 'Maplewood Avenue', where the houses are numbered from 1 to 49. A community group has decided to undertake a green renovation project, aiming to install solar panels on the houses.

They have a few questions before they begin the project.

(i) How many houses are there on 'Maplewood Avenue' ?   *1*

(ii) The house numbers follow an Arithmetic Progression. What is the first term of the A.P. and the common difference ?   *1*

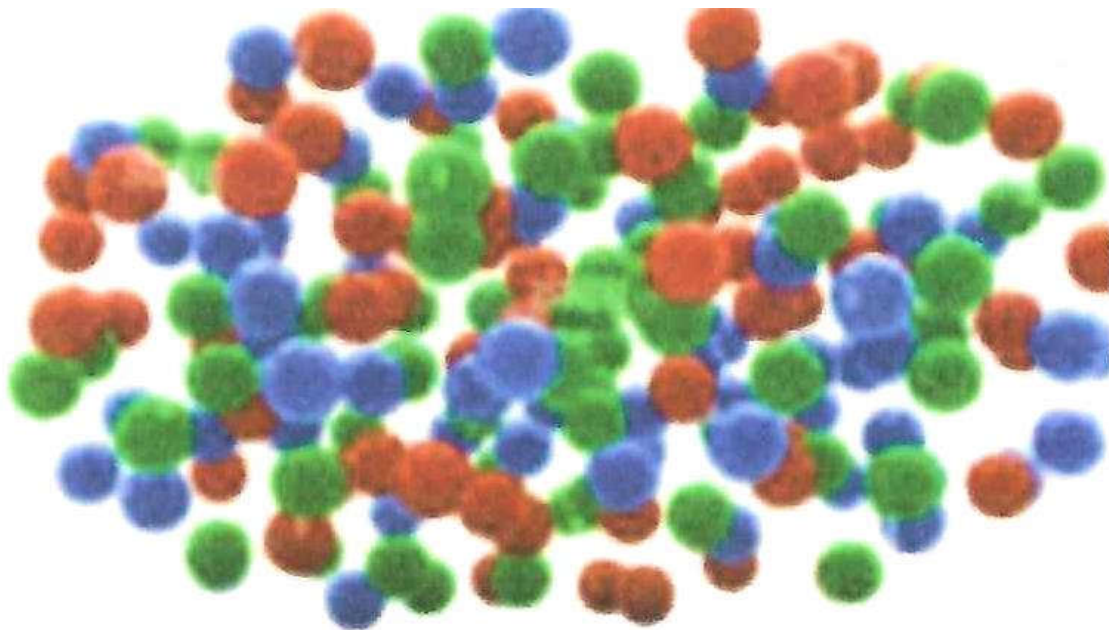(iii) (a) If the group wanted to calculate the sum of all house numbers from 1 to 49, how much would that be ?   *2*

          OR

(b) What is the sum of the house numbers between 15 and 30 ?   *2*

38. आरव तथा आशिमा भाई बहन हैं तथा आशिमा के जन्मदिन पर आरव ने उसे एक बैग भेंट में दिया जिसमें 8 लाल रंग की टॉफियाँ, 10 हरे रंग की टॉफियाँ तथा 6 नीले रंग की टॉफियाँ हैं। आशिमा ने बैग में से यादृच्छया एक टॉफी निकालने का फैसला किया। यह जानने के लिए कि विशेष रंग की टॉफी निकलने की क्या संभावना है, वह निम्नलिखित प्रश्न पूछती है :

(i)   एक हरी टॉफी प्राप्त करने की क्या प्रायिकता है ?   *1*

(ii)   एक नीली टॉफी प्राप्त करने की क्या प्रायिकता है ?   *1*

(iii)   (क)   एक टॉफी जो लाल न हो, को प्राप्त करने की क्या प्रायिकता है ?   *2*
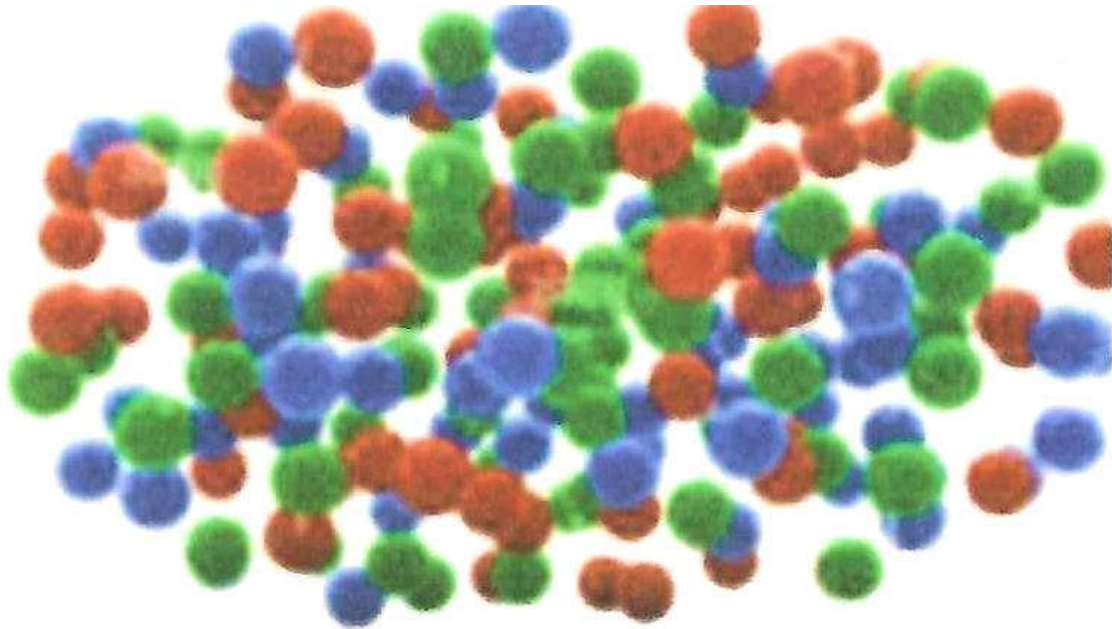
अथवा

       (ख)   एक लाल या एक हरी टॉफी को प्राप्त करने की क्या प्रायिकता है ?   *2*

Case Study – 3

38. Aarav and Ashima are brother and sister and on Ashima's birthday, Aarav gifts her a bag filled with 8 red toffees, 10 green toffees and 6 blue toffees. Ashima decides to randomly draw a toffee from the bag. She wants to find the chances of picking a toffee of specific colour and asks the following questions :

(i) What is the probability of getting a green toffee ? *1*

(ii) What is the probability of getting a blue toffee ? *1*

(iii) (a) What is the probability of getting a non-red toffee ? *2*

OR

(b) What is the probability of getting a red or a green toffee ? *2*

Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
SECONDARY SCHOOL SUPPLEMENTARY EXAMINATION, 2025
SUBJECT NAME : MATHEMATICS (BASIC) (SUB. CODE-241)

General Instructions: -

1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	**"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, evaluation done and several other aspects. It's leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc. may invite action under various rules of the Board and IPC."**
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them.**
4	The Marking scheme carries only suggested value points for the answers. These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after deliberation and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark (✓) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right (✓) while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
11	A full scale of marks _____ (example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).This is in view of the reduced syllabus and number of questions in question paper.

13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
	● Leaving answer or part thereof unassessed in an answer book.
	● Giving more marks for an answer than assigned to it.
	● Wrong totaling of marks awarded on an answer.
	● Wrong transfer of marks from the inside pages of the answer book to the title page.
	● Wrong question wise totaling on the title page.
	● Wrong totaling of marks of the two columns on the title page.
	● Wrong grand total.
	● Marks in words and figures not tallying/not same.
	● Wrong transfer of marks from the answer book to online award list.
	● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
	● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
14	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0) Marks.
15	Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for spot Evaluation**" before starting the actual evaluation.
17	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

Set 430/S/1
MARKING SCHEME MATHEMATICS (BASIC)

SECTION A

*This section comprises **20** Multiple Choice Questions (MCQs) carrying **1** mark each.*   *20×1=20*

1. If the first term of an A.P. is 'a' and its common difference is 'b', then its 10th term is :

    (A)   a + 10b   (B)   10a + b

    (C)   a + 9b   (D)   9a + b

Ans: (C) a + 9b	1

2. If the point $(3, \frac{3}{4})$ is the mid-point of the line segment joining the points

    $(k, 0)$ and $(7, \frac{3}{2})$, then the value of 'k' is :

    (A)   – 1   (B)   1

    (C) $\frac{3}{2}$ (D)   5

Ans: (A) - 1	1

3. The area of a sector of a circle with radius 7 cm, when the angle of the sector is 60°, is :
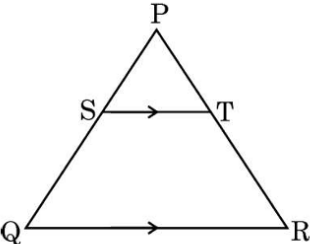
    (A) $\frac{22}{3}$ sq cm   (B) $\frac{77}{3}$ sq cm

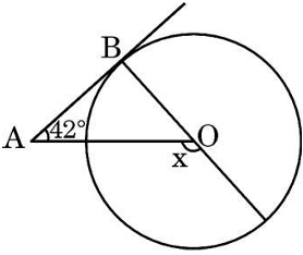   (C) $\frac{44}{7}$ sq cm   (D) $\frac{132}{7}$ sq cm

|	
Ans: (B) $\frac{77}{3}$ sq. cm.	1

4. Two different coins are tossed together. The probability of getting exactly one tail is :

    (A) $\frac{1}{4}$ (B) $\frac{1}{2}$

    (C) $\frac{3}{4}$ (D)   1

Ans: (B) $\frac{1}{2}$	1

5. In the given figure, in Δ PQR, ST ‖ QR. If PS = 16 mm and PQ = 40 mm, then PT : TR is :

(A) 2 : 3   (B) 3 : 2
(C) 2 : 5   (D) 5 : 2

Ans: (A) 2 : 3	1

6. Which of the following is an ***incorrect*** statement ?
(A) Two congruent triangles are also similar.
(B) A square and a rhombus are not similar.
(C) Two triangles are similar if their corresponding sides are proportional.
(D) Two polygons are similar if and only if their corresponding sides are in proportion.

Ans: (D) Two polygons are similar if and only if their corresponding sides are in proportion	1

7. The value of $\dfrac{1 - \tan^2 45°}{1 + \tan^2 45°}$ is equal to the value of :

(A) tan 30°   (B) tan 60°
(C) tan 90°   (D) tan 0°

Ans: (D) tan 0°	1

8. The empirical relationship between the three measures of central tendency is :
(A) 3 Median = Mode + 2 Mean
(B) 3 Median = Mode – 2 Mean
(C) 3 Mode = Median + 2 Mean
(D) 3 Mean = Mode – 2 Median

Ans: (A) 3 Median = Mode + 2 Mean	1

9. A fair die is thrown once. The probability of getting an even number less than 3 is :

(A) $\frac{1}{6}$ (B) $\frac{1}{3}$

(C) $\frac{1}{2}$ (D) 0

Ans: (A) $\frac{1}{6}$ 1

10. The probability of the happening of an event is 'p' and the probability of non-happening of the same event is 'q'. The relation between 'p' and 'q' is :

(A) p + q + 1 = 0   (B) p = q − 1

(C) p + q = 1   (D) p = 1, q = 1

Ans: (C) p + q = 1   1

11. If α and β are the zeroes of the polynomial $p(x) = 2x^2 + 6x - 6$, then the value of $\frac{1}{\alpha} + \frac{1}{\beta}$ is equal to :

(A) − 1   (B) 1

(C) − 3   (D) 3

Ans: (B) 1   1

12. In the given figure, AB is a tangent to the circle with centre O. If $\angle BAO = 42°$, then the value of x is :

(A) 42°   (B) 38°

(C) 48°   (D) 132°

Ans: (D) 132°   1

13. The distance between two parallel tangents to a circle of radius 3·5 cm is :

(A) 3·5 cm   (B) 14 cm

(C) 1·75 cm   (D) 7 cm

Ans: (D) 7 cm   1

14. Which of the following is *not* the graph of a quadratic polynomial ?

(A)

(B)

(C)

(D)
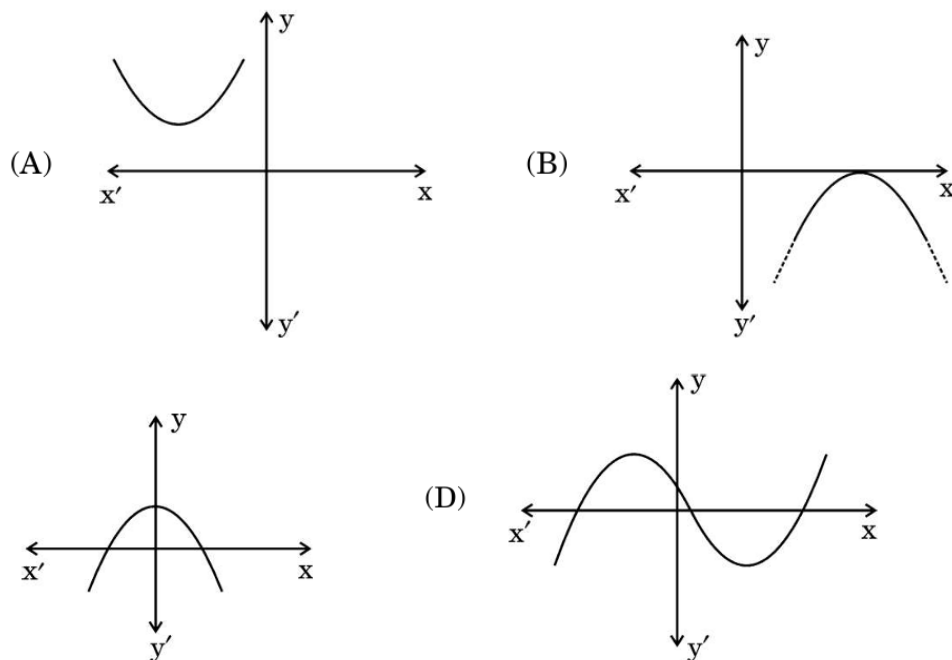
Ans: (D)   1

15. If the quadratic equation $ax^2 + ax + c = 0$ $(a \neq 0)$ has real and equal roots, then :

(A) $a = 4c$ (B) $4a = c$

(C) $a = -4c$ (D) $c = -4a$

Ans: (A) $a = 4c$ 1

16. The next term of the A.P. $\sqrt{5}$, $\sqrt{20}$, $\sqrt{45}$, ... is :

(A) $\sqrt{60}$ (B) $4\sqrt{5}$

(C) $\sqrt{75}$ (D) $\sqrt{125}$

Ans: (B) $4\sqrt{5}$ 1

17. The solution of the pair of linear equations $3x + 4y = 5$; $4x + 3y = 9$ is :

(A) $x = -3, y = 1$

(B) $x = 3, y = 1$

(C) $x = 3, y = -1$

(D) $x = -3, y = -1$

Ans: (C) $x = 3, y = -1$ 1

18. If $x \tan 45° \cos 60° = \sqrt{3} \sin 60° \cot 60°$, then the value of x is :

(A) 1

(B) $\dfrac{1}{\sqrt{3}}$

(C) $\sqrt{3}$

(D) $\dfrac{\sqrt{3}}{2}$

Ans: (C) $\sqrt{3}$	1

Questions number 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is **not** the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* Area of a sector of a circle with radius r and angle with degree measure θ is $\dfrac{\theta}{360} \times 2\pi r$.

Reason (R) : Area of segment of a circle =
Area of the corresponding sector – Area of the corresponding triangle.

Ans: (D) Assertion (A) is false, but Reason (R) is true.	1

20. *Assertion (A) :* If two triangles are equiangular, then they are similar.

Reason (R) : If two triangles are similar, then they are congruent.

Ans: (C) Assertion (A) is true, but Reason (R) is false.	1

SECTION B

*This section comprises **5** Very Short Answer (VSA) type questions carrying **2** marks each.*   5×2=10

21. In a school, there are two Sections A and B of Class X. There are 48 students in Section A and 36 students in Section B. Determine the minimum number of books required for their class library so that they can be distributed equally among the students of Section A or that of Section B.

Solution: $48 = 2 \times 2 \times 2 \times 2 \times 3$	½
$36 = 2 \times 2 \times 3 \times 3$	½
LCM of (48, 36) = $2 \times 2 \times 2 \times 2 \times 3 \times 3 = 144$	1
Minimum number of books required for their class library so that they can be distributed equally among the students of Section A or that of Section B are 144	

22. (a) Find the zeroes of the polynomial $7y^2 - \dfrac{11}{3}y - \dfrac{2}{3}$.

OR

(b) Find a quadratic polynomial in x, whose one zero is 15 and sum of the zeroes is 42.

Solution: (a) Let $p(y) = 7y^2 - \dfrac{11}{3}y - \dfrac{2}{3}$	
$= \dfrac{1}{3}[21y^2 - 11y - 2]$	
$= \dfrac{1}{3}(3y - 2)(7y + 1)$	1
$\Rightarrow y = \dfrac{2}{3}, \dfrac{-1}{7}$	½ + ½
$\therefore$ Zeroes of the polynomial are $\dfrac{2}{3}, \dfrac{-1}{7}$	
OR	
(b) Other zero = 42 − 15 = 27	½
Product of zeroes = (15)(27) = 405	½

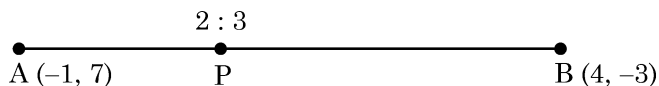|	
$\therefore$ Quadratic polynomial is f(x) = $x^2 - 42x + 405$	1

23. (a) Find the coordinates of the point which divides the join of $(-1, 7)$ and $(4, -3)$ in the ratio $2 : 3$.

OR

(b) Using distance formula, prove that the points A(3, 1), B(6, 4) and C(8, 6) are collinear.

Solution: (a)

2 : 3

A (–1, 7)   P   B (4, –3)

Let P (x, y) divides AB in the ratio 2: 3 internally

$$x = \frac{2(4) + 3(-1)}{2 + 3} = 1$$ 1

$$y = \frac{2(-3) + 3(7)}{2 + 3} = 3$$ 1

$\therefore$ Coordinate of the point P (1, 3)

OR

(b)

$$AB = \sqrt{18} = 3\sqrt{2}$$ ½

$$BC = \sqrt{8} = 2\sqrt{2}$$ ½

$$AC = \sqrt{50} = 5\sqrt{2}$$ ½

$$3\sqrt{2} + 2\sqrt{2} = 5\sqrt{2}$$

$$AB + BC = AC$$ ½
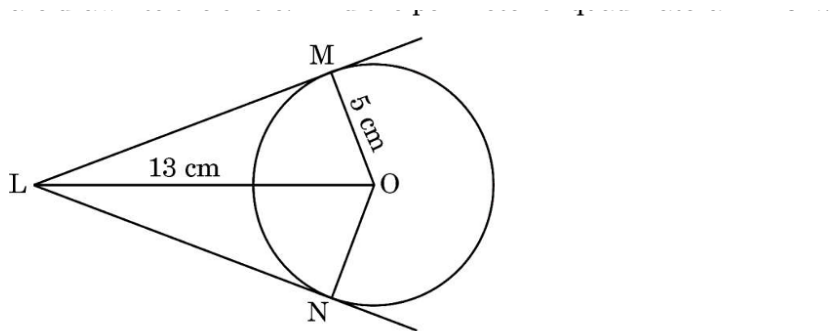
$\Rightarrow$ A, B and C are collinear.

24. In the given figure, from a point L which is at a distance of 13 cm from the centre O of a circle of radius 5 cm, the pair of tangents LM and LN are drawn to the circle. Find the perimeter of quadrilateral LMON.
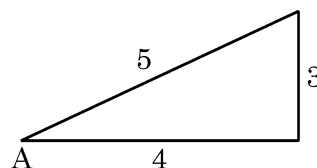
M

5 cm

L 13 cm O

N

Solution: In Δ OLM, $\angle$OML $= 90°$

$\therefore$ LM $= \sqrt{(13)^2 - (5)^2} = 12$ (By Pythagoras. theorem)   **1**

LM $=$ LN $= 12$ cm (tangents from external point to the circle are equal in length)

OM $=$ ON $= 5$ cm

$\therefore$ Perimeter of quadrilateral LMON $= 12 + 12 + 5 + 5 = 34$ cm.   **1**

---

25.   If $3 \cot A = 4,$ then determine the value of $\cos^2 A - \sin^2 A.$

Solution:

$\cos^2 A - \sin^2 A = \left(\dfrac{4}{5}\right)^2 - \left(\dfrac{3}{5}\right)^2$

$= \dfrac{7}{25}$

A   4

5   3

½ + ½

1

SECTION C

*This section comprises **6** Short Answer (SA) type questions carrying **3** marks each.*   *6×3=18*

26.   (a)   Solve the following system of linear equations :

$\dfrac{x}{a} - \dfrac{y}{b} = 0; \ ax + by = a^2 + b^2$

OR

(b)   For what value of 'p' will the following system of linear equations have ***no*** solution ?

$(2p - 1)x + (p - 1)y = 2p + 1$

$3x + y = 1$

Solution: (a) Solving the given equations to get x $=$ a

and y $=$ b   1½

1½

OR

(b)

For no solution,

$\dfrac{2p - 1}{3} = \dfrac{p - 1}{1} \neq \dfrac{2p + 1}{1}$ 1

$\dfrac{2p - 1}{3} = \dfrac{p - 1}{1} \Rightarrow p = 2$ and $\dfrac{p - 1}{1} \neq \dfrac{2p + 1}{1} \Rightarrow p \neq -2$ 2

27. If the point Q(0, 1) is equidistant from points P(5, − 3) and R(x, 6), then find the value/s of x. Also, find the distance QR and PR.

Solution:

PQ = RQ

$$\sqrt{(5-0)^2 + (-3-1)^2} = \sqrt{(x-0)^2 + (6-1)^2}$$

$$\sqrt{25 + 16} = \sqrt{x^2 + 25}$$

Squaring both sides,

$$41 = (x)^2 + 25$$

$$(x)^2 = 16$$

$$x = 4, -4$$

1

R (4, 6) or R (−4, 6)

When $x = 4$:

$$QR = \sqrt{41}$$

$$PR = \sqrt{82}$$

1

When $x = -4$:

$$QR = \sqrt{41}$$

$$PR = \sqrt{162} \; or \; 9\sqrt{2}$$

1

28. Prove that :

$$\frac{\sin\theta - 2\sin^3\theta}{2\cos^3\theta - \cos\theta} = \tan\theta$$

Solution: LHS = $\dfrac{\sin\theta - 2\sin^3\theta}{2\cos^3\theta - \cos\theta}$

$$= \frac{\sin\theta\,(1 - 2\sin^2\theta)}{\cos\theta\,(2\cos^2\theta - 1)}$$

1

$$= \frac{\sin\theta\,(1 - 2\sin^2\theta)}{\cos\theta\,[2(1 - \sin^2\theta) - 1]}$$

1

$$= \frac{\sin \theta \, (1 - 2 \sin^2 \theta)}{\cos \theta \, (2 - 2 \sin^2 \theta - 1)}$$

$$= \frac{\sin \theta \, (1 - 2 \sin^2 \theta)}{\cos \theta \, (1 - 2 \sin^2 \theta)} = \tan \theta = \text{RHS}$$

1

---

29. (a) The length of the minute-hand of a clock is 14 cm. Find the area swept by this minute-hand in 5 minutes.

OR

(b) To warn ships for underwater rocks, a lighthouse throws a red coloured light over a sector of central angle 80° up to a distance of 16·5 km. Find the area of the sea over which the ships are warned.

Solution: (a) Angle made by minute hand in 5 minutes $= \frac{360}{60} \times 5 = 30°$

$\therefore \ \theta = 30°$

1

Length of minute hand = radius = 14 cm

Area swept by minute hand in 5 minutes = Area of sector $= \frac{\pi r^2 \theta}{360°}$

$$= \frac{22}{7} \times 14 \times 14 \times \frac{30}{360}$$

1

$$= \frac{154}{3} \text{ cm}^2 \text{ or } 51.33 \text{ cm}^2$$

1

OR

(b) $\theta = 80°, \ r = 16.5 \text{ km}.$

Area of the sea $= \frac{\pi r^2 \theta}{360°}$

$$= \frac{22}{7} \times 16.5 \times 16.5 \times \frac{80}{360}$$

2

$$= \frac{1331}{7} \text{ km}^2 \text{ or } 190.14 \text{ km}^2$$

1

30. The following table shows the marks obtained by 110 students of class X in a school during a particular academic session. Find the mode of the distribution.

Marks Obtained :	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
Number of Students :	21	25	30	24	10

Solution: Modal Class is $40 - 60$

$l = 40,\ f_1 = 30,\ f_0 = 25,\ f_2 = 24,\ h = 20$

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

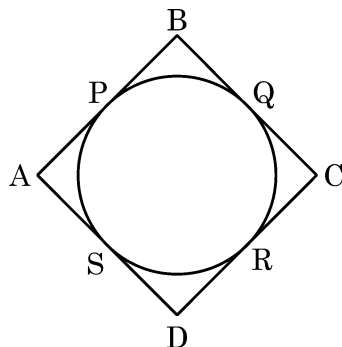$$= 40 + \left(\frac{30 - 25}{60 - 25 - 24} \right) \times 20$$

$$= 40 + 9.1 = 49.1$$

2½

½

31. Prove that the parallelogram circumscribing a circle is a rhombus.

Solution:

The lengths of tangents drawn from an external point to a circle are equal.

∴   AP = AS   (i)

       BP = BQ   (ii)

       CR = CQ   (iii)

       DR = DS   (iv)

Adding (i), (ii), (iii) and (iv)

AP + BP + CR + DR = AS + BQ + CQ + DS

∴   AB + CD = AD + BC

$\Rightarrow 2AB = 2\,BC$ [As ABCD is parallelogram ∴ AB = CD, AD = BC]

$\Rightarrow AB = BC$

1

1

$\therefore$ AB = BC = CD = DA

$\therefore$ Parallelogram ABCD is a rhombus.   } 1

SECTION D

This section comprises 4 Long Answer (LA) type questions carrying 5 marks each.   *4×5=20*

32. (a) An aeroplane when flying at a height of 5000 m above the ground passes vertically above another aeroplane at an instant when the angles of elevation of the two planes from a point on the ground are 60° and 45° respectively. Find the vertical distance between the aeroplanes at that instant. [Use $\sqrt{3}$ = 1·732]

OR

(b) A TV tower stands vertically on a bank of a canal. From a point on the other bank directly opposite the tower, the angle of elevation of the top of the tower is 60°. From a point 20 m away from this point on the same bank, the angle of elevation of the top of the tower is 30°. Find the height of the tower and the width of the canal. [Use $\sqrt{3}$ = 1·73]

Solution: (a)
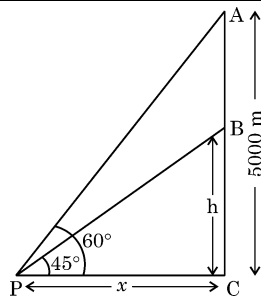
| | 1 For Figure |

Let A and B be the positions of two aeroplanes.

Let BC = h, PC = x

In right Δ BCP,

$\tan 45° = \dfrac{h}{x}$ $\Rightarrow x = h$ --- (i)   **1½**

In right Δ ACP,

$\tan 60° = \dfrac{5000}{x}$ $\Rightarrow$ $\sqrt{3}\,x = 5000$

$\sqrt{3}$ h = 5000 (using (i) x = h)

h = $\dfrac{5000}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{5000\sqrt{3}}{3}$ **1½**
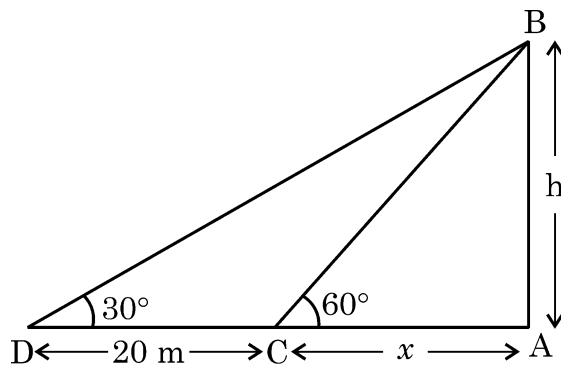
∴ Vertical distance between aeroplanes = AB = 5000 – h

$$= 5000 - \dfrac{5000\sqrt{3}}{3}$$

$$= 5000 - \dfrac{5000\,(1.732)}{3}$$

$$= 2113.33 \text{ m}$$ **1**

OR

(b)

In right Δ BAC, $\dfrac{\text{h}}{x}$ = tan 60° ⇒ h = $\sqrt{3}\,x$ (i)   **1½**

In right Δ BAD, $\dfrac{\text{h}}{20 + x}$ = tan 30°

$\sqrt{3}$ h = 20 + x

$\sqrt{3}\,(\sqrt{3}x)$ = 20 + x (Using (i) h = $\sqrt{3}\,x$)

3x = 20 + x

x = 10 m   **1½**

∴ Width of canal = 10 m.

Height of tower   h = $\sqrt{3}\,x$

h = $10\sqrt{3}$ m

h = 10(1.73) = 17.3 m   **1**

1
For
Figure

33. **(a)** In a class test, the sum of marks obtained by Ananya in Mathematics and Science is 28. Had she got 3 marks more in Mathematics and 4 marks less in Science, the product of marks obtained in the two subjects would have been 180. Find the marks obtained in the two subjects separately.

OR

(b) Solve for x :

$$\frac{150}{x} + x + 18 = 10x + \frac{15}{x}; \quad x \neq 0$$

Solution: (a)

Let marks obtained by Ananya in Mathematics be x
Sum of marks = 28
∴ Marks in Science = $28 - x$

ATQ
$(x + 3)(28 - x - 4) = 180$ | **2**
$\quad (x + 3)(24 - x) = 180$
$\quad x^2 - 21x + 108 = 0$
$\quad (x - 12)(x - 9) = 0$ | **1**
$\quad x = 12, 9$ | **1**
If Marks in Mathematics = 12
then Marks in Science = $28 - 12 = 16$ | **½**
If Marks in Mathematics = 9

then Marks in Science = $28 - 9 = 19$ | **½**

OR

(b)

$$\frac{150}{x} + x + 18 = 10x + \frac{15}{x}$$ | **2**

$9x^2 - 18x - 135 = 0$ or $x^2 - 2x - 15 = 0$ | **2**

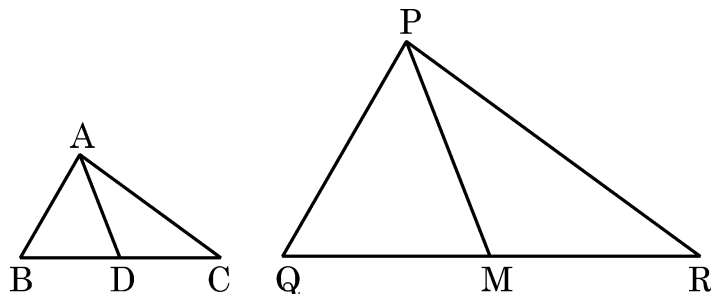$\quad (x - 5)(x + 3) = 0$

$\quad x = 5, -3$ | **1**

34. If AD and PM are medians of triangles ABC and PQR respectively, where $\triangle ABC \sim \triangle PQR$, then prove that $\dfrac{AB}{PQ} = \dfrac{AD}{PM}$.

Solution:

Given: AD and PM are medians of $\triangle ABC$ and $\triangle PQR$ respectively.

Also $\triangle ABC \sim \triangle PQR$

To Prove: $\dfrac{AB}{PQ} = \dfrac{AD}{PM}$

Proof:

$\triangle ABC \sim \triangle PQR$

$\Rightarrow \dfrac{AB}{PQ} = \dfrac{BC}{QR}$ **1**

$\dfrac{AB}{PQ} = \dfrac{\frac{1}{2}\,BC}{\frac{1}{2}\,QR}$

$\dfrac{AB}{PQ} = \dfrac{BD}{QM}$ ($\because$ D is midpoint of BC and M is midpoint of QR) **1**

In $\triangle ABD$ and $\triangle PQM$,

$\angle B = \angle Q$ ($\because \triangle ABC \sim \triangle PQR$)

$\dfrac{AB}{PQ} = \dfrac{BD}{QM}$ (Proved above)

$\therefore \triangle ABD \sim \triangle PQM$ (SAS similarity)

$\therefore$ Their corresponding sides are proportional **2**

$\Rightarrow \dfrac{AB}{PQ} = \dfrac{AD}{PM}$ Hence proved **1**

35. A tent is in the shape of a cylinder surmounted by a conical top of same radius. If the height and diameter of the cylindrical part are 2·1 m and 4 m respectively, and the slant height of the top is 2·8 m, find the area of the canvas used for making the tent. Also, find the cost of the canvas of the tent at the rate of ₹ 500 per m².

Solution:(a)

Radius of cone = radius of cylinder = $\frac{4}{2}$ m = 2 m

Slant height of cone = 2.8 m

Height of cylinder = 2.1 m

Surface Area of the tent = Surface area of cone + Surface area of cylinder

$$= \pi rl + 2\pi rh$$

$$= \pi r(l + 2h) = \frac{22}{7} \times 2 \,[2.8 + 2 \times 2.1]$$

1½+1½

$$= 44 \text{ m}^2$$

1

Cost of canvas of tent at the rate of ₹ 500 per m² = 44 × 500 = ₹ 22,000

1

SECTION E

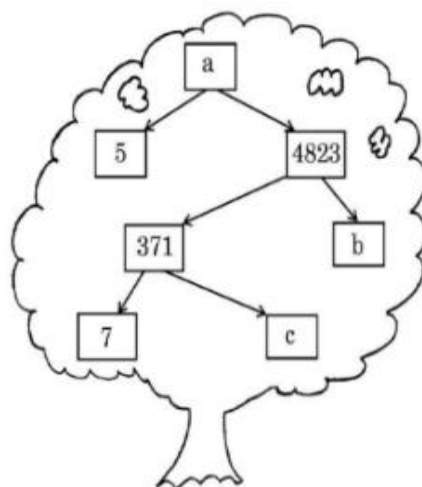*This section comprises **3** case study based questions carrying **4** marks each.*   *3×4=12*

Case Study – 1

36. A Mathematics exhibition is being conducted in your school and one of your friends is making a model of a 'factor tree'. He has some difficulty and asks for your help in completing a quiz for the audience.

Observe the following 'factor tree' and answer the following questions :

(i)   What is the value of a ?   *1*

(ii)   (a)   What is the value of b ?   *2*

                   OR

       (b)   What is the value of c ?   *2*

(iii)   Write the prime factorisation of 24115.   *1*

Solution:	
(i) $a = 5 \times 4823 = 24115$	1

(ii)   (a) $4823 = 371 \times b$
 	
         $b = \dfrac{4823}{371} = 13$
             OR
	2

(ii) (b) $371 = 7 \times c$ $c = \dfrac{371}{7} = 53$	2
(iii) $24115 = 5 \times 7 \times 13 \times 53$	1

Case Study – 2

37.   In a charming village, there is a street called 'Maplewood Avenue', where the houses are numbered from 1 to 49. A community group has decided to undertake a green renovation project, aiming to install solar panels on the houses.

They have a few questions before they begin the project.

(i)   How many houses are there on 'Maplewood Avenue' ?   *1*

(ii) The house numbers follow an Arithmetic Progression. What is the
      first term of the A.P. and the common difference ?   *1*

(iii) (a)   If the group wanted to calculate the sum of all house
            numbers from 1 to 49, how much would that be ?   *2*

            OR

      (b)   What is the sum of the house numbers between 15 and 30 ?   *2*

Solution: (i) 49 houses   1

   (ii) First term 'a' = 1, common difference = 1   1

   (iii) (a)   Sum (S_{49}) $= \dfrac{n}{2} [a + l]$

$$= \dfrac{49}{2} [1 + 49]$$ 1½

$$= 1225$$ ½

            OR

   (iii) (b)   Sum of house numbers between 15 & 30

            16 + 17 + 18 + ... + 29

$$= \dfrac{n}{2} [2a + (n - 1) d] = \dfrac{14}{2} [2 \times 16 + 13]$$ 1½

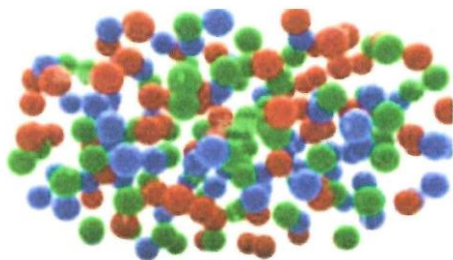$$= 315$$ ½

Case Study – 3

38. Aarav and Ashima are brother and sister and on Ashima's birthday, Aarav gifts her a bag filled with 8 red toffees, 10 green toffees and 6 blue toffees. Ashima decides to randomly draw a toffee from the bag. She wants to find the chances of picking a toffee of specific colour and asks the following questions :

(i)	What is the probability of getting a green toffee ?	*1*
(ii)	What is the probability of getting a blue toffee ?	*1*
(iii)	(a) What is the probability of getting a non-red toffee ?	*2*
	OR	
	(b) What is the probability of getting a red or a green toffee ?	*2*

Solution: (i) P (green toffee) = $\dfrac{10}{24}$ *or* $\dfrac{5}{12}$	1
(ii) P (blue toffee) = $\dfrac{6}{24}$ *or* $\dfrac{1}{4}$	1
	2
(iii) (a) P (non-red toffee) = $\dfrac{10+6}{24}$ = $\dfrac{16}{24}$ *or* $\dfrac{2}{3}$	
OR	
(iii) (b) P (Red or Green toffee) = $\dfrac{8+10}{24}$ = $\dfrac{18}{24}$ *or* $\dfrac{3}{4}$	2