Series : L3NMK **SET ~ 2**

प्रश्न-पत्र कोड
Q.P. Code **30/3/2**

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 / NOTE :

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **27** हैं।
Please check that this question paper contains **27** printed pages.

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें।
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) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **38** प्रश्न हैं।
Please check that this question paper contains **38** questions.

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें।**
Please write down the Serial Number of the question in the answer-book at the given place before attempting it.

(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।
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 (मानक)

MATHEMATICS (STANDARD)

*निर्धारित समय : **3** घण्टे* *अधिकतम अंक : **80***
*Time allowed : **3** hours* *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. दिया गया है कि $\sin 2\alpha = \frac{\sqrt{3}}{2}$ है। $\sin 3\alpha$ का मान है :

(A) $\frac{3\sqrt{3}}{4}$ (B) $\frac{1}{2}$

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

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 $\pi = \frac{22}{7}$ wherever required, if not stated.*

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

SECTION A

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

1. Given that $\sin 2\alpha = \frac{\sqrt{3}}{2}$, the value of $\sin 3\alpha$ is :

(A) $\frac{3\sqrt{3}}{4}$ (B) $\frac{1}{2}$

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

2. एक बंटन के माध्यक तथा बहुलक क्रमश: 25·2 तथा 26·1 हैं। इस बंटन का माध्य है :

(A) 24·75

(B) 24·25

(C) 24·3

(D) 25·5

3. यदि किसी मीनार की छाया की लम्बाई उसकी ऊँचाई की $\sqrt{3}$ गुना है, तो सूर्य का उन्नतांश है :

(A) 45° (B) 30°

(C) 60° (D) 15°

4. यदि द्विघात समीकरण $\sqrt{3}x^2 - kx + 2\sqrt{3} = 0$ के मूल वास्तविक तथा समान हैं, तो k का मान है :

(A) $\pm \sqrt{24}$ (B) 0

(C) 4 (D) – 5

5. दिया गया है कि $\Delta ABC \sim \Delta QRP$ है जहाँ AB = 9 cm, BC = 5 cm तथा PR = 2 cm है। भुजा QR की लम्बाई है :

(A) 0·9 cm (B) $\frac{5}{18}$ cm

(C) $\frac{10}{9}$ cm (D) 3·6 cm

6. द्विघात बहुपद p(x) के शून्यकों का योगफल तथा गुणनफल क्रमश: $\frac{-1}{3}$ तथा 2 है। बहुपद p(x) है :

(A) $3x^2 - x + 6$

(B) $x^2 + \frac{1}{3}x - 2$

(C) $3x^2 - x + 2$

(D) $-3x^2 - x - 6$

2. The median and mode of a distribution are 25·2 and 26·1 respectively. The mean of the distribution is :

(A) 24·75

(B) 24·25

(C) 24·3

(D) 25·5

3. If the length of the shadow of a tower is $\sqrt{3}$ times that of its height, then altitude of the Sun is :

(A) 45° (B) 30°

(C) 60° (D) 15°

4. If the roots of the quadratic equation $\sqrt{3}x^2 - kx + 2\sqrt{3} = 0$ are real and equal, then the value(s) of k is/are :

(A) $\pm \sqrt{24}$ (B) 0

(C) 4 (D) – 5

5. It is given that $\Delta ABC \sim \Delta QRP$ such that AB = 9 cm, BC = 5 cm and PR = 2 cm. Length of side QR is :

(A) 0·9 cm (B) $\frac{5}{18}$ cm

(C) $\frac{10}{9}$ cm (D) 3·6 cm

6. The sum and product of zeroes of a quadratic polynomial p(x) are $\frac{-1}{3}$ and 2 respectively. The polynomial p(x) is :

(A) $3x^2 - x + 6$

(B) $x^2 + \frac{1}{3}x - 2$

(C) $3x^2 - x + 2$

(D) $-3x^2 - x - 6$

7. द्विघात समीकरण $4x^2 - (a - 1)^2 = 0$ के मूल हैं :

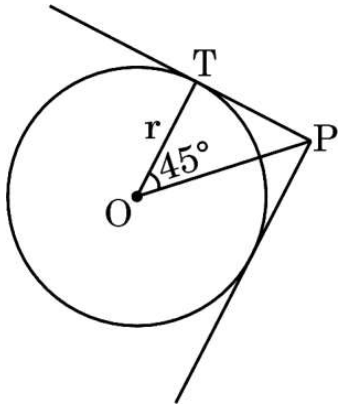
(A) $a - 1, a + 1$

(B) $\frac{a-1}{2}, \frac{-a+1}{2}$

(C) $\frac{a-1}{2}, \frac{-a-1}{2}$

(D) $\pm (a - 1)$

8. दी गई आकृति में, केन्द्र O तथा त्रिज्या r वाले वृत्त पर खींची गई स्पर्श रेखा PT है । यदि $\angle POT = 45°$ है, तो OP की लम्बाई है :



(A) $r\sqrt{2}$ (B) $\sqrt{2r}$

(C) $2r$ (D) r^2

9. तीन सिक्कों को एक साथ उछाला गया । केवल एक चित्त आने की प्रायिकता है :

(A) $\frac{1}{8}$ (B) $\frac{3}{4}$

(C) $\frac{1}{2}$ (D) $\frac{3}{8}$

10. 12 तथा 250 के बीच की संख्याओं में 4 के गुणजों की संख्या है :

(A) 59 (B) 59·5

(C) 60 (D) 61

11. $\left(\frac{1}{3}\cot^2 30° - \frac{1}{2}\sec^2 60°\right)$ का मान है :

(A) -1 (B) -2

(C) $\frac{5}{8}$ (D) $\frac{7}{8}$

7. The roots of the quadratic equation $4x^2 - (a - 1)^2 = 0$ are :

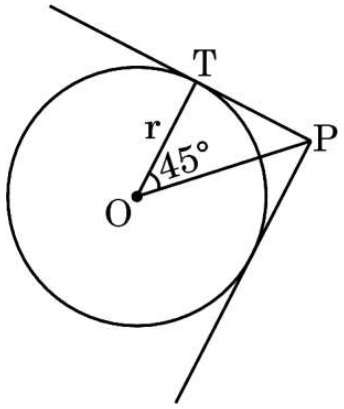
(A) $a - 1, a + 1$

(B) $\frac{a-1}{2}, \frac{-a+1}{2}$

(C) $\frac{a-1}{2}, \frac{-a-1}{2}$

(D) $\pm (a - 1)$

8. In the given figure, PT is a tangent to the circle with centre O and radius r. If $\angle POT = 45°$, then the length of OP is :



(A) $r\sqrt{2}$ (B) $\sqrt{2r}$

(C) $2r$ (D) r^2

9. Three coins are tossed together. The probability of getting exactly one head, is :

(A) $\frac{1}{8}$ (B) $\frac{3}{4}$

(C) $\frac{1}{2}$ (D) $\frac{3}{8}$

10. The number of multiples of 4 lying between 12 and 250 is :

(A) 59 (B) 59·5

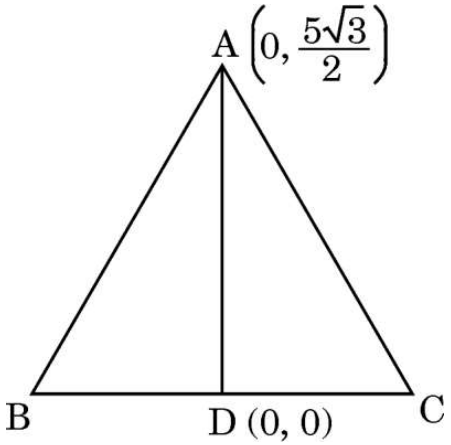
(C) 60 (D) 61

11. The value of $\left(\frac{1}{3}\cot^2 30° - \frac{1}{2}\sec^2 60°\right)$ is :

(A) -1 (B) -2

(C) $\frac{5}{8}$ (D) $\frac{7}{8}$

12. दी गई आकृति में, Δ ABC एक समबाहु त्रिभुज है। बिंदुओं A$\left(0, \frac{5\sqrt{3}}{2}\right)$ तथा D(0, 0) को जोड़ने वाली माध्यिका AD है। बिंदु B तथा C के निर्देशांक (इसी क्रम में) हैं :



(A) (– 5, 0), (5, 0)

(B) $\left(-\frac{5}{2}, 0\right), \left(\frac{5}{2}, 0\right)$

(C) (– 10, 0), (10, 0)

(D) $(-5\sqrt{3}, 0), (5\sqrt{3}, 0)$

13. समांतर श्रेढ़ी (A.P.) $\frac{-1}{3}, \frac{2}{3}, \frac{5}{3}, \frac{8}{3}, \ldots$ का nवाँ पद है :

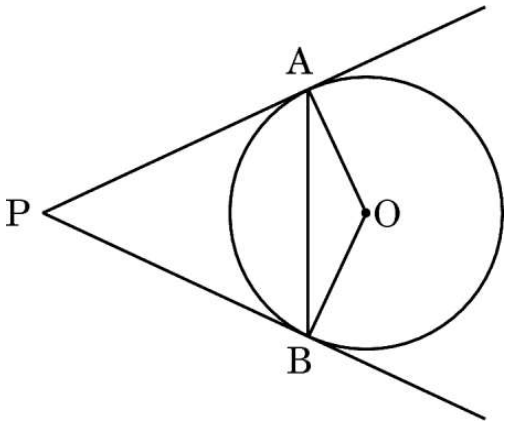
(A) $3n - 4$

(B) $n - \frac{4}{3}$

(C) $\frac{n-2}{3}$

(D) $\frac{n-4}{3}$

14. केन्द्र O वाले वृत्त पर खींची गई दो स्पर्श रेखाएँ PA तथा PB हैं। यदि $\angle$ PBA = 65° है, तो $\angle$ APB का मान है :



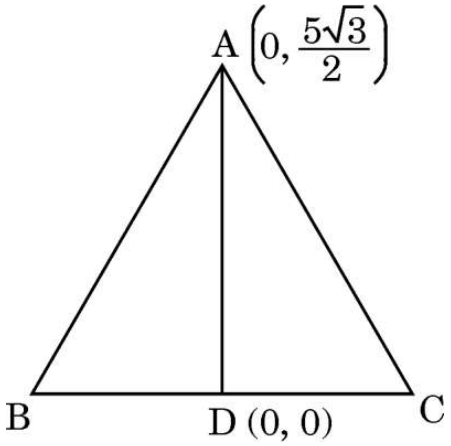
(A) 65°

(B) 60°

(C) 50°

(D) 35°

12. In the given figure, Δ ABC is an equilateral triangle. AD is a median of the triangle joining the points $A\left(0, \frac{5\sqrt{3}}{2}\right)$, D(0, 0). Points B and C are (in same order) :



(A) (– 5, 0), (5, 0)

(B) $\left(-\frac{5}{2}, 0\right), \left(\frac{5}{2}, 0\right)$

(C) (– 10, 0), (10, 0)

(D) $(-5\sqrt{3}, 0), (5\sqrt{3}, 0)$

13. The n^{th} term of the A.P. $\frac{-1}{3}, \frac{2}{3}, \frac{5}{3}, \frac{8}{3}, \ldots$ is :

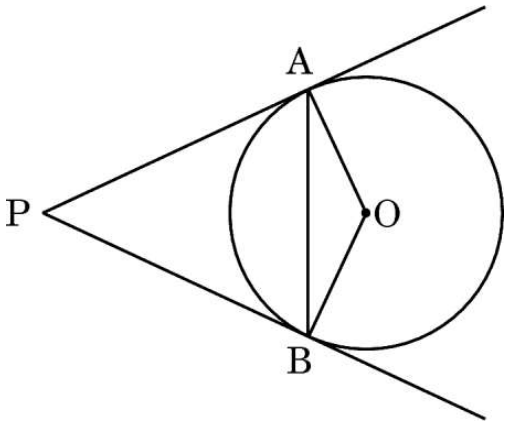
(A) $3n - 4$

(B) $n - \frac{4}{3}$

(C) $\frac{n-2}{3}$

(D) $\frac{n-4}{3}$

14. PA and PB are tangents to a circle centred at O. If ∠ PBA = 65°, then ∠ APB equals :



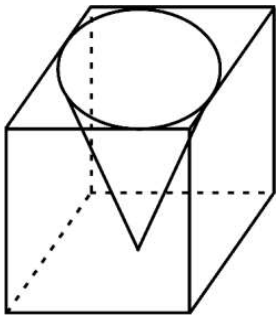
(A) 65°

(B) 60°

(C) 50°

(D) 35°

15. एक ठोस घन में से, जिसके प्रत्येक किनारे की लम्बाई l है, अधिकतम आकार का शंकु खोदकर निकाला जाता है। शंकु का आयतन है :



(A) $\frac{\pi l^3}{12}$ (B) $\frac{\pi l^3}{3}$

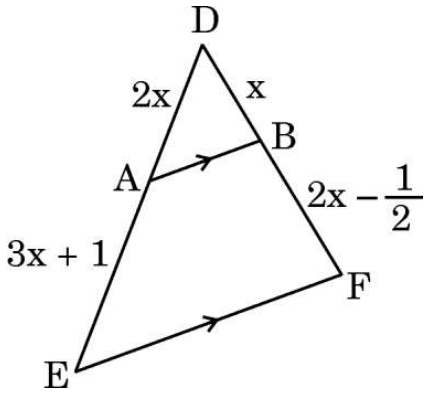
(C) $l^3\left(1-\frac{\pi}{3}\right)$ (D) $\frac{\pi l^3}{8}$

16. समीकरण $2x - 6y = 7$ को निरूपित करने वाली रेखा के समांतर एक अन्य रेखा का समीकरण है :

(A) $y = 3x - 7$ (B) $2x = 9 - 6y$

(C) $x - 3y = 7$ (D) $x = \frac{7}{2} - 3y$

17. त्रिभुज DEF में AB $\parallel$ EF है। x का मान है :



(A) 0, 2 (B) केवल 2

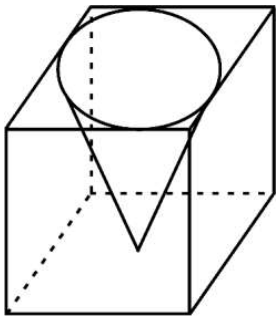
(C) − 2 (D) 1

18. $(3 \times 11 \times 13 + 3)$:

(A) एक अभाज्य संख्या है (B) 13 से विभाजित होती है

(C) एक भाज्य संख्या है (D) एक विषम संख्या है

15. A cone of maximum size is carved out from a solid cube of edge length l. The volume of the cone is :



(A) $\frac{\pi l^3}{12}$ (B) $\frac{\pi l^3}{3}$

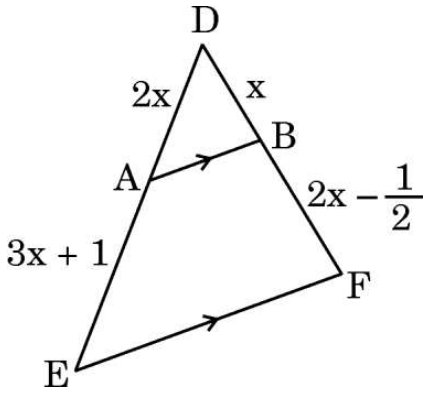
(C) $l^3\left(1-\frac{\pi}{3}\right)$ (D) $\frac{\pi l^3}{8}$

16. Equation of another line parallel to the line represented by $2x - 6y = 7$ is :

(A) $y = 3x - 7$ (B) $2x = 9 - 6y$

(C) $x - 3y = 7$ (D) $x = \frac{7}{2} - 3y$

17. In Δ DEF, AB $\parallel$ EF. The value of x is :



(A) 0, 2 (B) 2 only

(C) – 2 (D) 1

18. $(3 \times 11 \times 13 + 3)$ is :

(A) a prime number (B) divisible by 13

(C) a composite number (D) an odd number

*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) :* किसी वृत्त के केन्द्र से स्पर्श रेखा की न्यूनतम दूरी, त्रिज्या के बराबर होती है।

तर्क (R) : त्रिज्या स्पर्श रेखा के लम्बवत् होती है।

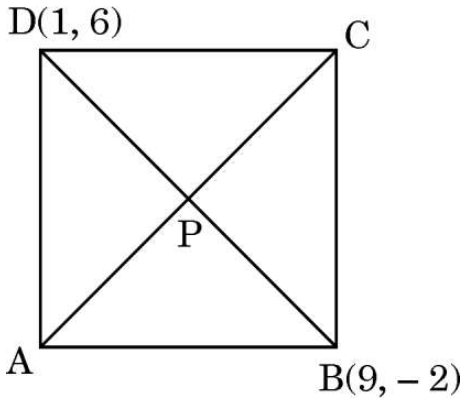
20. *अभिकथन (A) :* $\theta = 45°$ के लिए, $\tan 2\theta$ का मान परिभाषित नहीं है।

तर्क (R) : $\sin 90° \neq \cos 90°$.

खण्ड ख

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

21. (क) वर्ग ABCD के विकर्ण AC तथा BD बिंदु P पर प्रतिच्छेद करते हैं। बिंदु B तथा D के निर्देशांक क्रमश: (9, – 2) तथा (1, 6) हैं।



*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 the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the 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) :* Radius is the smallest distance of a tangent from the centre of the circle.

Reason (R) : Radius is perpendicular to the tangent.

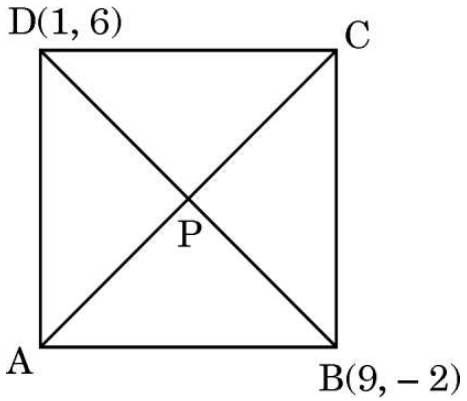
20. *Assertion (A) :* $\tan 2\theta$ is not defined at $\theta = 45°$.

Reason (R) : $\sin 90° \neq \cos 90°$.

SECTION B

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

21. (a) Diagonals AC and BD of square ABCD intersect at P. Coordinates of points B and D are (9, – 2) and (1, 6) respectively.



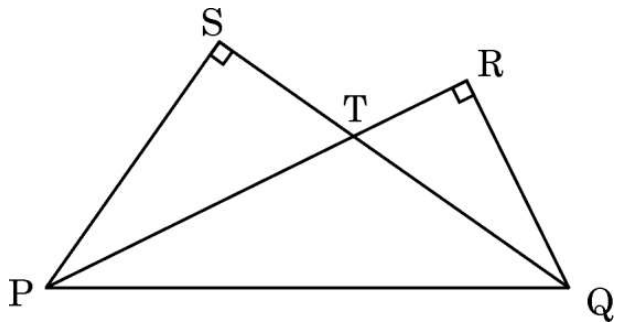
(i) बिंदु P के निर्देशांक ज्ञात कीजिए।

(ii) वर्ग की भुजा की लम्बाई ज्ञात कीजिए।

अथवा

(ख) रेखा $x + y = 5$ पर स्थित उस बिंदु के निर्देशांक बताइए जो (6, 4) तथा (5, 2) से समदूरस्थ हो।

22. कर्ण PQ पर दो समकोण त्रिभुज Δ PSQ तथा Δ PRQ बनाए गए हैं। यदि PR तथा QS बिंदु T पर प्रतिच्छेद करते हैं, तो सिद्ध कीजिए कि $ST \times TQ = PT \times TR$ है।



23. लकड़ी के उस पट्टे (Plank) की लम्बाई बताइए जिसकी सहायता से 4 m 20 cm तथा 5 m 4 cm लम्बाई को न्यूनतम समय में पूरा-पूरा नापा जा सके।

24. (क) एक समांतर श्रेढ़ी (A.P.) में प्रथम पद 32 तथा अन्तिम पद – 10 है। यदि सार्व अन्तर – 2 हो, तो पदों की संख्या एवं उनका योगफल ज्ञात कीजिए।

अथवा

(ख) उस समांतर श्रेढ़ी (A.P.) के प्रथम 28 पदों का योगफल ज्ञात कीजिए जिसका nवाँ पद $a_n = 3n - 2$ है।

25. 0·5 cm त्रिज्या वाली 1000 थर्मोकोल गेंदों को 20 cm त्रिज्या वाले गोलाकार गुब्बारे में भरा गया है। गुब्बारे में मौजूद हवा का आयतन ज्ञात कीजिए।

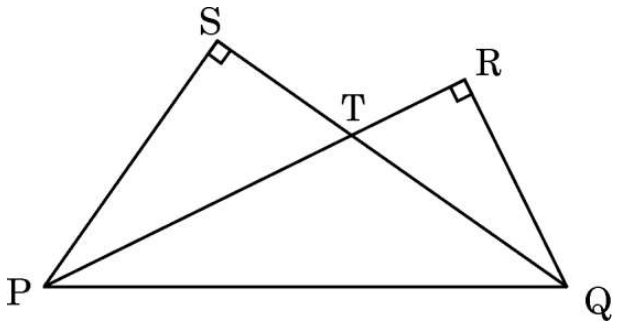
(i) Find the co-ordinates of point P.

(ii) Find the length of the side of the square.

OR

(b) Find the coordinates of a point on the line $x + y = 5$ which is equidistant from (6, 4) and (5, 2).

22. Two right triangles PRQ and PSQ are drawn on the same hypotenuse PQ. If PR and QS intersect at T, prove that $ST \times TQ = PT \times TR$.



23. Find the length of the plank that can be used to measure the lengths 4 m 20 cm and 5 m 4 cm exactly, in the least time.

24. (a) In an A.P., the first term is 32 and the last term is – 10. If the common difference is – 2, then find the number of terms and their sum.

OR

(b) Find the sum of the first 28 terms of an A.P. whose n^{th} term is given by $a_n = 3n - 2$.

25. 1000 small thermocol balls of radius 0·5 cm are kept in a spherical balloon of radius 20 cm. Find the volume of air in the balloon.

खण्ड ग

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

26. दो ऐसे क्रमागत ऋणात्मक पूर्णांक ज्ञात कीजिए जिनके वर्गों का योगफल 481 है।

27. एक बिंदु P, A(– 3, 5) तथा B(7, – 4) को जोड़ने वाले रेखाखंड को एक निश्चित अनुपात में विभाजित करता है। यदि बिंदु P, समीकरण $y = 2x$ द्वारा निरूपित रेखा पर स्थित है, तो अनुपात AP : PB तथा बिंदु P के निर्देशांक ज्ञात कीजिए।

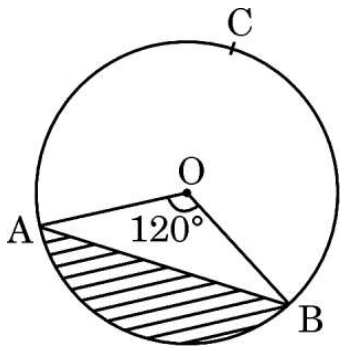
28. (क) यदि $\sin\theta + \cos\theta = \sqrt{3}$ है, तो सिद्ध कीजिए कि $\tan\theta + \cot\theta = 1$ है।

अथवा

(ख) सिद्ध कीजिए :

$$(\sin A + \sec A)^2 + (\cos A + \text{cosec } A)^2 = (1 + \sec A \text{ cosec } A)^2$$

29. दी गई आकृति में, 7 cm त्रिज्या वाले वृत्त के केन्द्र पर जीवा AB 120° का कोण अंतरित करती है। ज्ञात कीजिए (i) दीर्घ त्रिज्यखंड OACB का परिमाप, और (ii) छायांकित भाग का क्षेत्रफल, यदि Δ OAB का क्षेत्रफल $21{\cdot}2\ cm^2$ है।



30. (क) बाह्य बिंदु P से, O केन्द्र वाले वृत्त पर स्पर्श रेखाएँ PA तथा PB खींची गई हैं। सिद्ध कीजिए कि $\angle APB = 2 \angle OAB$ है।

अथवा

SECTION C

*This section has **6** Short Answer (SA) type questions carrying **3** marks each.* $6 \times 3 = 18$

26. Find two consecutive negative integers, sum of whose squares is 481.

27. A point P divides the line segment joining the points A(– 3, 5) and B(7, – 4) in a certain ratio. If the point P lies on the line y = 2x, then find the ratio AP : PB and coordinates of point P.

28. (a) If $\sin\theta + \cos\theta = \sqrt{3}$, then prove that

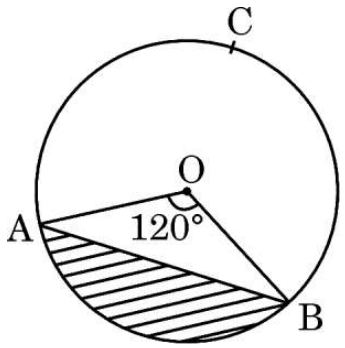
$$\tan\theta + \cot\theta = 1$$

OR

(b) Prove that :

$$(\sin A + \sec A)^2 + (\cos A + \text{cosec } A)^2 = (1 + \sec A \text{ cosec } A)^2$$

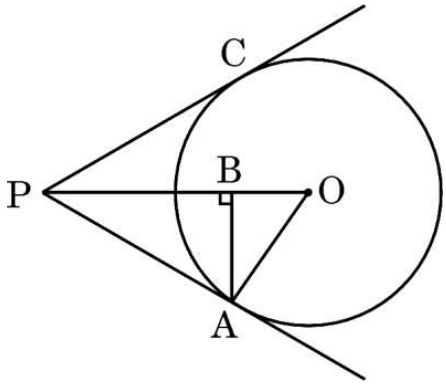
29. In the given figure, chord AB subtends an angle of 120° at the centre of the circle with radius 7 cm. Find (i) perimeter of major sector OACB, and (ii) area of the shaded segment, if area of Δ OAB = 21·2 cm^2.



30. (a) Two tangents PA and PB are drawn to a circle with centre O from an external point P. Prove that $\angle$ APB = 2 $\angle$ OAB.

OR

(ख) दी गई आकृति में, PA, O केन्द्र वाले वृत्त पर खींची गई ऐसी स्पर्श रेखा है कि OA = 10 cm, AB = 8 cm तथा AB ⊥ OP है। PB की लम्बाई ज्ञात कीजिए।



31. सिद्ध कीजिए कि $\sqrt{3}$ एक अपरिमेय संख्या है।

खण्ड घ

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

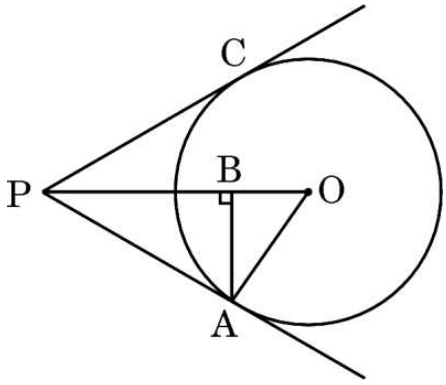
32. समतल भूमि पर एक मीनार ऊर्ध्वाधर खड़ी है और ऊपर एक ध्वज को लगाया गया है। मीनार से 30 m की दूरी पर भूमि पर स्थित एक बिंदु से ध्वजदंड के शिखर तथा पाद पर क्रमश: 60° तथा 30° का उन्नयन कोण बनाती हुई तारें बाँधी गई हैं। मीनार की ऊँचाई तथा बाँधी गई तारों की लम्बाइयाँ ज्ञात कीजिए। ($\sqrt{3}$ = 1·73 लीजिए)

33. (क) निम्नलिखित आँकड़ों का माध्यक 137 है। x तथा y के मान ज्ञात कीजिए, जहाँ सभी बारम्बारताओं का योगफल 68 है।

वर्ग	*बारम्बारता*
65 – 85	4
85 – 105	5
105 – 125	x
125 – 145	20
145 – 165	14
165 – 185	y
185 – 205	4

अथवा

(b) In the given figure, PA is the tangent to the circle with centre O such that OA = 10 cm, AB = 8 cm and AB ⊥ OP. Find the length of PB.



31. Prove that $\sqrt{3}$ is an irrational number.

SECTION D

*This section has **4** Long Answer (LA) type questions carrying **5** marks each.* $4 \times 5 = 20$

32. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff. From a point on the ground 30 m away from the tower, wires are attached to the top and bottom of the flagstaff making angles of elevation 60° and 30° respectively. Find the height of the tower and lengths of the wires attached. (Take $\sqrt{3} = 1{\cdot}73$)

33. (a) The median of the following data is 137. Find the values of x and y, given that total of frequencies is 68.

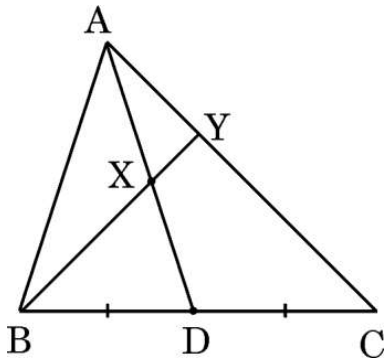
Class	*Frequency*
65 – 85	4
85 – 105	5
105 – 125	x
125 – 145	20
145 – 165	14
165 – 185	y
185 – 205	4

OR

(ख) निम्नलिखित आँकड़ों का माध्य तथा बहुलक ज्ञात कीजिए।

वर्ग	*बारम्बारता*
0 – 10	3
10 – 20	6
20 – 30	11
30 – 40	10
40 – 50	13
50 – 60	3
60 – 70	4

34. बिंदु X, Δ ABC की माध्यिका AD पर स्थित ऐसा बिंदु है कि AX : XD = 2 : 3 है। BX को बढ़ाने पर यह भुजा AC को बिंदु Y पर प्रतिच्छेद करती है। सिद्ध कीजिए कि BX = 4 XY है।



35. (क) निम्नलिखित रैखिक समीकरण युग्म को ग्राफीय विधि से हल कीजिए :

$$2x + 3y = 5, \quad -3x + y = -2$$

अथवा

(ख) दो अंकों की एक संख्या के अंकों का योगफल 11 है। संख्या के अंकों को पलटने पर प्राप्त संख्या दी गई संख्या से 9 अधिक हो जाती है। संख्या ज्ञात करने के लिए :

(i) उपर्युक्त परिस्थिति को रैखिक समीकरणों के रूप में लिखिए।

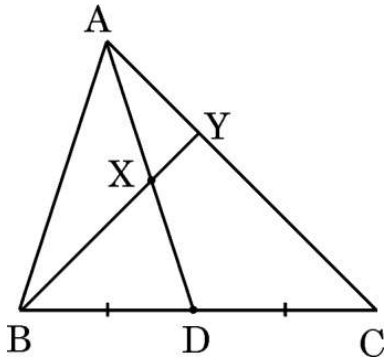
(ii) दर्शाइए कि इन समीकरणों का अद्वितीय हल है।

(iii) समीकरणों को हल करके दी गई दो अंकों की संख्या ज्ञात कीजिए।

(b) Find mean and mode of the following distribution :

Class	*Frequency*
0 – 10	3
10 – 20	6
20 – 30	11
30 – 40	10
40 – 50	13
50 – 60	3
60 – 70	4

34. In Δ ABC, AD is a median. X is a point on AD such that AX : XD = 2 : 3. BX is extended so that it intersects AC at Y. Prove that BX = 4 XY.



35. (a) Solve the following system of equations graphically :

$2x + 3y = 5, \; -3x + y = -2$

OR

(b) The sum of the digits of a 2-digit number is 11. The number obtained by interchanging its digits exceeds the given number by 9. To know the number :

(i) form the linear equations representing the above situation.

(ii) verify that the equations have a unique solution.

(iii) solve the equations to get the given 2-digit number.

खण्ड ङ

*इस खण्ड में **3** प्रकरण अध्ययन आधारित प्रश्न हैं जिनमें प्रत्येक के **4** अंक हैं।* *3×4=12*

प्रकरण अध्ययन – 1

36. कुछ दोस्त ताश की दो एकसमान गड्डियों को लेकर उनसे ताश खेलना चाहते थे। ताश के पत्तों को फेंटते समय तीन पत्ते नीचे गिर गए। उन्होंने शेष पत्तों को अच्छी प्रकार फेंटकर यादृच्छया एक पत्ता निकाला। यह मानते हुए कि गिरे हुए तीन पत्तों में एक पान की बेगम, एक हुकुम का दस तथा एक चिड़ी का इक्का है, निम्नलिखित प्रश्नों के उत्तर दीजिए :



(i) इसकी क्या प्रायिकता है कि निकाला गया पत्ता एक फेस कार्ड (face card) है ? *1*

(ii) प्रायिकता ज्ञात कीजिए कि निकाला गया पत्ता बेगम या बादशाह है। *1*

(iii) (क) क्या आपको लगता है कि यदि कोई पत्ता नहीं गिरता, तो निकाले गए पत्ते के बेगम होने की प्रायिकता ज्यादा होती ? तर्क सहित उत्तर दीजिए। *2*

अथवा

(iii) (ख) प्रायिकता ज्ञात कीजिए कि निकाला गया पत्ता गुलाम है। इसकी तुलना उस स्थिति में निकाली गई प्रायिकता से कीजिए यदि कोई पत्ता नहीं गिरता। किस परिस्थिति में निकाले गए पत्ते के गुलाम होने की प्रायिकता अधिक है ? *2*

SECTION E

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

Case Study – 1

36. A group of friends wanted to play cards with two identical packs together. While shuffling the cards, three cards are dropped. Rest of the cards are shuffled and one card is drawn at random. Assuming that the dropped cards were a queen of hearts, a ten of spades and an ace of clubs, answer the following questions :



(i) Find the probability that the drawn card is a face card. *1*

(ii) Find the probability that the drawn card is either a king or a queen. *1*

(iii) (a) Do you think that the probability of getting a queen was higher if none of the cards were dropped ? Justify your answer. *2*

OR

(iii) (b) Find the probability that the drawn card is a jack. Compare it with the probability when none of the cards were dropped. In which case is the probability of getting a jack higher ? *2*

प्रकरण अध्ययन – 2

37. मेज पर रखने के लिए 'लीफी बॉल फाउन्टेन' का एक मॉडल बनाया गया। पानी सहजता से गेंद की सतह से बहता हुआ एक सुसज्जित बेलनाकार टंकी में जाता है जहाँ से पुन: वापस आता है।

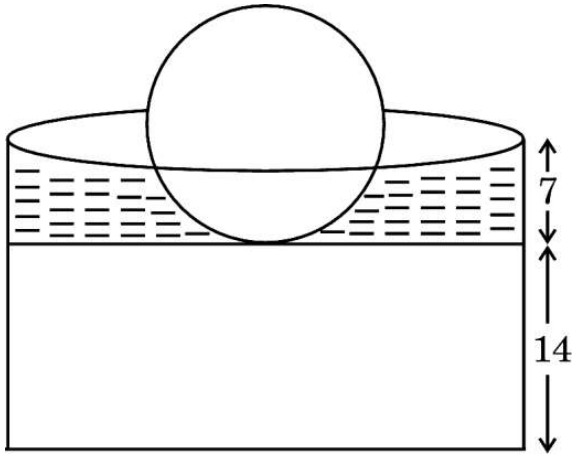
गोलाकार गेंद का व्यास 21 cm है।

बेलनाकार टंकी – बाह्य व्यास 50 cm है तथा आंतरिक व्यास 40 cm है।

ठोस आधार की ऊँचाई 14 cm है।

भरे हुए पानी की ऊँचाई 7 cm है।





उपर्युक्त आकृति के आधार पर निम्नलिखित प्रश्नों के उत्तर दीजिए :

(i) फव्वारे की कुल ऊँचाई ज्ञात कीजिए। *1*

(ii) गेंद का आयतन ज्ञात कीजिए। *1*

(iii) (क) यदि गेंद का एक-तिहाई हिस्सा पानी में डूबा हो, तो टंकी में पानी का आयतन ज्ञात कीजिए। *2*

अथवा

(iii) (ख) बेलनाकार भाग का बाह्य वक्र पृष्ठीय क्षेत्रफल तथा गेंद के पृष्ठीय क्षेत्रफल का योगफल ज्ञात कीजिए। *2*

Case Study – 2

37. A model of Leafy Ball Fountain is made to be kept on the tabletop. Water gently cascades down the ball into a decorative cylindrical pool where it is recycled.

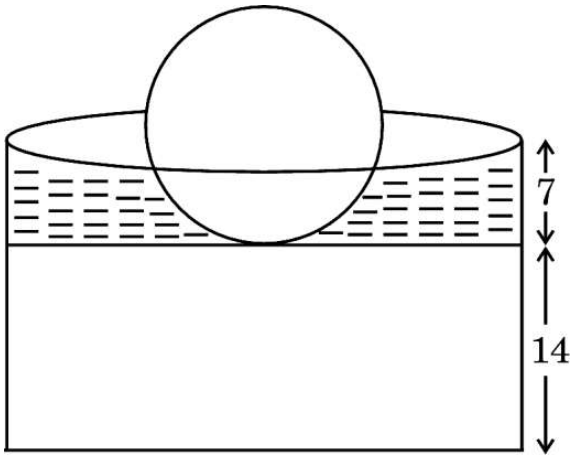
The diameter of spherical ball is 21 cm.

Cylindrical pool – Outer diameter is 50 cm and inner diameter is 40 cm.

Height of solid base is 14 cm.

Height of water filled is 7 cm.





Observe the figure and answer the following questions :

(i) Determine the total height of the fountain. *1*

(ii) Find the volume of the ball. *1*

(iii) (a) If one-third of the ball is submerged in the water, find the volume of the water filled in the pool. *2*

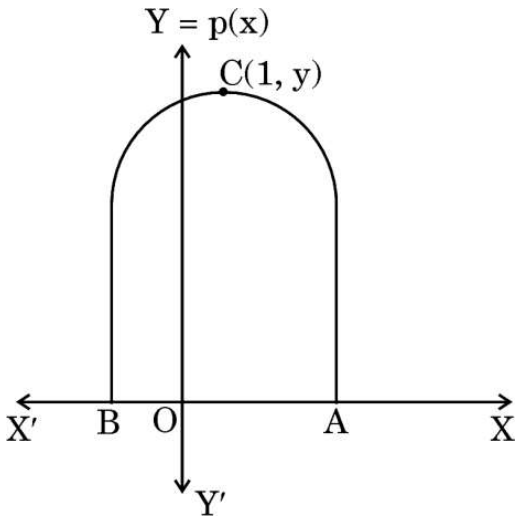
OR

(iii) (b) Find the sum of the outer curved surface area of the cylindrical part and surface area of the ball. *2*

प्रकरण अध्ययन – 3

38. रंगमंच के नाटक के दौरान, मंच की पृष्ठभूमि के लिए भवन मेहराब (arches) का प्रयोग किया गया। नीचे दिखाई गई एक मेहराब (arch) के वक्र को बहुपद $p(x) = -x^2 + 2x + 8$ के द्वारा निरूपित किया जा सकता है। यहाँ x मंच की सतह पर लम्बाई (फुट में) को दर्शाता है।





उपर्युक्त आकृति के आधार पर निम्नलिखित प्रश्नों के उत्तर दीजिए।

(i) मेहराब की ऊँचाई ज्ञात कीजिए। *1*

(ii) (क) बहुपद $p(x)$ के शून्यक ज्ञात कीजिए। उपर्युक्त ग्राफ में कौन-से बिंदु शून्यक को दर्शाते हैं ? *2*

अथवा

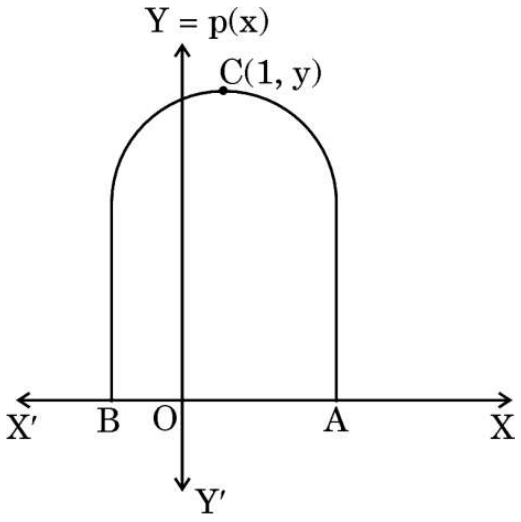
(ii) (ख) मंच की सतह पर मेहराब का विस्तार (span) ज्ञात कीजिए। *2*

(iii) उपर्युक्त वक्र तथा y-अक्ष के प्रतिच्छेदी बिंदु के निर्देशांक लिखिए। *1*

Case Study – 3

38. During a theatre drama, a backdrop of building arches was used. The shape of the curve shown below can be represented by the polynomial $p(x) = -x^2 + 2x + 8$, where x is the length (in feet) on stage level.





Based on the figure given above, answer the following questions :

(i) Determine the height of the arch. *1*

(ii) (a) Find zeroes of the polynomial p(x). Which points on the graph represent the zeroes ? *2*

OR

(ii) (b) Find the span of the arch on the stage floor. *2*

(iii) Write the coordinates of the point of intersection of the above curve with the y-axis. *1*

Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
Secondary School Examination, 2026
MATHEMATICS (STANDARD) (041) (PAPER CODE 30/3/2)

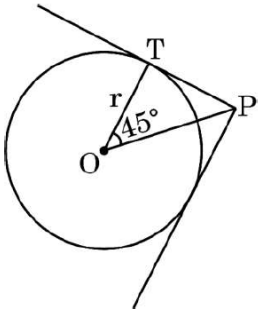
General Instructions: -

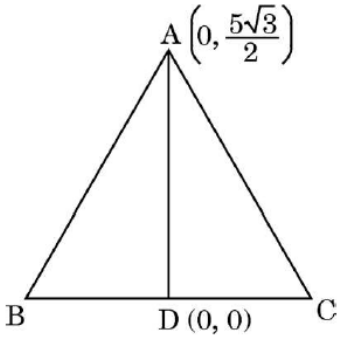
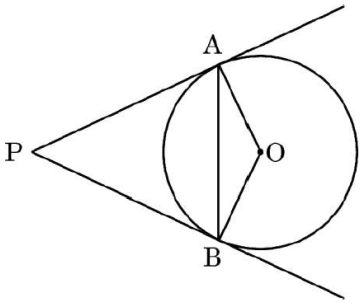
1.	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested 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 BNS."**
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. In Class-X, while evaluating the Competency-based questions, please try to understand given answer and even if reply is not from Marking Scheme but correct competency is enumerated by the candidate, due marks should be awarded.**
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 totalled up and written on the left-hand margin and encircled. This may be followed strictly.
8.	If a question does not have any parts, marks must be awarded on the left-hand margin and encircled. This may also be followed strictly.

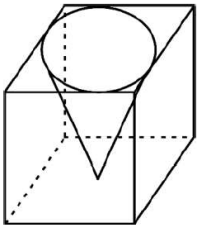
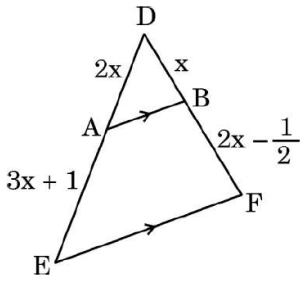
9.	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10.	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
11.	A full scale of marks **0 to 80** (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 totalling of marks awarded to an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. ● Wrong question wise totalling on the title page. ● Wrong totalling 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 totalled 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.

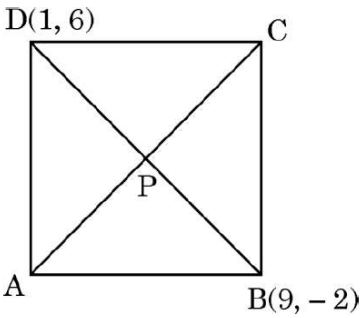
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/3/2)

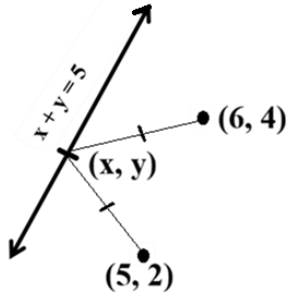
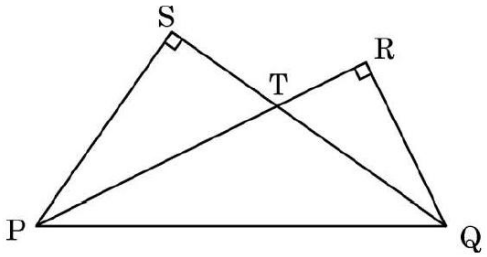
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Step	Marks
	SECTION A This section has **20** Multiple Choice Questions (MCQs) carrying 1 mark each.		
1.	Given that $\sin 2\alpha = \frac{\sqrt{3}}{2}$, the value of $\sin 3\alpha$ is : (A) $\frac{3\sqrt{3}}{4}$ (B) $\frac{1}{2}$ (C) 1 (D) $\frac{\sqrt{3}}{4}$		
Sol.	(C) 1		**1**
2.	The median and mode of a distribution are 25·2 and 26·1 respectively. The mean of the distribution is : (A) 24·75 (B) 24·25 (C) 24·3 (D) 25·5		
Sol.	(A) 24.75		**1**
3.	If the length of the shadow of a tower is $\sqrt{3}$ times that of its height, then altitude of the Sun is : (A) 45° (B) 30° (C) 60° (D) 15°		
Sol.	(B) 30°		**1**
4.	If the roots of the quadratic equation $\sqrt{3}x^2 - kx + 2\sqrt{3} = 0$ are real and equal, then the value(s) of k is/are : (A) $\pm\sqrt{24}$ (B) 0 (C) 4 (D) – 5		
Sol.	(A) $\pm\sqrt{24}$		**1**
5.	It is given that $\Delta ABC \sim \Delta QRP$ such that AB = 9 cm, BC = 5 cm and PR = 2 cm. Length of side QR is : (A) 0·9 cm (B) $\frac{5}{18}$ cm (C) $\frac{10}{9}$ cm (D) 3·6 cm		
Sol.	(D) 3.6 cm		**1**

6.	The sum and product of zeroes of a quadratic polynomial p(x) are $\frac{-1}{3}$ and 2 respectively. The polynomial p(x) is : (A) $3x^2 - x + 6$ (B) $x^2 + \frac{1}{3}x - 2$ (C) $3x^2 - x + 2$ (D) $-3x^2 - x - 6$		
Sol.	(D) $-3x^2 - x - 6$		**1**
7.	The roots of the quadratic equation $4x^2 - (a-1)^2 = 0$ are : (A) $a - 1, a + 1$ (B) $\frac{a-1}{2}, \frac{-a+1}{2}$ (C) $\frac{a-1}{2}, \frac{-a-1}{2}$ (D) $\pm(a - 1)$		
Sol.	(B) $\frac{a-1}{2}, \frac{-a+1}{2}$		**1**
8.	In the given figure, PT is a tangent to the circle with centre O and radius r. If $\angle POT = 45°$, then the length of OP is :  (A) $r\sqrt{2}$ (B) $\sqrt{2r}$ (C) $2r$ (D) r^2		
Sol.	(A) $r\sqrt{2}$		**1**
9.	Three coins are tossed together. The probability of getting exactly one head, is : (A) $\frac{1}{8}$ (B) $\frac{3}{4}$ (C) $\frac{1}{2}$ (D) $\frac{3}{8}$		
Sol.	(D) $\frac{3}{8}$		**1**
10.	The number of multiples of 4 lying between 12 and 250 is : (A) 59 (B) 59·5 (C) 60 (D) 61		
Sol.	(A) 59		**1**

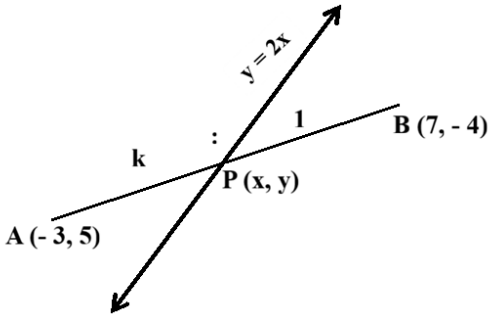
11.	The value of $\left(\frac{1}{3}\cot^2 30° - \frac{1}{2}\sec^2 60°\right)$ is : (A) -1 (B) -2 (C) $\frac{5}{8}$ (D) $\frac{7}{8}$		
Sol.	(A) -1		**1**
12.	In the given figure, Δ ABC is an equilateral triangle. AD is a median of the triangle joining the points $A\left(0, \frac{5\sqrt{3}}{2}\right)$, D(0, 0). Points B and C are (in same order) :  (A) (– 5, 0), (5, 0) (B) $\left(-\frac{5}{2}, 0\right), \left(\frac{5}{2}, 0\right)$ (C) (– 10, 0), (10, 0) (D) $(-5\sqrt{3}, 0), (5\sqrt{3}, 0)$		
Sol.	(B) $\left(-\frac{5}{2}, 0\right), \left(\frac{5}{2}, 0\right)$		**1**
13.	The n^{th} term of the A.P. $\frac{-1}{3}, \frac{2}{3}, \frac{5}{3}, \frac{8}{3}, \ldots$ is : (A) $3n - 4$ (B) $n - \frac{4}{3}$ (C) $\frac{n-2}{3}$ (D) $\frac{n-4}{3}$		
Sol.	(B) $n - \frac{4}{3}$		**1**
14.	PA and PB are tangents to a circle centred at O. If $\angle$ PBA = 65°, then $\angle$ APB equals :  (A) 65° (B) 60° (C) 50° (D) 35°		
Sol.	(C) 50°		**1**

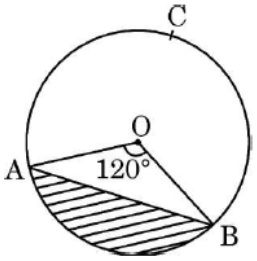
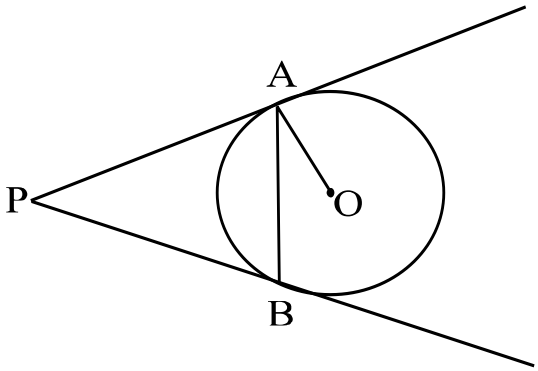
15.	A cone of maximum size is carved out from a solid cube of edge length l. The volume of the cone is :  (A) $\frac{\pi l^3}{12}$ (B) $\frac{\pi l^3}{3}$ (C) $l^3\left(1-\frac{\pi}{3}\right)$ (D) $\frac{\pi l^3}{8}$		
Sol.	(A) $\frac{\pi l^3}{12}$		**1**
16.	Equation of another line parallel to the line represented by $2x - 6y = 7$ is : (A) $y = 3x - 7$ (B) $2x = 9 - 6y$ (C) $x - 3y = 7$ (D) $x = \frac{7}{2} - 3y$		
Sol.	(C) $x - 3y = 7$		**1**
17.	In Δ DEF, AB $\parallel$ EF. The value of x is :  (A) 0, 2 (B) 2 only (C) – 2 (D) 1		
Sol.	(B) 2 only		**1**
18.	$(3 \times 11 \times 13 + 3)$ is : (A) a prime number (B) divisible by 13 (C) a composite number (D) an odd number		
Sol.	(C) a composite number		**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 the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.		

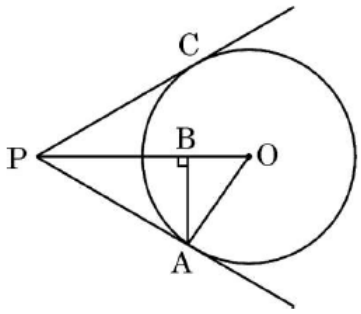
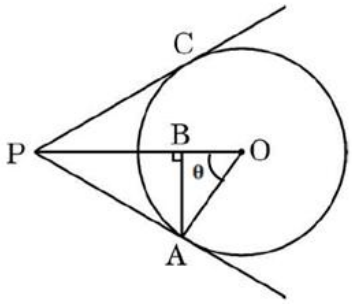
19.	*Assertion (A) :* Radius is the smallest distance of a tangent from the centre of the circle. *Reason (R) :* Radius is perpendicular to the tangent.		
Sol.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).		**1**
20.	*Assertion (A) :* $\tan 2\theta$ is not defined at $\theta = 45°$. *Reason (R) :* $\sin 90° \neq \cos 90°$.		
Sol.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).		**1**
	SECTION B This section has **5** Very Short Answer (VSA) type questions carrying 2 marks each.		
21 (a)	Diagonals AC and BD of square ABCD intersect at P. Coordinates of points B and D are (9, – 2) and (1, 6) respectively.  (i) Find the co-ordinates of point P. (ii) Find the length of the side of the square.		
Sol.	(i) Coordinates of P are $\left(\frac{9+1}{2}, \frac{-2+6}{2}\right) = (5, 2)$ (ii) $2\ AB^2 = BD^2$ $\Rightarrow 2\ AB^2 = (9 - 1)^2 + (-2 - 6)^2$ $\Rightarrow AB = 8$ Hence, the length of the side of square is 8 units.	**I** **II** **III**	**1** ½ ½
	OR		

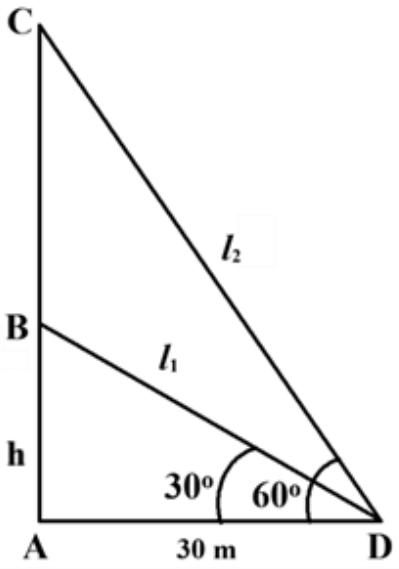
21 (b)	Find the coordinates of a point on the line x + y = 5 which is equidistant from (6, 4) and (5, 2).		
Sol.	 Let the required point be (x, y) which is equidistant from (6, 4) and (5, 2) $\therefore (6 - x)^2 + (4 - y)^2 = (5 - x)^2 + (2 - y)^2$ $\Rightarrow 2x + 4y = 23$ --- (i) Since point (x, y) also lies on the line x + y = 5 $\therefore x + y = 5$ --- (ii) Solving (i) and (ii), we get $x = -\frac{3}{2}$ and $y = \frac{13}{2}$ So, the coordinates of the required point are $\left(-\frac{3}{2}, \frac{13}{2}\right)$	**I** **II** **III**	**1** ½ ½
22.	Two right triangles PRQ and PSQ are drawn on the same hypotenuse PQ. If PR and QS intersect at T, prove that ST × TQ = PT × TR. 		
Sol.	Δ STP ~ ΔRTQ $\frac{ST}{TP} = \frac{RT}{TQ} \Rightarrow ST \times TQ = PT \times TR$	**I** **II**	**1** **1**
23.	Find the length of the plank that can be used to measure the lengths 4 m 20 cm and 5 m 4 cm exactly, in the least time.		
Sol.	4 m 20 cm = 420 cm and 5 m 4 cm = 504 cm Size of plank should be maximum, so we will find HCF (420, 504) $420 = 2^2 \times 3 \times 5 \times 7$ and $504 = 2^3 \times 3^2 \times 7$ HCF (420, 504) = 84 $\therefore$ the required length of the plank is 84 cm	**I** **II** **III**	½ **1** ½

24 (a)	In an A.P., the first term is 32 and the last term is – 10. If the common difference is – 2, then find the number of terms and their sum.		
Sol.	Here a = 32, l = – 10 and d = – 2		
	$\therefore$ 32 + (n – 1)(– 2) = – 10	**I**	½
	$\Rightarrow$ n = 22	**II**	½
	$S_{22} = \frac{22}{2} \times [32 + (-10)]$	**III**	½
	= 242	**IV**	½
	OR		
24 (b)	Find the sum of the first 28 terms of an A.P. whose n^{th} term is given by $a_n = 3n - 2$.		
Sol.	$a_1 = 3(1) - 2 = 1$	**I**	½
	and $a_{28} = 3(28) - 2 = 82$	**II**	½
	$S_{28} = \frac{28}{2} \times (1 + 82)$	**III**	½
	= 1162	**IV**	½
25.	1000 small thermocol balls of radius 0·5 cm are kept in a spherical balloon of radius 20 cm. Find the volume of air in the balloon.		
Sol.	Volume of air in the ballon = Volume of spherical balloon – Volume of 1000 thermocol balls		
	$= \frac{4}{3} \times \frac{22}{7} \times (20)^3 - 1000 \times \frac{4}{3} \times \frac{22}{7} \times (0.5)^3$	**I**	**1**
	= 33000 cm^3	**II**	**1**
	SECTION C		
	This section has **6** Short Answer (SA) type questions carrying 3 marks each.		
26.	Find two consecutive negative integers, sum of whose squares is 481.		
Sol.	Let two consecutive negative integers be x and (x + 1)		
	According to given statement,		
	$x^2 + (x + 1)^2 = 481$	**I**	**1**
	$\Rightarrow x^2 + x - 240 = 0$	**II**	½
	$\Rightarrow (x + 16)(x - 15) = 0$	**III**	**1**
	$\therefore$ x = – 16 or 15		
	x = 15 does not satisfy the given condition.		
	So, required integers are – 16 and – 15.	**IV**	½

27.	A point P divides the line segment joining the points A(– 3, 5) and B(7, – 4) in a certain ratio. If the point P lies on the line y = 2x, then find the ratio AP : PB and coordinates of point P.		
Sol.			
	Let AP : PB = k : 1	**I**	½
	Coordinates of point P are $\left(\frac{7k-3}{k+1}, \frac{-4k+5}{k+1}\right)$	**II**	½
	Since point P lies on the line y = 2x		
	Therefore, $\frac{-4k+5}{k+1} = 2 \times \left(\frac{7k-3}{k+1}\right)$	**III**	½
	$\Rightarrow k = \frac{11}{18}$		
	∴ AP : PB = 11 : 18	**IV**	½
	Coordinates of P are $\left(\frac{7\times11-3\times18}{11+18}, \frac{-4\times11+5\times18}{11+18}\right) = \left(\frac{23}{29}, \frac{46}{29}\right)$	**V**	**1**
28 (a)	If $\sin\theta + \cos\theta = \sqrt{3}$, then prove that $\tan\theta + \cot\theta = 1$		
Sol.	$(\sin\theta + \cos\theta)^2 = (\sqrt{3})^2$	**I**	½
	$\Rightarrow \sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta = 3$		
	$\Rightarrow \sin\theta\cos\theta = 1$ --- (i)	**II**	**1**
	LHS = $\tan\theta + \cot\theta = \frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta} = \frac{\sin^2\theta+\cos^2\theta}{\cos\theta\sin\theta} = \frac{1}{\cos\theta\sin\theta}$	**III**	**1**
	= 1 [using (i)]	**IV**	½
	= RHS		
	OR		
28 (b)	Prove that : $(\sin A + \sec A)^2 + (\cos A + \operatorname{cosec} A)^2 = (1 + \sec A \operatorname{cosec} A)^2$		
Sol.	LHS = $\left(\sin A + \frac{1}{\cos A}\right)^2 + \left(\cos A + \frac{1}{\sin A}\right)^2$	**I**	½
	$= \sin^2 A + \frac{1}{\cos^2 A} + \frac{2\sin A}{\cos A} + \cos^2 A + \frac{1}{\sin^2 A} + \frac{2\cos A}{\sin A}$	**II**	**1**
	$= 1 + \left(\frac{1}{\sin^2 A} + \frac{1}{\cos^2 A}\right) + 2\left(\frac{\sin A}{\cos A} + \frac{\cos A}{\sin A}\right)$		
	$= 1 + \frac{1}{\cos^2 A \sin^2 A} + \frac{2}{\cos A \sin A}$	**III**	**1**

	$= 1 + \sec^2 A \operatorname{cosec}^2 A + 2 \sec A \operatorname{cosec} A$ $= (1 + \sec A \operatorname{cosec} A)^2 = \text{RHS}$	 **IV**	 ½
29.	In the given figure, chord AB subtends an angle of 120° at the centre of the circle with radius 7 cm. Find (i) perimeter of major sector OACB, and (ii) area of the shaded segment, if area of Δ OAB = 21·2 cm^2.  		
Sol.	(i) Perimeter of major sector = length of major arc ACB + 2 × radius $= \frac{(360-120)}{360} \times 2 \times \frac{22}{7} \times 7 + 2 \times 7$ $= \frac{130}{3}$ cm or 43.3 cm So, perimeter of major sector is $\frac{130}{3}$ cm or 43.3 cm (ii) Area of shaded segment = Area of minor sector – Area of ΔOAB $= \frac{120}{360} \times \frac{22}{7} \times 7 \times 7 - 21.2$ $= 30.1\ cm^2$ So, area of shaded segment is 30.1 cm^2.	 **I** **II** **III** **IV**	 **1** ½ **1** ½
30 (a)	Two tangents PA and PB are drawn to a circle with centre O from an external point P. Prove that ∠ APB = 2 ∠ OAB.		
Sol.	 Correct figure. OA ⊥ AP ∴ ∠PAB = 90° – ∠OAB --- (i) PA = PB ∴ ∠PAB = ∠PBA Hence, ∠APB = 180° – 2∠PAB Using (i), ∠APB = 180° – 2(90° – ∠OAB) ⇒ ∠APB = 2∠OAB	 **I** **II** **III** **IV** **V**	 ½ ½ **1** ½ ½

	OR		
30 (b)	In the given figure, PA is the tangent to the circle with centre O such that OA = 10 cm, AB = 8 cm and AB ⊥ OP. Find the length of PB.  		
Sol.	 		
	In right angled ΔOBA, OB = $\sqrt{(10)^2-(8)^2}$ = 6 cm	**I**	½
	Let ∠AOB = θ		
	So, tan θ = $\frac{8}{6}$ --- (i)	**II**	½
	In right angled ΔOAP		
	$\frac{AP}{10}$ = tan θ		
	∴ $\frac{AP}{10}=\frac{8}{6}$ [using (i)]	**III**	½
	⇒ AP = $\frac{40}{3}$ cm	**IV**	½
	∴ OP = $\sqrt{\left(\frac{40}{3}\right)^2+(10)^2}=\frac{50}{3}$ cm	**V**	½
	PB = OP – OB = $\frac{50}{3}-6=\frac{32}{3}$ cm or 10.6 cm	**VI**	½
	Alternate solution:		
	In right angled ΔOBA,		
	OB = $\sqrt{(10)^2-(8)^2}$ = 6 cm	**I**	½
	In right angled ΔPBA		
	$PA^2 = PB^2 + (8)^2 = PB^2 + 64$ --- (i)	**II**	½
	In right angled ΔPAO		
	$PA^2 = OP^2 - (10)^2 = (PB + 6)^2 - 100$ --- (ii)	**III**	**1**

	From (i) and (ii), we have $PB^2 + 64 = (PB + 6)^2 - 100 \Rightarrow PB = \frac{32}{3}$ cm or 10.6 cm	**IV**	**1**
31.	Prove that $\sqrt{3}$ is an irrational number.		
Sol.	Let $\sqrt{3}$ be a rational number. $\therefore \sqrt{3} = \frac{p}{q}$, where $q \neq 0$ and p & q are coprime. $3q^2 = p^2 \implies p^2$ is divisible by $3 \implies$ p is divisible by 3 ----- (i) Let $p = 3a$, where 'a' is some integer $9a^2 = 3q^2 \implies q^2 = 3a^2 \implies q^2$ is divisible by $3 \implies$ q is divisible by 3 ----- (ii) (i) and (ii) leads to contradiction as 'p' and 'q' are coprime. $\therefore \sqrt{3}$ is an irrational number.	**I** **II** **III** **IV**	½ **1** **1** ½
	SECTION D This section has **4** Long Answer (LA) type questions carrying 5 marks each.		
32.	A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff. From a point on the ground 30 m away from the tower, wires are attached to the top and bottom of the flagstaff making angles of elevation 60° and 30° respectively. Find the height of the tower and lengths of the wires attached. (Take $\sqrt{3} = 1{\cdot}73$)		
Sol.	 Correct figure Let AB be the tower of height 'h' m and BC be the flagstaff. In right angled ΔBAD $\frac{h}{30} = \tan 30° = \frac{1}{\sqrt{3}}$	**I** **II**	**1** **1**

	$\Rightarrow h = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 10\sqrt{3} = 17.3$	**III**	½
	∴ height of the tower is 17.3 m		
	Also, $\frac{30}{l_1} = \cos 30° = \frac{\sqrt{3}}{2}$	**IV**	**1**
	$\Rightarrow l_1 = \frac{60}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 20\sqrt{3} = 34.6$	**V**	½
	∴ length of wire attached to the bottom of the flagstaff is 34.6 m		
	In right angled ΔCAD		
	$\frac{30}{l_2} = \cos 60° = \frac{1}{2}$	**VI**	½
	$\Rightarrow l_2 = 60$	**VII**	½
	∴ length of wire attached to the top of the flagstaff is 60 m		
33 (a)	The median of the following data is 137. Find the values of x and y, given that total of frequencies is 68.		

Class	*Frequency*
65 – 85	4
85 – 105	5
105 – 125	x
125 – 145	20
145 – 165	14
165 – 185	y
185 – 205	4

Sol.				

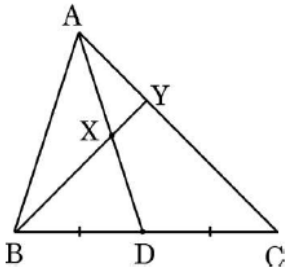
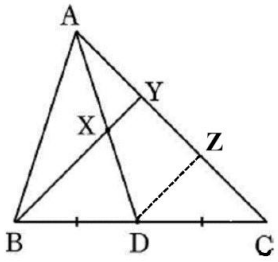
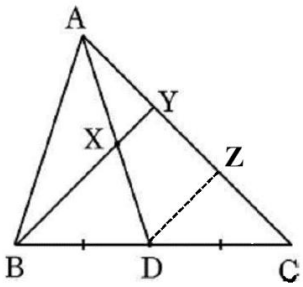
Class	***f***	***cf***
65 – 85	4	4
85 – 105	5	9
105 – 125	x	9 + x
125 – 145	20	29 + x
145 – 165	14	43 + x
165 – 185	y	43 + x + y
185 – 205	4	47 + x + y

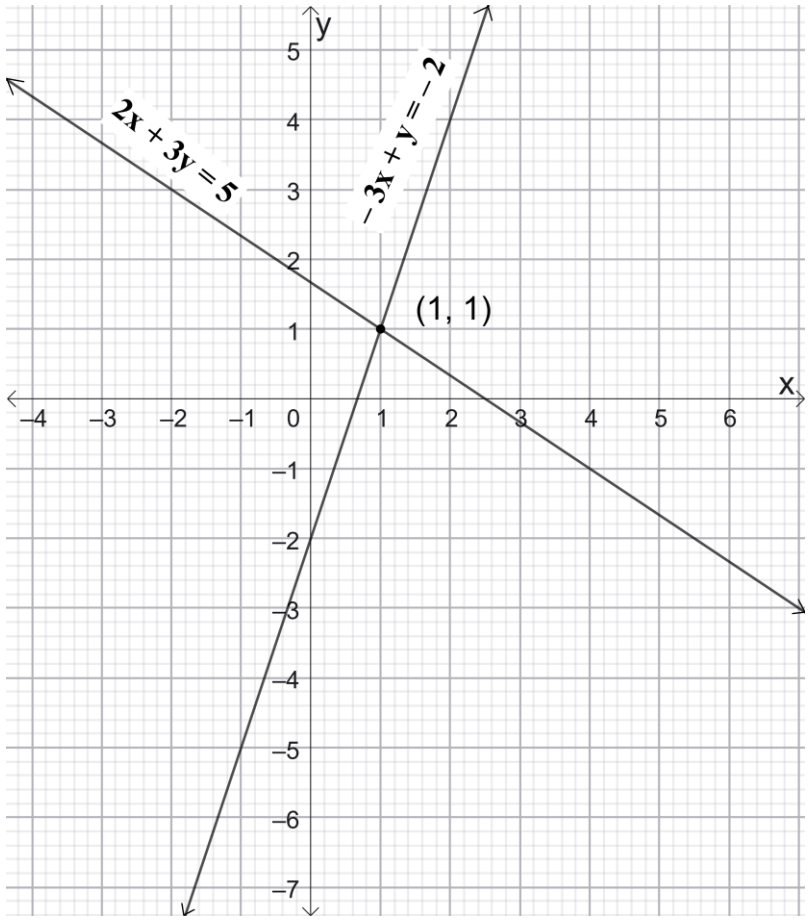
Correct table	**I**	**1½**
Given, Median = 137		
∴ Median Class is 125 – 145.	**II**	½

	$125 + \left[\frac{\frac{68}{2} - (9+x)}{20}\right] \times 20 = 137$	**III**	**1**
	$\Rightarrow x = 13$	**IV**	**1**
	Also, $47 + x + y = 68$ $\therefore 47 + 13 + y = 68 \Rightarrow y = 8$	**V**	**1**
	OR		
33 (b)	Find mean and mode of the following distribution : *Class* / *Frequency* 0 – 10 : 3 10 – 20 : 6 20 – 30 : 11 30 – 40 : 10 40 – 50 : 13 50 – 60 : 3 60 – 70 : 4		
Sol.			

Class	x_i	f_i	$u_i = \frac{x_i - 35}{10}$	$f_i u_i$
0 – 10	5	3	–3	– 9
10 – 20	15	6	–2	– 12
20 – 30	25	11	–1	– 11
30 – 40	35	10	0	0
40 – 50	45	13	1	13
50 – 60	55	3	2	6
60 – 70	65	4	3	12
Total		**50**		**– 1**

Correct table	**I**	**2**
Mean = $35 + \frac{(-1)}{50} \times 10 = 34.8$	**II**	**1**
Modal class is 40 – 50.	**III**	**½**

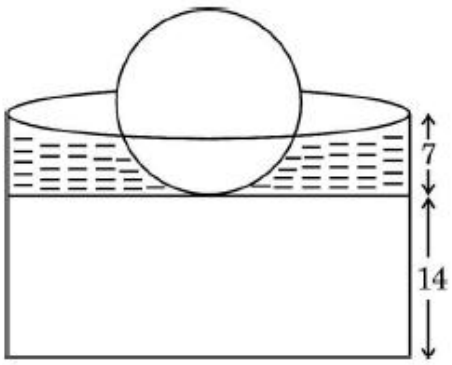
	Mode = $40 + \left(\frac{13-10}{2\times13-10-3}\right)\times10$ = 42.3 (approx.)	**IV** **V**	**1** **½**
34.	In Δ ABC, AD is a median. X is a point on AD such that AX : XD = 2 : 3. BX is extended so that it intersects AC at Y. Prove that BX = 4 XY. 		
Sol.			
	Draw DZ ‖ BY.	**I**	**½**
	In ΔCBY, DZ ‖ BY		
	$\therefore \frac{CD}{DB} = \frac{CZ}{ZY} = 1$	**II**	**1**
	Therefore, DZ = $\frac{1}{2}$ BY --- (i)	**III**	**½**
	In ΔADZ, DZ ‖ XY		
	So, Δ AXY ~ Δ ADZ		
	$\therefore \frac{AX}{AD} = \frac{XY}{DZ}$	**IV**	**1**
	$\Rightarrow \frac{2}{5} = \frac{XY}{DZ}$ or DZ = $\frac{5}{2}$ XY ---- (ii)	**V**	**½**
	Using (i) and (ii),		
	BY = 5 XY	**VI**	**1**
	Therefore BX = BY – XY = 4 XY	**VII**	**½**
	Alternate solution: 		
	Draw DZ ‖ BY.	**I**	**½**

	Δ AXY ~ Δ ADZ	**II**	½
	$\therefore \frac{AX}{AD} = \frac{XY}{DZ} \Rightarrow \frac{2}{2+3} = \frac{XY}{DZ}$		
	$\Rightarrow$ 2 DZ = 5 XY --- (i)	**III**	**1**
	Now, Δ CDZ ~ Δ CBY		
	$\therefore \frac{CD}{CB} = \frac{DZ}{BY}$	**IV**	½
	But CD = $\frac{1}{2}$ BC		
	So, $\frac{DZ}{BY} = \frac{1}{2} \Rightarrow$ BY = 2 DZ --- (ii)	**V**	**1**
	From (i) and (ii), we get		
	BY = 5 XY	**VI**	**1**
	$\Rightarrow$ (BX + XY) = 5 XY		
	$\Rightarrow$ BX = 4 XY	**VII**	½
35 (a)	Solve the following system of equations graphically : $2x + 3y = 5,\ -3x + y = -2$		
Sol.			
	Correct graph of equation 2x + 3y = 5	**I**	**2**
	Correct graph of equation – 3x + y = – 2	**II**	**2**
	Correct solution x = 1 and y = 1	**III**	½ + ½
	OR		

35 (b)	The sum of the digits of a 2-digit number is 11. The number obtained by interchanging its digits exceeds the given number by 9. To know the number : (i) form the linear equations representing the above situation. (ii) verify that the equations have a unique solution. (iii) solve the equations to get the given 2-digit number.		
Sol.	Let the digit at unit's place be x and at ten's place be y.		
	The number is 10 y + x	**I**	½
	(i) As per given statements		
	x + y = 11 --- ①	**II**	**1**
	10 x + y = 10 y + x + 9		
	⇒ x – y = 1 --- ②	**III**	**1**
	(ii) Here, $\frac{a_1}{a_2} = \frac{1}{1}, \frac{b_1}{b_2} = \frac{1}{-1}$ or -1		
	Since $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	**IV**	**1**
	Therefore, system of equations have a unique solution.		
	(iii) Solving equations ① & ②, we get		
	x = 6 and y = 5	**V**	½ + ½
	Therefore, given number is 56.	**VI**	½
	SECTION E		
	This section has **3** case study based questions carrying 4 marks each.		
36.	**Case Study – 1** A group of friends wanted to play cards with two identical packs together. While shuffling the cards, three cards are dropped. Rest of the cards are shuffled and one card is drawn at random. Assuming that the dropped cards were a queen of hearts, a ten of spades and an ace of clubs, answer the following questions : 		

	(i) Find the probability that the drawn card is a face card. (ii) Find the probability that the drawn card is either a king or a queen. (iii) (a) Do you think that the probability of getting a queen was higher if none of the cards were dropped ? Justify your answer. **OR** (iii) (b) Find the probability that the drawn card is a jack. Compare it with the probability when none of the cards were dropped. In which case is the probability of getting a jack higher ?		
Sol.	Total number of cards = $2 \times 52 - 3 = 101$		
	(i) P (a face card) = $\frac{23}{101}$	**I**	**1**
	(ii) P (either a king or a queen) = $\frac{15}{101}$	**I**	**1**
	(iii) (a)Yes	**I**	½
	P (a queen when no cards were dropped) = $\frac{8}{104}$	**II**	½
	P (a queen when cards were dropped) = $\frac{7}{101}$	**III**	½
	$\because \frac{8}{104} > \frac{7}{101}$ as 808 > 728	**IV**	½
	So probability of getting a queen was higher if none of the cards were dropped.		
	OR		
	(iii) (b) P (a jack when cards were dropped) = $\frac{8}{101}$	**I**	½
	P (a jack when no cards were dropped) = $\frac{8}{104}$	**II**	½
	Since $\frac{8}{101} > \frac{8}{104}$ as 101 < 104		
	Therefore probability of getting a jack is higher when 3 cards were dropped.	**III**	**1**
37.	**Case Study – 2** A model of Leafy Ball Fountain is made to be kept on the tabletop. Water gently cascades down the ball into a decorative cylindrical pool where it is recycled. The diameter of spherical ball is 21 cm. Cylindrical pool – Outer diameter is 50 cm and inner diameter is 40 cm. Height of solid base is 14 cm. Height of water filled is 7 cm.		





Observe the figure and answer the following questions :

(i) Determine the total height of the fountain.

(ii) Find the volume of the ball.

(iii) (a) If one-third of the ball is submerged in the water, find the volume of the water filled in the pool.

OR

(iii) (b) Find the sum of the outer curved surface area of the cylindrical part and surface area of the ball.

Sol.

(i) Total height of the fountain = 14 + 21 = 35 cm — **I** — **1**

(ii) Volume of the ball = $\frac{4}{3} \times \frac{22}{7} \times \frac{21}{2} \times \frac{21}{2} \times \frac{21}{2}$ — **I** — **½**

$= 4851 \text{ cm}^3$ — **II** — **½**

(iii) (a) Volume of water = Volume of inner upper part $- \frac{1}{3} \times$ Volume of the ball

$= \frac{22}{7} \times 20 \times 20 \times 7 - \frac{1}{3} \times 4851$ — **I** — **1**

$= 7183 \text{ cm}^3$ — **II** — **1**

OR

(iii) (b) Required area = Outer CSA of cylinderical part + Surface area of the ball

$= 2 \times \frac{22}{7} \times 25 \times (14 + 7) + 4 \times \frac{22}{7} \times \frac{21}{2} \times \frac{21}{2}$ — **I** — **1**

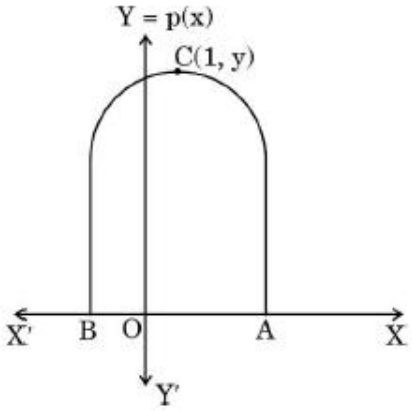
$= 4686 \text{ cm}^2$ — **II** — **1**

38.

Case Study – 3

During a theatre drama, a backdrop of building arches was used. The shape of the curve shown below can be represented by the polynomial $p(x) = -x^2 + 2x + 8$, where x is the length (in feet) on stage level.





Based on the figure given above, answer the following questions :

(i) Determine the height of the arch.

(ii) (a) Find zeroes of the polynomial p(x). Which points on the graph represent the zeroes ?

OR

(ii) (b) Find the span of the arch on the stage floor.

(iii) Write the coordinates of the point of intersection of the above curve with the y-axis.

Sol.	(i) $p(1) = -(1)^2 + 2 \times 1 + 8 = 9$ So, height of the arch is 9 feet.	**I**	**1**
	(ii) (a) $p(x) = -x^2 + 2x + 8$ $= -(x - 4)(x + 2)$	**I**	**1**
	$\therefore$ zeroes are -2 and 4.	**II**	½
	Points B and A on the graph represent the zeroes.	**III**	½
	OR		
	(ii) (b) $p(x) = -x^2 + 2x + 8$ $= -(x - 4)(x + 2)$	**I**	½
	$\therefore$ zeroes are -2 and 4.	**II**	½
	Hence, Coordinates of point A and B are (4, 0) and (– 2, 0) respectively. Span of the arch on the stage floor, AB = 4 + 2 = 6 So, span of the arch on the stage floor is 6 feet.	**III**	**1**
	(iii) $p(0) = -(0)^2 + 2 \times 0 + 8 = 8$	**I**	½
	$\therefore$ the given curve intersects y-axis at (0, 8)	**II**	½