



Series WX1YZ/5



SET~1

रोल नं.							
Roll No.							

प्रश्न-पत्र कोड  
Q.P. Code 30/5/1

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.

## गणित (मानक) MATHEMATICS (STANDARD)

\*

निर्धारित समय : 3 घण्टे

Time allowed : 3 hours

अधिकतम अंक : 80

Maximum Marks : 80

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 प्रश्न का क्रमांक अवश्य लिखें।  
Please write down the serial number of the question in the answer-book 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 छात्र 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 students will read the question paper only and will not write any answer on the answer-book during this period.





### सामान्य निर्देश :

निम्नलिखित निर्देशों को बहुत सावधानी से पढ़िए और उनका सख्ती 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 एक-एक अंक के प्रश्न हैं।
- (iv) खण्ड ख में प्रश्न संख्या 21 से 25 तक अति लघु-उत्तरीय (VSA) प्रकार के दो-दो अंकों के प्रश्न हैं।
- (v) खण्ड ग में प्रश्न संख्या 26 से 31 तक लघु-उत्तरीय (SA) प्रकार के तीन-तीन अंकों के प्रश्न हैं।
- (vi) खण्ड घ में प्रश्न संख्या 32 से 35 तक दीर्घ-उत्तरीय (LA) प्रकार के पाँच-पाँच अंकों के प्रश्न हैं।
- (vii) खण्ड ङ में प्रश्न संख्या 36 से 38 तक प्रकरण अध्ययन आधारित चार-चार अंकों के प्रश्न हैं। प्रत्येक प्रकरण अध्ययन में आंतरिक विकल्प दो-दो 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 बहुविकल्पीय प्रश्न (MCQ) हैं, जिनमें प्रत्येक प्रश्न 1 अंक का है।

1. शून्यक – 3 और 5 वाले बहुपदों की संख्या है :
 

(a) केवल एक	(b) अनन्त
(c) ठीक दो	(d) अधिक-से-अधिक दो
2. समीकरण युग्म  $ax + 2y = 9$  और  $3x + by = 18$  समांतर रेखाएँ निरूपित करेगा, जहाँ a, b पूर्णांक हैं, यदि :
 

(a) $a = b$	(b) $3a = 2b$
(c) $2a = 3b$	(d) $ab = 6$
3. एक A.P., जिसका nवाँ पद  $a_n = 3n + 7$  द्वारा दिया गया है, का सार्व अंतर होगा :
 

(a) 7	(b) 3
(c) $3n$	(d) 1





### General Instructions :

Read the following instructions carefully and 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 calculators is **not** allowed.

### SECTION A

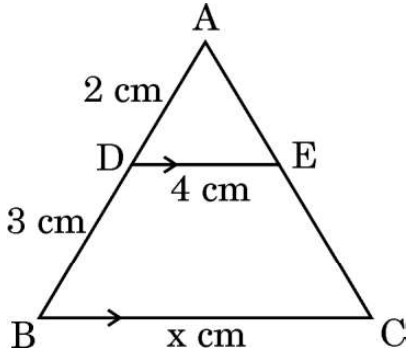
This section comprises multiple choice questions (MCQs) of 1 mark each.

1. The number of polynomials having zeroes  $-3$  and  $5$  is :
  - (a) only one
  - (b) infinite
  - (c) exactly two
  - (d) at most two
2. The pair of equations  $ax + 2y = 9$  and  $3x + by = 18$  represent parallel lines, where  $a, b$  are integers, if :
  - (a)  $a = b$
  - (b)  $3a = 2b$
  - (c)  $2a = 3b$
  - (d)  $ab = 6$
3. The common difference of the A.P. whose  $n^{\text{th}}$  term is given by  $a_n = 3n + 7$ , is :
  - (a)  $7$
  - (b)  $3$
  - (c)  $3n$
  - (d)  $1$





4. दी गई आकृति में,  $DE \parallel BC$ .  $x$  का मान है :



- (a) 6 (b) 12.5  
(c) 8 (d) 10

5. मूल  $(2 + \sqrt{3})$  और  $(2 - \sqrt{3})$  वाला एक द्विघात समीकरण है :

- (a)  $x^2 - 4x + 1 = 0$  (b)  $x^2 + 4x + 1 = 0$   
(c)  $4x^2 - 3 = 0$  (d)  $x^2 - 1 = 0$

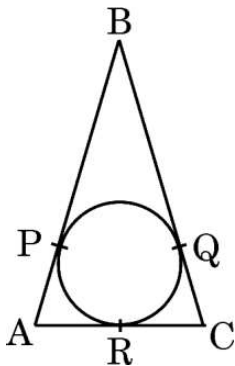
6. यदि  $\tan \theta = \frac{5}{12}$  है, तो  $\frac{\sin \theta + \cos \theta}{\sin \theta - \cos \theta}$  का मान है :

- (a)  $-\frac{17}{7}$  (b)  $\frac{17}{7}$   
(c)  $\frac{17}{13}$  (d)  $-\frac{7}{13}$

7. बिन्दुओं  $P\left(-\frac{11}{3}, 5\right)$  और  $Q\left(-\frac{2}{3}, 5\right)$  के बीच की दूरी है :

- (a) 6 इकाई (b) 4 इकाई  
(c) 2 इकाई (d) 3 इकाई

8. दी गई आकृति में,  $AB = BC = 10$  cm । यदि  $AC = 7$  cm है, तो BP की लम्बाई होगी :

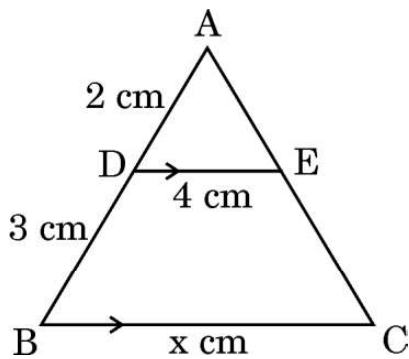


- (a) 3.5 cm (b) 7 cm  
(c) 6.5 cm (d) 5 cm

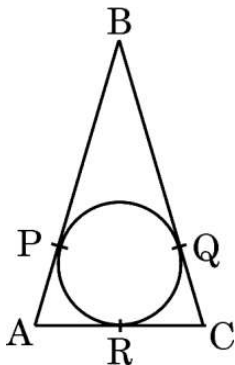




4. In the given figure,  $DE \parallel BC$ . The value of  $x$  is :



- (a) 6 (b) 12.5  
(c) 8 (d) 10
5. A quadratic equation whose roots are  $(2 + \sqrt{3})$  and  $(2 - \sqrt{3})$  is :
- (a)  $x^2 - 4x + 1 = 0$  (b)  $x^2 + 4x + 1 = 0$   
(c)  $4x^2 - 3 = 0$  (d)  $x^2 - 1 = 0$
6. If  $\tan \theta = \frac{5}{12}$ , then the value of  $\frac{\sin \theta + \cos \theta}{\sin \theta - \cos \theta}$  is :
- (a)  $-\frac{17}{7}$  (b)  $\frac{17}{7}$   
(c)  $\frac{17}{13}$  (d)  $-\frac{7}{13}$
7. The distance between the points  $P\left(-\frac{11}{3}, 5\right)$  and  $Q\left(-\frac{2}{3}, 5\right)$  is :
- (a) 6 units (b) 4 units  
(c) 2 units (d) 3 units
8. In the given figure,  $AB = BC = 10$  cm. If  $AC = 7$  cm, then the length of BP is :



- (a) 3.5 cm (b) 7 cm  
(c) 6.5 cm (d) 5 cm





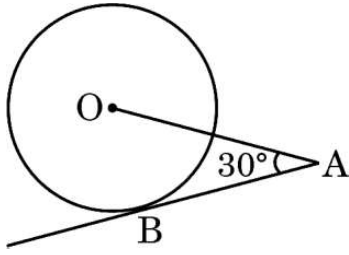
9. 3 m गहरी और 40 m चौड़ी नदी में पानी 2 km/h की दर से बह रहा है । 2 मिनट में समुद्र में कितना पानी गिर जाएगा ?

- (a)  $800 \text{ m}^3$  (b)  $4000 \text{ m}^3$   
(c)  $8000 \text{ m}^3$  (d)  $2000 \text{ m}^3$

10. यदि किन्हीं आँकड़ों के लिए, माध्य और माध्यक क्रमशः 12 और 15 हैं, तो बहुलक होगा :

- (a) 13.5 (b) 21  
(c) 6 (d) 14

11. दी गई आकृति में, केन्द्र O के एक वृत्त पर AB एक स्पर्श-रेखा है । यदि  $OA = 6 \text{ cm}$  और  $\angle OAB = 30^\circ$  है, तो वृत्त की त्रिज्या होगी :



- (a) 3 cm (b)  $3\sqrt{3} \text{ cm}$   
(c) 2 cm (d)  $\sqrt{3} \text{ cm}$

12.  $\left( \frac{2 \tan 30^\circ}{1 + \tan^2 30^\circ} \right)$  बराबर है :

- (a)  $\sin 60^\circ$  (b)  $\cos 60^\circ$   
(c)  $\tan 60^\circ$  (d)  $\sin 30^\circ$

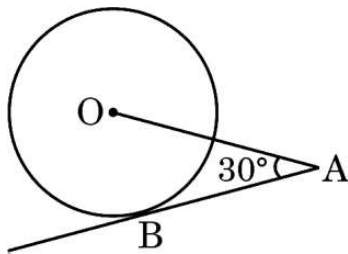
13. त्रिभुजों ABC और DEF में,  $\frac{AB}{DE} = \frac{BC}{FD}$  । निम्नलिखित में से कौन-सा इन दो त्रिभुजों को समरूप बनाएगा ?

- (a)  $\angle A = \angle D$  (b)  $\angle B = \angle D$   
(c)  $\angle B = \angle E$  (d)  $\angle A = \angle F$





9. Water in a river which is 3 m deep and 40 m wide is flowing at the rate of 2 km/h. How much water will fall into the sea in 2 minutes ?
- (a)  $800 \text{ m}^3$  (b)  $4000 \text{ m}^3$   
(c)  $8000 \text{ m}^3$  (d)  $2000 \text{ m}^3$
10. If the mean and the median of a data are 12 and 15 respectively, then its mode is :
- (a) 13.5 (b) 21  
(c) 6 (d) 14
11. In the given figure, AB is a tangent to the circle centered at O. If  $OA = 6 \text{ cm}$  and  $\angle OAB = 30^\circ$ , then the radius of the circle is :



- (a) 3 cm (b)  $3\sqrt{3} \text{ cm}$   
(c) 2 cm (d)  $\sqrt{3} \text{ cm}$
12.  $\left( \frac{2 \tan 30^\circ}{1 + \tan^2 30^\circ} \right)$  is equal to :
- (a)  $\sin 60^\circ$  (b)  $\cos 60^\circ$   
(c)  $\tan 60^\circ$  (d)  $\sin 30^\circ$
13. In  $\Delta ABC$  and  $\Delta DEF$ ,  $\frac{AB}{DE} = \frac{BC}{FD}$ . Which of the following makes the two triangles similar ?
- (a)  $\angle A = \angle D$  (b)  $\angle B = \angle D$   
(c)  $\angle B = \angle E$  (d)  $\angle A = \angle F$





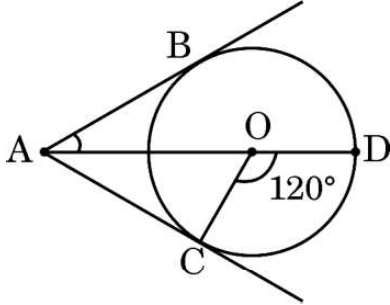
14. A.P. : 10, 7, 4, ....., - 62 में अंतिम पद से 11वाँ पद है :

- (a) 25 (b) 16  
(c) - 32 (d) 0

15. दो सिक्के एक साथ उछाले जाते हैं। कम-से-कम एक पट आने की प्रायिकता होगी :

- (a)  $\frac{1}{4}$  (b)  $\frac{1}{2}$   
(c)  $\frac{3}{4}$  (d) 1

16. दी गई आकृति में, केन्द्र O वाले एक वृत्त पर AC और AB स्पर्श-रेखाएँ हैं। यदि  $\angle COD = 120^\circ$  है, तो  $\angle BAO$  बराबर है :



- (a)  $30^\circ$  (b)  $60^\circ$   
(c)  $45^\circ$  (d)  $90^\circ$

17. निम्नलिखित में से कौन-सी संख्या, किसी घटना के घटने की प्रायिकता *नहीं* हो सकती है ?

- (a) 0 (b)  $\frac{7}{0.01}$   
(c) 0.07 (d)  $\frac{0.07}{3}$

18. यदि किसी सांख्यिकी आँकड़ों, जिसमें n पद हैं, के प्रत्येक पद को 2 से कम कर दिया जाए, तो आँकड़ों का माध्य :

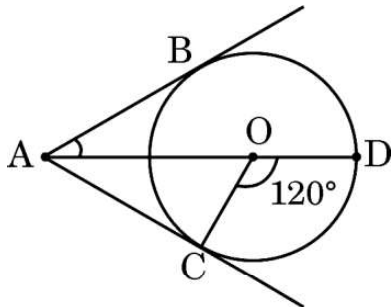
- (a) 2 कम हो जाएगा  
(b) अपरिवर्तित रहेगा  
(c)  $2n$  कम हो जाएगा  
(d) 1 कम हो जाएगा







14. The 11<sup>th</sup> term from the end of the A.P. : 10, 7, 4, ....., - 62 is :
- (a) 25 (b) 16  
(c) - 32 (d) 0
15. Two coins are tossed together. The probability of getting at least one tail is :
- (a)  $\frac{1}{4}$  (b)  $\frac{1}{2}$   
(c)  $\frac{3}{4}$  (d) 1
16. In the given figure, AC and AB are tangents to a circle centered at O. If  $\angle COD = 120^\circ$ , then  $\angle BAO$  is equal to :



- (a)  $30^\circ$  (b)  $60^\circ$   
(c)  $45^\circ$  (d)  $90^\circ$
17. Which of the following numbers **cannot** be the probability of happening of an event ?
- (a) 0 (b)  $\frac{7}{0.01}$   
(c) 0.07 (d)  $\frac{0.07}{3}$
18. If every term of the statistical data consisting of n terms is decreased by 2, then the mean of the data :
- (a) decreases by 2  
(b) remains unchanged  
(c) decreases by 2n  
(d) decreases by 1





प्रश्न संख्या 19 और 20 अभिकथन एवं तर्क आधारित प्रश्न हैं और प्रत्येक प्रश्न का 1 अंक है। 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) : यदि केन्द्र  $O(2, 3)$  वाले एक वृत्त पर बिंदु  $A(4, 3)$  और  $B(x, 5)$  स्थित हैं, तो  $x$  का मान 2 होगा।

तर्क (R) : वृत्त की प्रत्येक जीवा का मध्य-बिंदु, वृत्त का केन्द्र होता है।

20. अभिकथन (A) : संख्या  $5^n$  कभी भी अंक शून्य (0) पर समाप्त नहीं होती है, जहाँ  $n$  कोई भी प्राकृत संख्या है।

तर्क (R) : 5 के अभाज्य गुणनखंडन में केवल दो ही गुणनखंड हैं, 1 और 5।

### खण्ड ख

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

21. (क) बिन्दु  $A(4, -5)$  और  $B(4, 5)$  को मिलाने वाले रेखाखंड को बिन्दु P से इस प्रकार विभाजित किया जाता है कि  $AP : AB = 2 : 5$  है। बिन्दु P के निर्देशांक ज्ञात कीजिए।

अथवा

(ख) बिन्दु  $P(x, y)$ , बिन्दुओं  $A(5, 1)$  तथा  $B(1, 5)$  से समदूरस्थ है। सिद्ध कीजिए कि  $x = y$ .





Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. 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) : If the points A(4, 3) and B(x, 5) lie on a circle with centre O(2, 3), then the value of x is 2.

Reason (R) : Centre of a circle is the mid-point of each chord of the circle.

**20.** Assertion (A) : The number  $5^n$  cannot end with the digit 0, where n is a natural number.

Reason (R): Prime factorisation of 5 has only two factors, 1 and 5.

### SECTION B

This section comprises very short answer (VSA) type questions of 2 marks each.

**21.** (a) The line segment joining the points A(4, - 5) and B(4, 5) is divided by the point P such that  $AP : AB = 2 : 5$ . Find the coordinates of P.

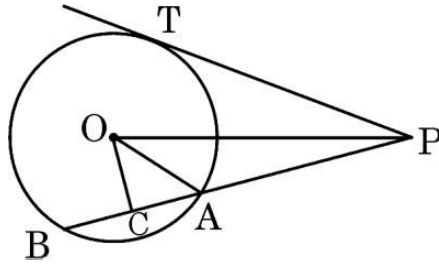
**OR**

(b) Point P(x, y) is equidistant from points A(5, 1) and B(1, 5). Prove that  $x = y$ .





22. दी गई आकृति में, केन्द्र O वाले वृत्त पर PT एक स्पर्श-रेखा है। जीवा AB पर OC लंबवत है। सिद्ध कीजिए कि  $PA \cdot PB = PC^2 - AC^2$ .



23. अभाज्य गुणखंडन से 96 और 120 का HCF और LCM ज्ञात कीजिए।
24. बिन्दुओं  $(5, -6)$  और  $(-1, -4)$  को मिलाने वाले रेखाखंड को  $y$ -अक्ष जिस अनुपात में विभाजित करता है, उस अनुपात को ज्ञात कीजिए।
25. (क) यदि  $a \cos \theta + b \sin \theta = m$  तथा  $a \sin \theta - b \cos \theta = n$  है, तो सिद्ध कीजिए कि  $a^2 + b^2 = m^2 + n^2$ .

अथवा

- (ख) सिद्ध कीजिए :

$$\sqrt{\frac{\sec A - 1}{\sec A + 1}} + \sqrt{\frac{\sec A + 1}{\sec A - 1}} = 2 \operatorname{cosec} A$$

खण्ड ग

इस खण्ड में लघु-उत्तरीय (SA) प्रकार के प्रश्न हैं, जिनमें प्रत्येक के 3 अंक हैं।

26. (क) सिद्ध कीजिए कि  $\sqrt{3}$  एक अपरिमेय संख्या है।

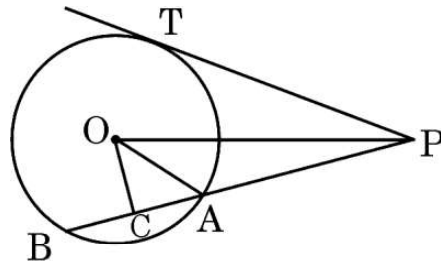
अथवा

- (ख) तीन अलग-अलग रोड क्रॉसिंग पर ट्रैफिक लाइट क्रमशः प्रत्येक 48 सेकण्ड, 72 सेकण्ड और 108 सेकण्ड के बाद बदल जाती हैं। यदि वे एक साथ सुबह 7 बजे बदलती हैं, तो वे आगे किस समय एक साथ बदलेंगी ?





22. In the given figure,  $PT$  is a tangent to the circle centered at  $O$ .  $OC$  is perpendicular to chord  $AB$ . Prove that  $PA \cdot PB = PC^2 - AC^2$ .



23. Using prime factorisation, find HCF and LCM of 96 and 120.
24. Find the ratio in which y-axis divides the line segment joining the points  $(5, -6)$  and  $(-1, -4)$ .
25. (a) If  $a \cos \theta + b \sin \theta = m$  and  $a \sin \theta - b \cos \theta = n$ , then prove that  $a^2 + b^2 = m^2 + n^2$ .

**OR**

- (b) Prove that :

$$\sqrt{\frac{\sec A - 1}{\sec A + 1}} + \sqrt{\frac{\sec A + 1}{\sec A - 1}} = 2 \operatorname{cosec} A$$

### SECTION C

*This section comprises short answer (SA) type questions of 3 marks each.*

26. (a) Prove that  $\sqrt{3}$  is an irrational number.

**OR**

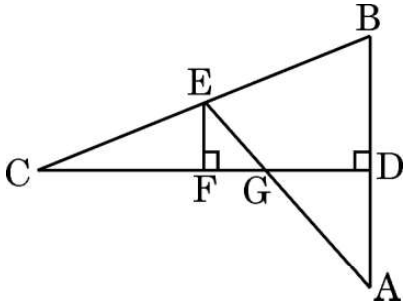
- (b) The traffic lights at three different road crossings change after every 48 seconds, 72 seconds and 108 seconds respectively. If they change simultaneously at 7 a.m., at what time will they change together next ?





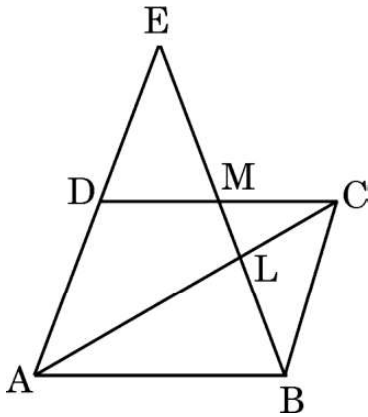
27. यदि एक A.P. का  $p$ वाँ पद  $q$  और  $q$ वाँ पद  $p$  है, तो सिद्ध कीजिए कि इसका  $n$ वाँ पद  $(p + q - n)$  होगा ।

28. (क) दी गई आकृति में,  $CD$ ,  $AB$  का लंब समद्विभाजक है ।  $EF$ ,  $CD$  के लंबवत है ।  $AE$ ,  $CD$  को  $G$  पर काटती है । सिद्ध कीजिए कि  $\frac{CF}{CD} = \frac{FG}{DG}$ .



अथवा

(ख) दी गई आकृति में,  $ABCD$  एक समांतर चतुर्भुज है ।  $BE$ ,  $CD$  को  $M$  पर समद्विभाजित करती है और  $AC$  को  $L$  पर काटती है । सिद्ध कीजिए कि  $EL = 2BL$ .



29. दो व्यक्ति एक सीधी सड़क पर 16 km की दूरी पर हैं । वे एक ही समय पर चलना आरम्भ करते हैं । यदि वे एक-दूसरे की ओर भिन्न चाल से चलते हैं, तो 2 घंटे पश्चात् मिलते हैं । यदि वे एक ही दिशा में पहले जैसी चाल से चलते हैं, तो 8 घंटे पश्चात् मिलते हैं । दोनों व्यक्तियों के चलने की चाल ज्ञात कीजिए ।

30. सिद्ध कीजिए :

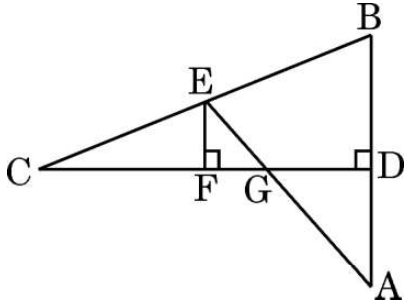
$$\frac{\tan \theta}{1 - \cot \theta} + \frac{\cot \theta}{1 - \tan \theta} = 1 + \sec \theta \operatorname{cosec} \theta$$





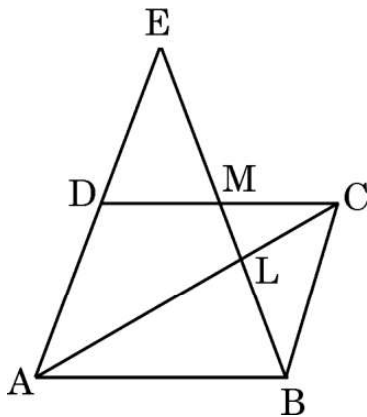
27. If  $p^{\text{th}}$  term of an A.P. is  $q$  and  $q^{\text{th}}$  term is  $p$ , then prove that its  $n^{\text{th}}$  term is  $(p + q - n)$ .

28. (a) In the given figure,  $CD$  is the perpendicular bisector of  $AB$ .  $EF$  is perpendicular to  $CD$ .  $AE$  intersects  $CD$  at  $G$ . Prove that  $\frac{CF}{CD} = \frac{FG}{DG}$ .



OR

(b) In the given figure,  $ABCD$  is a parallelogram.  $BE$  bisects  $CD$  at  $M$  and intersects  $AC$  at  $L$ . Prove that  $EL = 2BL$ .



29. Two people are 16 km apart on a straight road. They start walking at the same time. If they walk towards each other with different speeds, they will meet in 2 hours. Had they walked in the same direction with same speeds as before, they would have met in 8 hours. Find their walking speeds.

30. Prove that :

$$\frac{\tan \theta}{1 - \cot \theta} + \frac{\cot \theta}{1 - \tan \theta} = 1 + \sec \theta \operatorname{cosec} \theta$$





31. निम्नलिखित बारंबारता बंटन का माध्य ज्ञात कीजिए :

वर्ग अंतराल	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55	55 – 60
बारंबारता	14	22	16	6	5	3	4

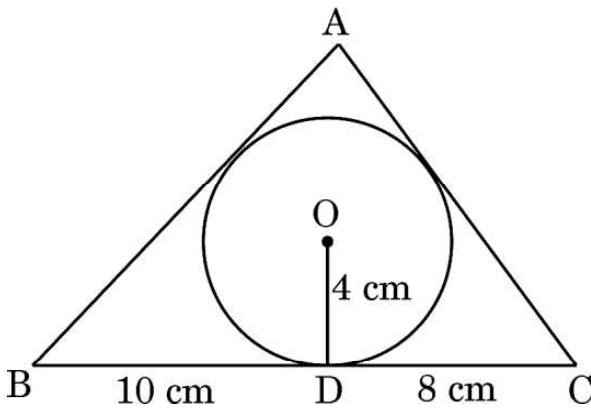
### खण्ड घ

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

32. एक प्रेक्षक एक गर्म हवा के गुब्बारे की टोकरी के उन्नयन कोण का अनुमान  $60^\circ$  लगाता है, जबकि एक अन्य पर्यवेक्षक जो 100 m दूर है, उन्नयन कोण का अनुमान  $30^\circ$  लगाता है। ज्ञात कीजिए :

- (क) जमीन से टोकरी की ऊँचाई।
- (ख) पहले प्रेक्षक की आँख से टोकरी की दूरी।
- (ग) टोकरी से दूसरे प्रेक्षक की क्षैतिज दूरी।

33. (क) 4 cm त्रिज्या वाले एक वृत्त के परिगत एक त्रिभुज ABC इस प्रकार खींचा गया है कि रेखाखंड BD और DC की लंबाइयाँ क्रमशः 10 cm और 8 cm हैं। भुजाएँ AB और AC की लंबाइयाँ ज्ञात कीजिए, यदि दिया गया है कि  $\Delta ABC$  का क्षेत्रफल  $90 \text{ cm}^2$  है।



अथवा







31. Find the mean of the following frequency distribution :

Classes	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55	55 – 60
Frequency	14	22	16	6	5	3	4

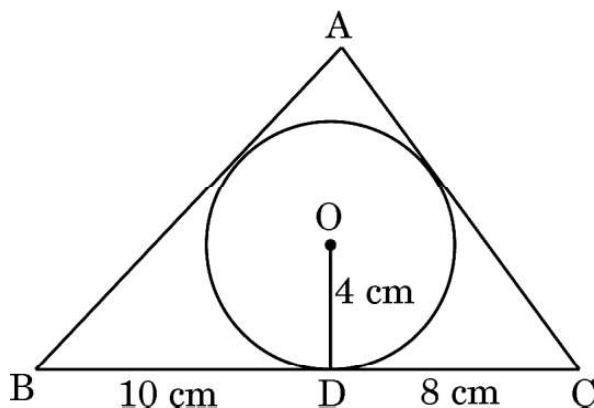
### SECTION D

*This section comprises long answer (LA) type questions of 5 marks each.*

32. One observer estimates the angle of elevation to the basket of a hot air balloon to be  $60^\circ$ , while another observer 100 m away estimates the angle of elevation to be  $30^\circ$ . Find :

- (a) The height of the basket from the ground.
- (b) The distance of the basket from the first observer's eye.
- (c) The horizontal distance of the second observer from the basket.

33. (a) A triangle ABC is drawn to circumscribe a circle of radius 4 cm such that the segments BD and DC are of lengths 10 cm and 8 cm respectively. Find the lengths of the sides AB and AC, if it is given that area  $\Delta ABC = 90 \text{ cm}^2$ .

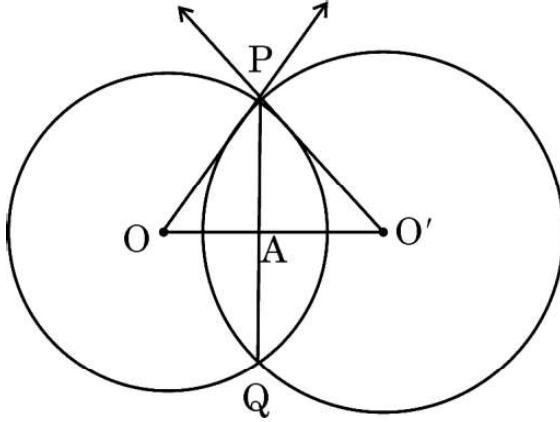


**OR**





- (ख) दो वृत्त हैं जिनके केंद्र O और O' हैं, और त्रिज्याएँ क्रमशः 6 cm और 8 cm हैं। दो बिन्दुओं P और Q पर वे इस प्रकार प्रतिच्छेद करते हैं कि OP और O'P दो वृत्तों की स्पर्श-रेखाएँ हैं। उभयनिष्ठ जीवा PQ की लम्बाई ज्ञात कीजिए।



34. (क) एक रेलगाड़ी एक औसतन गति से 54 km की दूरी तय करती है और बाद में 63 km की दूरी पहली गति से 6 km/h अधिक औसतन गति से तय करती है। यदि रेलगाड़ी पूरी यात्रा 3 घंटों में तय करती है, तो इसकी पहली औसतन गति क्या थी ?

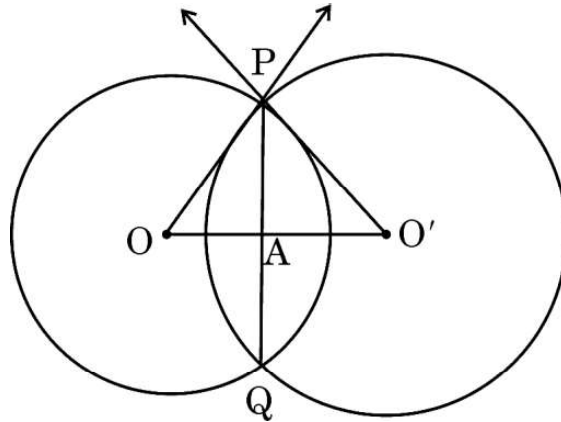
अथवा

- (ख) दो पाइप मिलकर एक टैंक को  $\frac{15}{8}$  घंटों में भर सकते हैं। अधिक व्यास वाला पाइप, छोटे व्यास वाले पाइप से, 2 घंटे कम में टैंक को भर सकता है। दोनों पाइप अलग-अलग टैंक को कितने समय में भर सकते हैं, ज्ञात कीजिए।
35. 15 m भुजा वाले एक वर्गाकार घास के मैदान के एक कोने पर लगे खूँटे से एक घोड़े को 5 m लंबी रस्सी से बाँध दिया गया है। इस मैदान के उस भाग का क्षेत्रफल, जहाँ घोड़ा घास चर सकता है, ज्ञात कीजिए। यदि रस्सी की लंबाई बढ़ाकर 10 m कर दी जाए तो घास चर सकने वाले क्षेत्रफल में बढ़ोतरी भी ज्ञात कीजिए। ( $\pi = 3.14$  का प्रयोग कीजिए)





- (b) Two circles with centres  $O$  and  $O'$  of radii 6 cm and 8 cm, respectively intersect at two points  $P$  and  $Q$  such that  $OP$  and  $O'P$  are tangents to the two circles. Find the length of the common chord  $PQ$ .



34. (a) A train travels at a certain average speed for a distance of 54 km and then travels a distance of 63 km at an average speed of 6 km/h more than the first speed. If it takes 3 hours to complete the journey, what was its first average speed ?

**OR**

- (b) Two pipes together can fill a tank in  $\frac{15}{8}$  hours. The pipe with larger diameter takes 2 hours less than the pipe with smaller diameter to fill the tank separately. Find the time in which each pipe can fill the tank separately.
35. A horse is tied to a peg at one corner of a square shaped grass field of side 15 m by means of a 5 m long rope. Find the area of that part of the field in which the horse can graze. Also, find the increase in grazing area if length of rope is increased to 10 m. (Use  $\pi = 3.14$ )



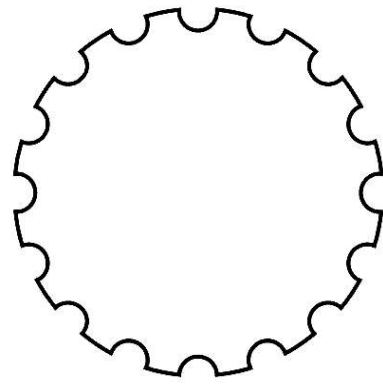


## खण्ड ड

इस खण्ड में 3 प्रकरण अध्ययन आधारित प्रश्न हैं जिनमें प्रत्येक के 4 अंक हैं ।

### प्रकरण अध्ययन - 1

36. एक गोल्फ की गेंद लगभग 300 – 500 डिम्पल के साथ गोलाकार होती है, जो खेलने के दौरान उसके वेग को बढ़ाने में मदद करते हैं । गोल्फ की गेंद पारंपरिक रूप से सफेद होती है, लेकिन रंगों में भी उपलब्ध होती है । दी गई आकृति में, एक गोल्फ की गेंद का व्यास 4.2 cm और इसकी सतह पर त्रिज्या 2 mm के 315 डिम्पल (अर्ध-गोलाकार) हैं ।



उपर्युक्त के आधार पर, निम्न प्रश्नों के उत्तर दीजिए :

- (i) एक ऐसे डिम्पल का पृष्ठीय क्षेत्रफल ज्ञात कीजिए । 1
- (ii) एक डिम्पल बनाने के लिए खोदी गई सामग्री का आयतन ज्ञात कीजिए । 1
- (iii) (क) परिवेश के संपर्क में आने वाला कुल पृष्ठीय क्षेत्रफल ज्ञात कीजिए । 2
- अथवा
- (iii) (ख) गोल्फ की गेंद का आयतन ज्ञात कीजिए । 2



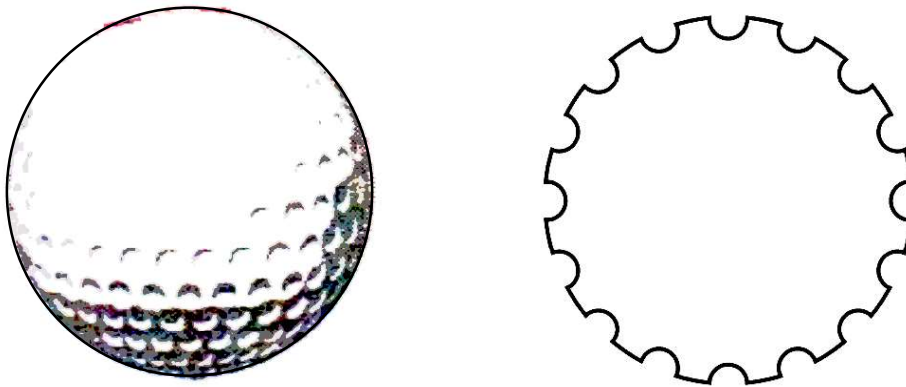


## SECTION E

*This section comprises 3 case study based questions of 4 marks each.*

### Case Study – 1

36. A golf ball is spherical with about 300 – 500 dimples that help increase its velocity while in play. Golf balls are traditionally white but available in colours also. In the given figure, a golf ball has diameter 4.2 cm and the surface has 315 dimples (hemi-spherical) of radius 2 mm.



Based on the above, answer the following questions :

- (i) Find the surface area of one such dimple. 1
- (ii) Find the volume of the material dug out to make one dimple. 1
- (iii) (a) Find the total surface area exposed to the surroundings. 2

**OR**

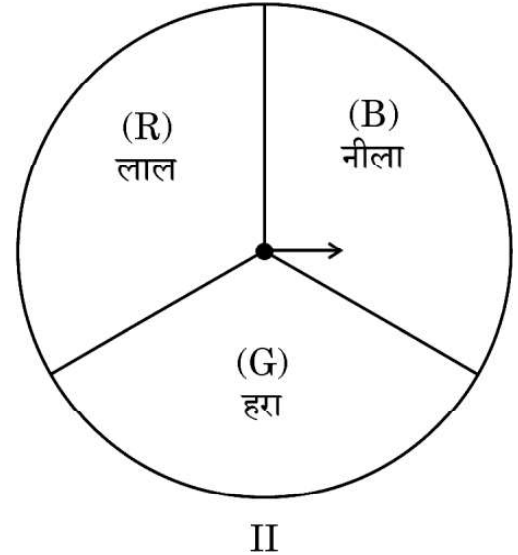
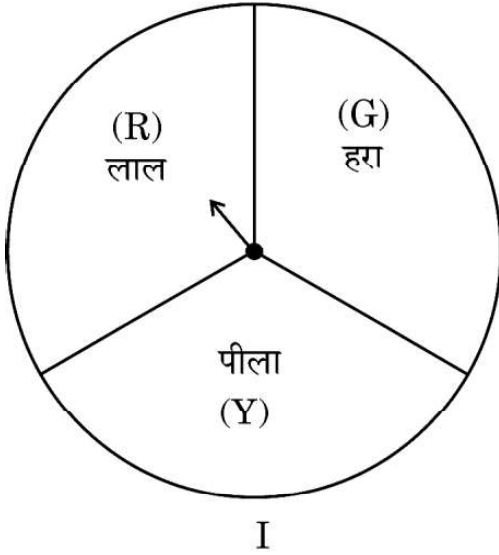
- (iii) (b) Find the volume of the golf ball. 2





## प्रकरण अध्ययन - 2

37. एक मिडिल स्कूल ने क्रिसमस कार्निवल पर निम्नलिखित स्पिनर गेम को फंड-रेज़र के रूप में चलाने का निर्णय लिया ।



**बैंगनी रंग बनाना :** प्रत्येक स्पिनर को एक बार स्पिन कीजिए । नीला और लाल, बैंगनी बनाते हैं । इसलिए, यदि एक स्पिनर लाल (R) और दूसरा नीला (B) दिखाता है, तो आप 'जीतते' हो । ऐसे परिणाम पर 'RB' लिखा जाता है ।

उपर्युक्त के आधार पर, निम्न प्रश्नों के उत्तर दीजिए :

- (i) गेम के सभी संभव परिणामों की सूची बनाइए । 1
- (ii) 'बैंगनी रंग बनाने' की प्रायिकता ज्ञात कीजिए । 1
- (iii) (क) प्रत्येक जीत के लिए, प्रतिभागी को ₹ 10 मिलते हैं, लेकिन अगर वह हार जाता है, तो उसे स्कूल को ₹ 5 का भुगतान करना होगा ।  
यदि 99 प्रतिभागियों ने गेम खेला हो, तो स्कूल ने कितना फंड एकत्र किया होगा ? 2

अथवा

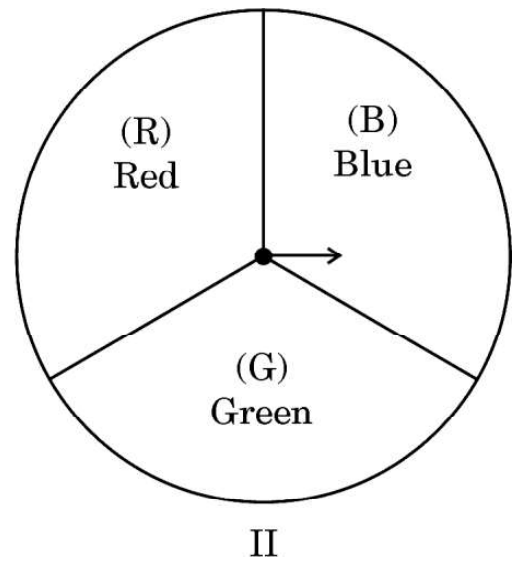
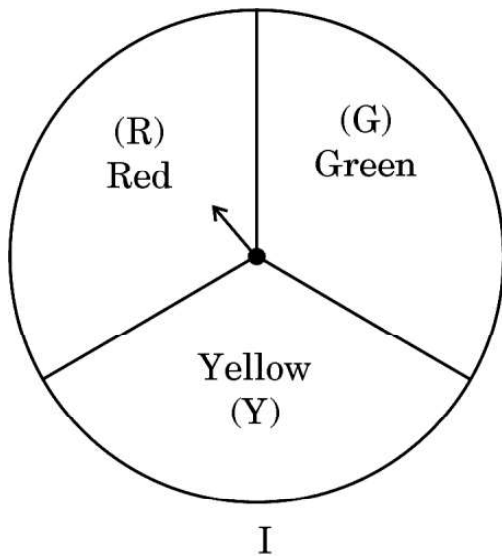
- (iii) (ख) यदि खेल में जीत या हार के लिए ₹ 5 की समान राशि तय की गई है, तो स्कूल ने कितना फंड एकत्र किया होगा ? (प्रतिभागियों की संख्या = 99) 2





## Case Study - 2

37. A middle school decided to run the following spinner game as a fund-raiser on Christmas Carnival.



*Making Purple* : Spin each spinner once. Blue and red make purple. So, if one spinner shows Red (R) and another Blue (B), then you 'win'. One such outcome is written as 'RB'.

Based on the above, answer the following questions :

- (i) List all possible outcomes of the game. 1
- (ii) Find the probability of 'Making Purple'. 1
- (iii) (a) For each win, a participant gets ₹ 10, but if he/she loses, he/she has to pay ₹ 5 to the school.  
If 99 participants played, calculate how much fund could the school have collected. 2

**OR**

- (iii) (b) If the same amount of ₹ 5 has been decided for winning or losing the game, then how much fund had been collected by school ? (Number of participants = 99) 2







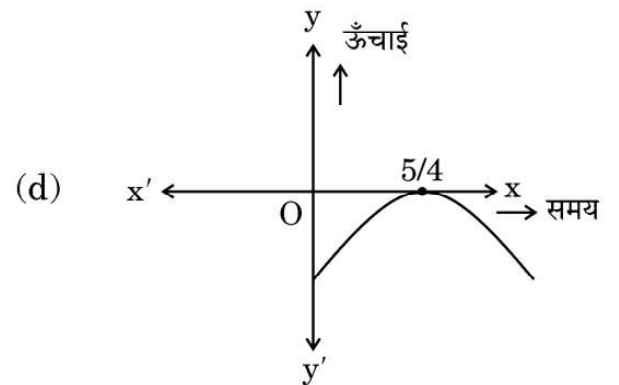
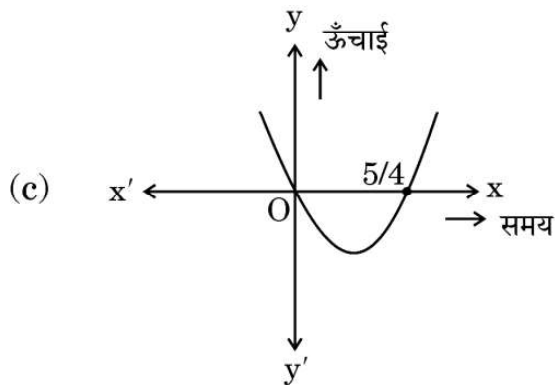
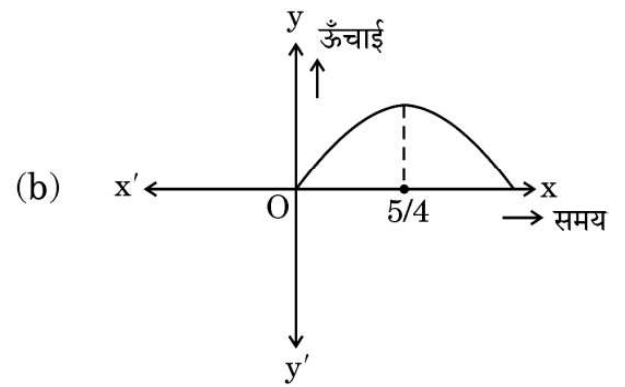
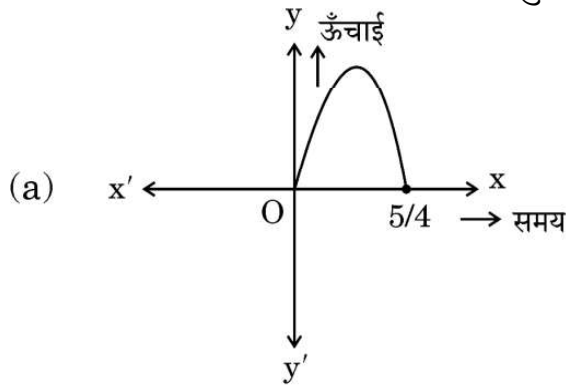
### प्रकरण अध्ययन - 3

38. एक्वेरियम के एक पूल में, एक डॉल्फिन 20 सेमी प्रति सेकण्ड की गति से यात्रा करते हुए, पानी से बाहर कूदती है।  $t$  सेकण्ड के बाद जल स्तर से उसकी ऊँचाई  $h = 20t - 16t^2$  द्वारा दी जाती है।



उपर्युक्त के आधार पर, निम्न प्रश्नों के उत्तर दीजिए :

- (i) बहुपद  $p(t) = 20t - 16t^2$  के शून्यक ज्ञात कीजिए। 1
- (ii) निम्नलिखित में से कौन-सा ग्राफ बहुपद  $p(t)$  को निरूपित करता है ? 1







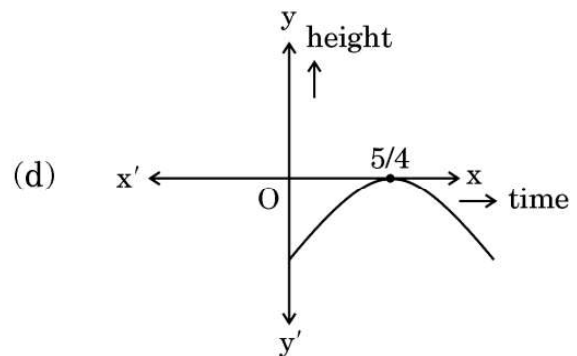
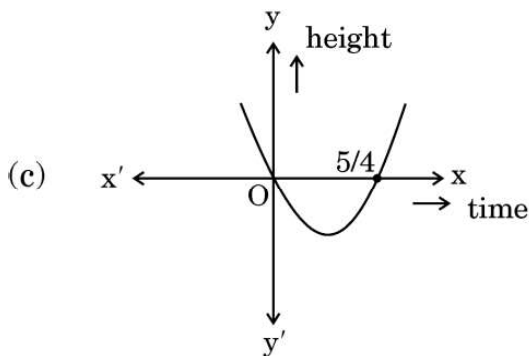
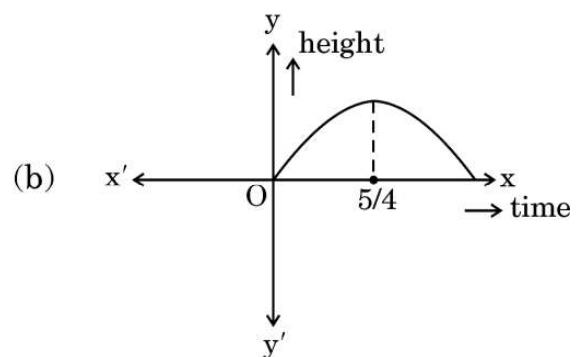
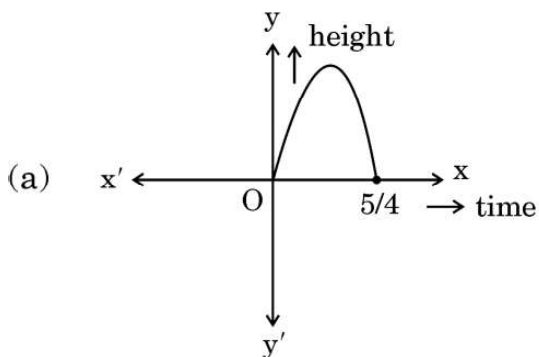
### Case Study - 3

38. In a pool at an aquarium, a dolphin jumps out of the water travelling at 20 cm per second. Its height above water level after  $t$  seconds is given by  $h = 20t - 16t^2$ .



Based on the above, answer the following questions :

- (i) Find zeroes of polynomial  $p(t) = 20t - 16t^2$ . 1
- (ii) Which of the following types of graph represents  $p(t)$ ? 1





(iii) (क)  $t = \frac{3}{2}$  पर h का मान क्या होगा ? परिणाम की व्याख्या कीजिए । 2

अथवा

(iii) (ख) दोबारा जल स्तर से टकराने से पहले डॉल्फिन ने कितनी दूरी तय की है ? 2





- (iii) (a) What would be the value of  $h$  at  $t = \frac{3}{2}$  ? Interpret the result. 2

**OR**

- (iii) (b) How much distance has the dolphin covered before hitting the water level again ? 2



**Marking Scheme**  
**Strictly Confidential**  
**(For Internal and Restricted use only)**  
**Secondary School Examination, 2023**  
**MATHEMATICS PAPER CODE 30/5/1**

**General Instructions: -**

<b>1</b>	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.
<b>2</b>	<b>“Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its’ 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.”</b>
<b>3</b>	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. <b>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.</b>
<b>4</b>	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.
<b>5</b>	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.
<b>6</b>	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. <b>This is most common mistake which evaluators are committing.</b>
<b>7</b>	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.
<b>8</b>	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	<b><u>In Q1-Q20, if a candidate attempts the question more than once (without canceling the previous attempt), marks shall be awarded for the first attempt only and the other answer scored out with a note “Extra Question”.</u></b>
10	<b><u>In Q21-Q38, 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”.</u></b>
11	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
12	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.
13	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.
14	Ensure that you do not make the following common types of errors committed by the Examiner in the past: - <ul style="list-style-type: none"> <li>● Leaving answer or part thereof unassessed in an answer book.</li> <li>● Giving more marks for an answer than assigned to it.</li> <li>● Wrong totaling of marks awarded on an answer.</li> <li>● Wrong transfer of marks from the inside pages of the answer book to the title page.</li> <li>● Wrong question wise totaling on the title page.</li> <li>● Wrong totaling of marks of the two columns on the title page.</li> <li>● Wrong grand total.</li> <li>● Marks in words and figures not tallying/not same.</li> <li>● Wrong transfer of marks from the answer book to online award list.</li> <li>● 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.)</li> <li>● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.</li> </ul>
15	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.
16	Any un assessed 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.
17	The Examiners should acquaint themselves with the guidelines given in the “ <b>Guidelines for spot Evaluation</b> ” before starting the actual evaluation.
18	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.
19	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.



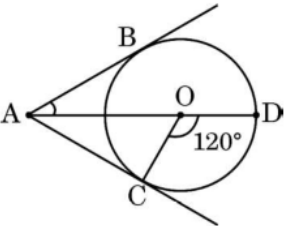








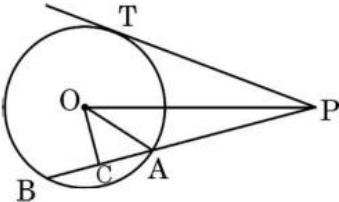


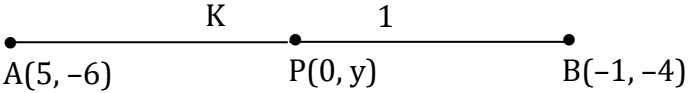
<b>Sol.</b>	(c) – 32	<b>1</b>
<b>15.</b>	Two coins are tossed together. The probability of getting at least one tail is : (a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{3}{4}$ (d) 1	
<b>Sol.</b>	(c) $\frac{3}{4}$	<b>1</b>
<b>16.</b>	In the given figure, AC and AB are tangents to a circle centered at O. If $\angle COD = 120^\circ$ , then $\angle BAO$ is equal to :  (a) $30^\circ$ (b) $60^\circ$ (c) $45^\circ$ (d) $90^\circ$	
<b>Sol.</b>	(a) $30^\circ$	<b>1</b>
<b>17.</b>	Which of the following numbers <b>cannot</b> be the probability of happening of an event ? (a) 0 (b) $\frac{7}{0.01}$ (c) 0.07 (d) $\frac{0.07}{3}$	
<b>Sol.</b>	(b) $\frac{7}{0.01}$	<b>1</b>

18.	<p>If every term of the statistical data consisting of <math>n</math> terms is decreased by 2, then the mean of the data :</p> <p>(a) decreases by 2  (b) remains unchanged  (c) decreases by <math>2n</math>  (d) decreases by 1</p>	
Sol.	<b>(a) decreases by 2</b>	<b>1</b>
<p><i>Questions number 19 and 20 are Assertion and Reason based questions carrying 1 mark each. 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.</i></p> <p>(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 <b>not</b> 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.</p>		
19.	<p><i>Assertion (A) :</i> If the points A(4, 3) and B(x, 5) lie on a circle with centre O(2, 3), then the value of x is 2.</p> <p><i>Reason (R) :</i> Centre of a circle is the mid-point of each chord of the circle.</p>	
Sol.	<b>(c) Assertion (A) is true, but Reason (R) is false</b>	<b>1</b>
20.	<p><i>Assertion (A) :</i> The number <math>5^n</math> cannot end with the digit 0, where <math>n</math> is a natural number.</p> <p><i>Reason (R) :</i> Prime factorisation of 5 has only two factors, 1 and 5.</p>	

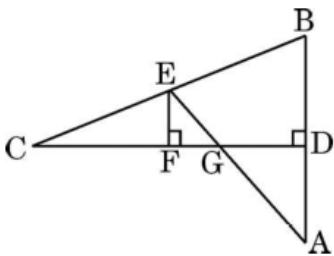




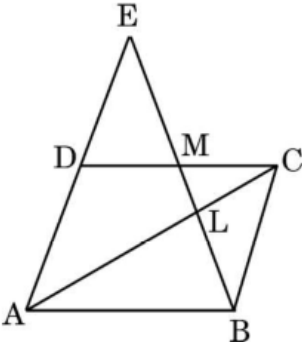
22.	<p>In the given figure, PT is a tangent to the circle centered at O. OC is perpendicular to chord AB. Prove that <math>PA \cdot PB = PC^2 - AC^2</math>.</p> 	
Sol.	$PA \cdot PB = (PC - AC) \cdot (PC + AC)$ $= (PC - AC)(PC + AC) \quad [AC = BC]$ $= PC^2 - AC^2$	<p>1</p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>
23.	Using prime factorisation, find HCF and LCM of 96 and 120.	
ol.	$96 = 2 \times 2 \times 2 \times 2 \times 2 \times 3$ $= 2^5 \times 3$ $120 = 2 \times 2 \times 2 \times 3 \times 5$ $= 2^3 \times 3 \times 5$ <p><b>HCF = 24</b></p> <p><b>LCM = 480</b></p>	<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>
24.	Find the ratio in which y-axis divides the line segment joining the points (5, -6) and (-1, -4).	

<p>Sol.</p>	 <p>Let the point of division be P(0, y) which divides AB in the ratio K : 1</p> $0 = \frac{-K + 5}{K + 1} \Rightarrow K = 5$ <p>Ratio is 5:1</p>	<p><math>\frac{1}{2}</math></p> <p>1</p> <p><math>\frac{1}{2}</math></p>
<p>25(a).</p>	<p>If <math>a \cos \theta + b \sin \theta = m</math> and <math>a \sin \theta - b \cos \theta = n</math>, then prove that <math>a^2 + b^2 = m^2 + n^2</math>.</p>	
<p>Sol.</p>	$m^2 + n^2 = (a \cos \theta + b \sin \theta)^2 + (a \sin \theta - b \cos \theta)^2$ $= a^2(\cos^2 \theta + \sin^2 \theta) + b^2(\sin^2 \theta + \cos^2 \theta)$ $= a^2 + b^2$	<p><math>\frac{1}{2}</math></p> <p>1</p> <p><math>\frac{1}{2}</math></p>
	<p>OR</p>	
<p>25(b).</p>	<p>Prove that :</p> $\sqrt{\frac{\sec A - 1}{\sec A + 1}} + \sqrt{\frac{\sec A + 1}{\sec A - 1}} = 2 \operatorname{cosec} A$	
<p>Sol.</p>	$\text{LHS} = \frac{\sqrt{\sec A - 1}}{\sqrt{\sec A + 1}} + \frac{\sqrt{\sec A + 1}}{\sqrt{\sec A - 1}}$ $= \frac{\sec A - 1 + \sec A + 1}{\sqrt{\sec^2 A - 1}}$	<p>1</p>

	$= \frac{2 \sec A}{\tan A}$ $= 2 \operatorname{cosec} A = \text{RHS}$	$\frac{1}{2}$  $\frac{1}{2}$
	<b>SECTION C</b> <b>This section comprises of short answer (SA) type questions of 3 marks each.</b>	
26(a).	Prove that $\sqrt{3}$ is an irrational number.	
Sol.	<p>Let <math>\sqrt{3}</math> be a rational number.</p> <p><math>\therefore \sqrt{3} = \frac{p}{q}</math>, let p &amp; q be co-primes and <math>q \neq 0</math></p> <p><math>3q^2 = p^2 \Rightarrow p^2</math> is divisible by 3 <math>\Rightarrow p</math> is divisible by 3</p> <p><math>\Rightarrow p = 3a</math>, where 'a' is some integer ----- (i)</p> <p><math>9a^2 = 3q^2 \Rightarrow q^2 = 3a^2 \Rightarrow q^2</math> is divisible by 3 <math>\Rightarrow q</math> is divisible by 3</p> <p><math>\Rightarrow q = 3b</math>, where 'b' is some integer ----- (ii)</p> <p>(i) and (ii) leads to contradiction as 'p' and 'q' are co-primes.</p> <p><math>\therefore \sqrt{3}</math> is an irrational number.</p>	$\frac{1}{2}$  <b>1</b>  $\frac{1}{2}$  <b>1</b>
	<b>OR</b>	
26(b)	The traffic lights at three different road crossings change after every 48 seconds, 72 seconds and 108 seconds respectively. If they change simultaneously at 7 a.m., at what time will they change together next ?	

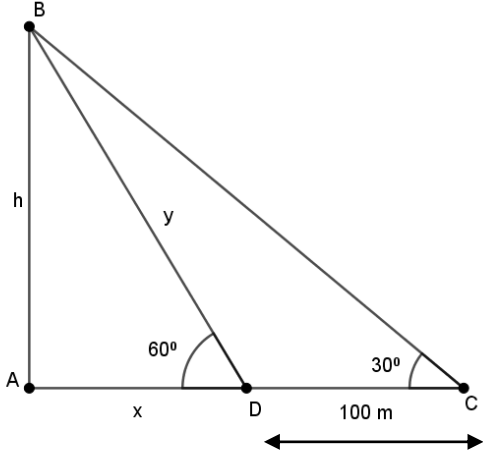
Sol.	<p>LCM = 432</p> <p>i.e. <math>\frac{432}{60} = 7 \text{ min } 12 \text{ sec.}</math></p> <p><math>\Rightarrow</math> traffic lights will change simultaneously again at 7 : 7 : 12 a.m.</p>	<p>2</p> <p>1</p>
27.	<p>If <math>p^{\text{th}}</math> term of an A.P. is <math>q</math> and <math>q^{\text{th}}</math> term is <math>p</math>, then prove that its <math>n^{\text{th}}</math> term is <math>(p + q - n)</math>.</p>	
Sol.	<p><math>a_p = a + (p - 1)d = q</math> _____ (i)</p> <p><math>a_q = a + (q - 1)d = p</math> _____ (ii)</p> <p><b>Solving (i) and (ii)</b></p> <p><math>d = -1, a = q + p - 1</math></p> <p><math>a_n = (q + p - 1) + (n - 1)(-1) = q + p - n</math></p>	<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2} + \frac{1}{2}</math></p> <p>1</p>
28(a).	<p>In the given figure, CD is the perpendicular bisector of AB. EF is perpendicular to CD. AE intersects CD at G. Prove that <math>\frac{CF}{CD} = \frac{FG}{DG}</math>.</p> 	



<p><b>Sol.</b></p>	<p><math>\Delta EFG \sim \Delta ADG</math></p> <p><math>\Rightarrow \frac{EF}{AD} = \frac{FG}{DG}</math> _____ (i)</p> <p><math>\Delta EFC \sim \Delta BDC</math></p> <p><math>\Rightarrow \frac{EF}{BD} = \frac{CF}{CD}</math></p> <p><math>\Rightarrow \frac{EF}{AD} = \frac{CF}{CD}</math> {BD = AD} _____ (ii)</p> <p>Using (i) and (ii)</p> <p><math>\frac{FG}{DG} = \frac{CF}{CD}</math></p>	<p>1</p> <p>1</p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>
	<p><b>OR</b></p>	
<p>28(b).</p>	<p>In the given figure, ABCD is a parallelogram. BE bisects CD at M and intersects AC at L. Prove that <math>EL = 2BL</math>.</p> 	

<p><b>Sol.</b></p>	<p><math>\Delta ALE \sim \Delta CLB</math></p> <p><math>\Rightarrow \frac{AL}{CL} = \frac{EL}{BL}</math> _____ (i)</p> <p><b>Also <math>\Delta CLM \sim \Delta ALB</math></b></p> <p><math>\Rightarrow \frac{AL}{CL} = \frac{AB}{CM}</math></p> <p><math>\Rightarrow \frac{AL}{CL} = \frac{CD}{CM}</math> {<b>AB = CD</b>} _____ (ii)</p> <p><b>Using (i) and (ii)</b></p> <p><math>\frac{EL}{BL} = \frac{2CM}{CM}</math></p> <p><math>\Rightarrow EL = 2BL</math></p>	<p><b>1</b></p> <p><b>1</b></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>
<p><b>29.</b></p>	<p>Two people are 16 km apart on a straight road. They start walking at the same time. If they walk towards each other with different speeds, they will meet in 2 hours. Had they walked in the same direction with same speeds as before, they would have met in 8 hours. Find their walking speeds.</p>	
<p><b>Sol.</b></p>	<p>Let walking speeds be x km/hr. and y km/hr. (<math>x &gt; y</math>)</p> <p>ATQ, <math>2x + 2y = 16</math></p> <p>and <math>8x - 8y = 16</math></p> <p>Solving to get <math>x = 5, y = 3</math></p> <p>Speeds are 5 km/hr. 3 km/hr.</p>	<p><b>1</b></p> <p><b>1</b></p> <p><math>\frac{1}{2} + \frac{1}{2}</math></p>

30.	Prove that : $\frac{\tan \theta}{1 - \cot \theta} + \frac{\cot \theta}{1 - \tan \theta} = 1 + \sec \theta \operatorname{cosec} \theta$																																														
Sol.	$\begin{aligned} \text{LHS} &= \frac{\frac{\sin \theta}{\cos \theta}}{1 - \frac{\cos \theta}{\sin \theta}} + \frac{\frac{\cos \theta}{\sin \theta}}{1 - \frac{\sin \theta}{\cos \theta}} \\ &= \frac{\sin^2 \theta}{\cos \theta(\sin \theta - \cos \theta)} + \frac{\cos^2 \theta}{\sin \theta(\cos \theta - \sin \theta)} \\ &= \frac{\sin^3 \theta - \cos^3 \theta}{\sin \theta \cos \theta(\sin \theta - \cos \theta)} \\ &= \frac{\sin^2 \theta + \cos^2 \theta + \sin \theta \cos \theta}{\sin \theta \cos \theta} \\ &= \frac{1}{\sin \theta \cos \theta} + 1 \\ &= 1 + \operatorname{cosec} \theta \sec \theta = \text{RHS} \end{aligned}$	1  1  $\frac{1}{2}$  $\frac{1}{2}$																																													
31.	Find the mean of the following frequency distribution : <table border="1" data-bbox="268 1101 1222 1222"> <tbody> <tr> <td>Classes</td> <td>25 – 30</td> <td>30 – 35</td> <td>35 – 40</td> <td>40 – 45</td> <td>45 – 50</td> <td>50 – 55</td> <td>55 – 60</td> </tr> <tr> <td>Frequency</td> <td>14</td> <td>22</td> <td>16</td> <td>6</td> <td>5</td> <td>3</td> <td>4</td> </tr> </tbody> </table>	Classes	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55	55 – 60	Frequency	14	22	16	6	5	3	4																														
Classes	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55	55 – 60																																								
Frequency	14	22	16	6	5	3	4																																								
Sol.	<table border="1" data-bbox="268 1264 1222 1691"> <thead> <tr> <th>C.I.</th> <th>x</th> <th>f</th> <th><math>u = \frac{x - 42.5}{5}</math></th> <th>fu</th> </tr> </thead> <tbody> <tr> <td>25 – 30</td> <td>27.5</td> <td>14</td> <td>-3</td> <td>-42</td> </tr> <tr> <td>30 – 35</td> <td>32.5</td> <td>22</td> <td>-2</td> <td>-44</td> </tr> <tr> <td>35 – 40</td> <td>37.5</td> <td>16</td> <td>-1</td> <td>-16</td> </tr> <tr> <td>40 – 45</td> <td>42.5</td> <td>6</td> <td>0</td> <td>0</td> </tr> <tr> <td>45 – 50</td> <td>47.5</td> <td>5</td> <td>1</td> <td>5</td> </tr> <tr> <td>50 – 55</td> <td>52.5</td> <td>3</td> <td>2</td> <td>6</td> </tr> <tr> <td>55 – 60</td> <td>57.5</td> <td>4</td> <td>3</td> <td>12</td> </tr> <tr> <td></td> <td></td> <td style="border-top: 1px solid black;">70</td> <td></td> <td style="border-top: 1px solid black;">-79</td> </tr> </tbody> </table>	C.I.	x	f	$u = \frac{x - 42.5}{5}$	fu	25 – 30	27.5	14	-3	-42	30 – 35	32.5	22	-2	-44	35 – 40	37.5	16	-1	-16	40 – 45	42.5	6	0	0	45 – 50	47.5	5	1	5	50 – 55	52.5	3	2	6	55 – 60	57.5	4	3	12			70		-79	For correct table  2 Marks
C.I.	x	f	$u = \frac{x - 42.5}{5}$	fu																																											
25 – 30	27.5	14	-3	-42																																											
30 – 35	32.5	22	-2	-44																																											
35 – 40	37.5	16	-1	-16																																											
40 – 45	42.5	6	0	0																																											
45 – 50	47.5	5	1	5																																											
50 – 55	52.5	3	2	6																																											
55 – 60	57.5	4	3	12																																											
		70		-79																																											

	$\text{Mean} = 42.5 - \frac{79}{70} \times 5 = 36.86$	<b>1</b>
	<p><b>SECTION D</b></p> <p><b>This section comprises of long answer (LA) type questions of 5 marks each.</b></p>	
<b>32.</b>	<p>One observer estimates the angle of elevation to the basket of a hot air balloon to be <math>60^\circ</math>, while another observer 100 m away estimates the angle of elevation to be <math>30^\circ</math>. Find :</p> <p>(a) The height of the basket from the ground.</p> <p>(b) The distance of the basket from the first observer's eye.</p> <p>(c) The horizontal distance of the second observer from the basket.</p>	
<b>Sol.</b>	 <p>Let B is the basket of hot air balloon</p> <p><math>\tan 60^\circ = \sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3}</math> _____ (i)</p> <p><math>\tan 30^\circ = \frac{1}{\sqrt{3}} = \frac{h}{x + 100} \Rightarrow x = h\sqrt{3} - 100</math> _____ (ii)</p>	<p><b>Correct Figure</b></p> <p><b>1 Mark</b></p> <p style="margin-top: 20px;"><b>1</b></p> <p style="margin-top: 20px;"><b>1</b></p>

using (i) and (ii)

$$(a) h = (h\sqrt{3} - 100)\sqrt{3} = 3h - 100\sqrt{3} \Rightarrow h = 50\sqrt{3} \text{ m}$$

$$(b) \sin 60^\circ = \frac{\sqrt{3}}{2} = \frac{h}{y} = \frac{50\sqrt{3}}{y} \Rightarrow y = 100 \text{ m}$$

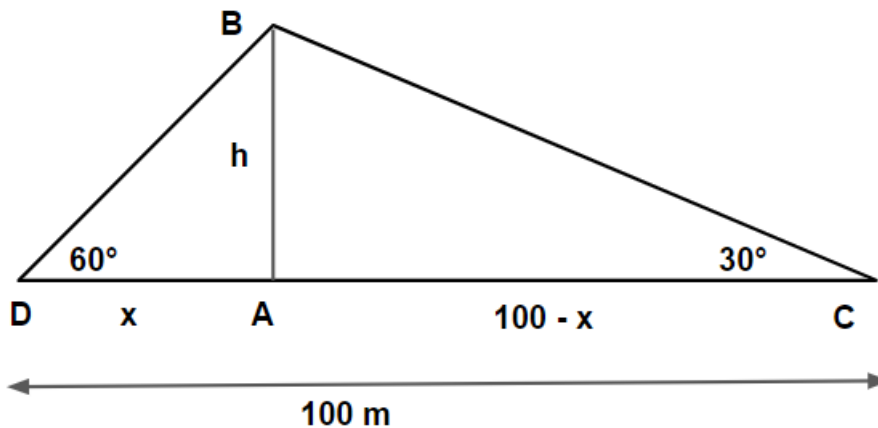
$$(c) x = \frac{h}{\sqrt{3}} = 50 \text{ m} \Rightarrow x + 100 = 150 \text{ m}$$

$\frac{1}{2}$

1

$\frac{1}{2}$

# ANOTHER SOLUTION AS PER BELOW FIGURE IS ALSO POSSIBLE



Correct  
Figure

1 Mark

Let B is the basket of hot air balloon. D and C be the positions of the first and second observer's respectively.

$$\tan 60^\circ = \sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3} \text{ (i)}$$

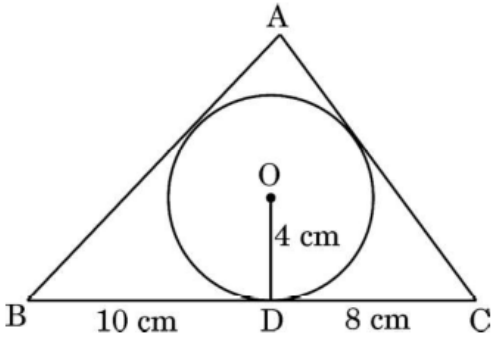
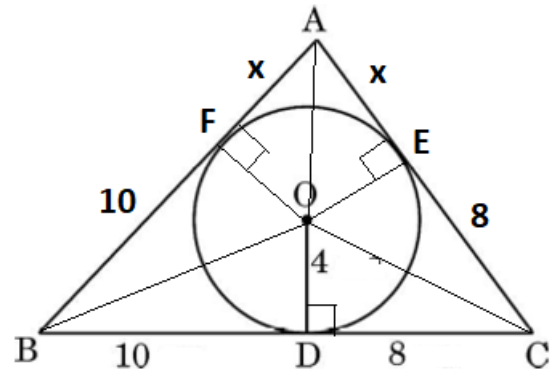
$$\tan 30^\circ = \frac{1}{\sqrt{3}} = \frac{h}{100-x} \Rightarrow \sqrt{3}h = 100 - x \text{ (ii)}$$

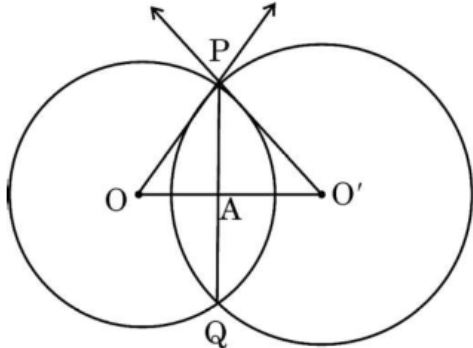
1

1

(a) using (i) and (ii)



	$h = \sqrt{3} (100 - \sqrt{3}h) \Rightarrow h = 25\sqrt{3} \text{ m}$ <p>(b) <math>\sin 60^\circ = \frac{\sqrt{3}}{2} = \frac{h}{BD} \Rightarrow BD = 50 \text{ m}</math></p> <p>(c) <math>x = \frac{h}{\sqrt{3}} = 25 \text{ m}</math></p> $\Rightarrow AC = 100 - x = 75 \text{ m}$	$\frac{1}{2}$  1  $\frac{1}{2}$
33(a).	<p>A triangle ABC is drawn to circumscribe a circle of radius 4 cm such that the segments BD and DC are of lengths 10 cm and 8 cm respectively. Find the lengths of the sides AB and AC, if it is given that area <math>\Delta ABC = 90 \text{ cm}^2</math>.</p> 	
Sol.		

	<p><b>Join OA, OB, OC and draw OE ⊥ AC and OF ⊥ AB.</b></p> <p><b>BF = 10 cm, CE = 8 cm, Let AF = AE = x</b></p> <p><b>ar Δ ABC = ar Δ BOC + ar Δ COA + ar Δ AOB</b></p> <p><b><math>90 = \frac{1}{2} \cdot 4 (BC + CA + AB)</math></b></p> <p><b><math>90 = 2(18 + 8 + x + 10 + x)</math></b></p> <p><b><math>90 = 4(18 + x)</math></b></p> <p><b><math>x = 4.5</math></b></p> <p><b>AB = 14.5 cm and AC = 12.5 cm</b></p>	<p><math>1\frac{1}{2}</math></p> <p><math>1\frac{1}{2}</math></p> <p><b>1</b></p> <p><b>1</b></p>
	<p><b>OR</b></p>	
<p><b>33(b).</b></p>	<p>Two circles with centres O and O' of radii 6 cm and 8 cm, respectively intersect at two points P and Q such that OP and O'P are tangents to the two circles. Find the length of the common chord PQ.</p> 	

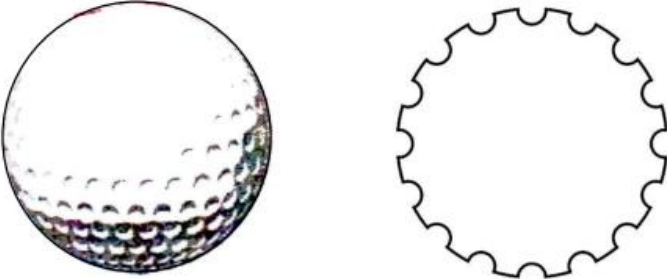
<p><b>Sol.</b></p>	<p><math>OO' = \sqrt{6^2 + 8^2} = 10 \text{ cm} \quad \{OP \perp O'P\}</math></p> <p>Let <math>OA = x, O'A = 10 - x</math></p> <p><math>AP^2 = 36 - x^2</math></p> <p>Also <math>AP^2 = 64 - (10 - x)^2</math></p> <p>Therefore <math>36 - x^2 = 64 - (10 - x)^2</math></p> <p><math>\Rightarrow 36 - x^2 = 64 - 100 - x^2 + 20x</math></p> <p><math>\Rightarrow x = 3.6</math></p> <p>In <math>\Delta PAO, AP^2 = 36 - (3.6)^2 = 23.04</math></p> <p><math>\Rightarrow AP = 4.8</math></p> <p>Length <math>PQ = 2 \times AP = 9.6 \text{ cm}</math></p>	<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p>2</p> <p>1</p> <p><math>\frac{1}{2}</math></p>
<p><b>34(a).</b></p>	<p>A train travels at a certain average speed for a distance of 54 km and then travels a distance of 63 km at an average speed of 6 km/h more than the first speed. If it takes 3 hours to complete the journey, what was its first average speed ?</p>	
<p><b>Sol.</b></p>	<p>Let first average speed of the train be <math>x</math> km/hr.</p> <p><math>\frac{54}{x} + \frac{63}{x+6} = 3</math></p> <p><math>\Rightarrow 54x + 324 + 63x = 3x^2 + 18x</math></p>	<p>2</p>



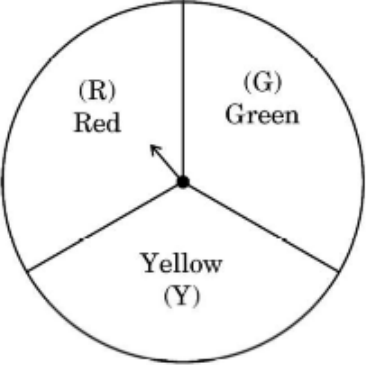
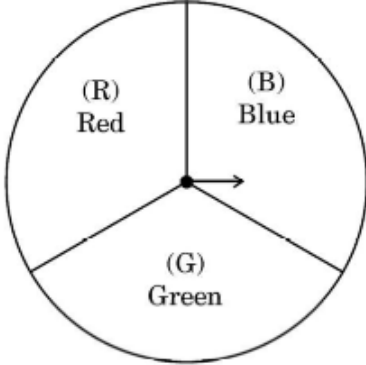
	$\Rightarrow 3x^2 - 99x - 324 = 0$ or $x^2 - 33x - 108 = 0$ $\Rightarrow (x - 36)(x + 3) = 0$ $\Rightarrow x = 36, -3$ (rejected) Therefore, first average speed of the train was 36 km/hr.	2  1
	OR	
34(b).	Two pipes together can fill a tank in $\frac{15}{8}$ hours. The pipe with larger diameter takes 2 hours less than the pipe with smaller diameter to fill the tank separately. Find the time in which each pipe can fill the tank separately.	
Sol.	Let the time taken by smaller diameter tap be $x$ hrs. Time taken by larger diameter tap is $(x - 2)$ hrs. Therefore $\frac{1}{x-2} + \frac{1}{x} = \frac{8}{15}$ $\Rightarrow 15(2x - 2) = 8x(x - 2)$ $\Rightarrow 8x^2 - 46x + 30 = 0$ $\Rightarrow 4x^2 - 23x + 15 = 0$ $\Rightarrow (4x - 3)(x - 5) = 0$ $\Rightarrow x = \frac{3}{4}, x = 5$	2  1  1



	$x \neq \frac{3}{4}$ as $x - 2 < 0$  <b>Smaller diameter tap fills in 5 hrs.</b>  <b>Larger diameter tap fills in 3 hrs.</b>	<b>1</b>
<b>35.</b>	A horse is tied to a peg at one corner of a square shaped grass field of side 15 m by means of a 5 m long rope. Find the area of that part of the field in which the horse can graze. Also, find the increase in grazing area if length of rope is increased to 10 m. (Use $\pi = 3.14$ )	
<b>Sol.</b>	<b>Area of that part of the field in which the horse can graze by means of a 5 m long rope</b> $= \frac{1}{4} \times 3.14 \times (5)^2$  $= 19.625 \text{ m}^2$  <b>Area of that part of the field in which the horse can graze by means of a 10 m long rope</b> $= \frac{1}{4} \times 3.14 \times (10)^2$  $= 78.5 \text{ m}^2$  <b>Increase in grazing area</b> $= 78.5 \text{ m}^2 - 19.625 \text{ m}^2 = 58.875 \text{ m}^2$	<b>1</b>  <b>1</b>  <b>1</b>  <b>1</b>
	<b>SECTION E</b>  <b>This section comprises of 3 case-study based questions of 4 marks each.</b>	

<p>36.</p>	<p>A golf ball is spherical with about 300 – 500 dimples that help increase its velocity while in play. Golf balls are traditionally white but available in colours also. In the given figure, a golf ball has diameter 4.2 cm and the surface has 315 dimples (hemi-spherical) of radius 2 mm.</p>  <p>Based on the above, answer the following questions :</p> <p>(i) Find the surface area of one such dimple.</p> <p>(ii) Find the volume of the material dug out to make one dimple.</p> <p>(iii) (a) Find the total surface area exposed to the surroundings.</p> <p style="text-align: center;"><b>OR</b></p> <p>(iii) (b) Find the volume of the golf ball.</p>	
<p>Sol.</p>	<p>(i) <math>SA = 2\pi r^2 = 2 \times \frac{22}{7} \times 4 = \frac{176}{7} \text{ mm}^2</math> or <math>25.1 \text{ mm}^2</math></p> <p>(ii) Volume of material dug out to make one dimple <math>= \frac{2}{3} \times \frac{22}{7} \times 8</math></p> <p><math>= \frac{352}{21} \text{ mm}^3</math> or <math>16.76 \text{ mm}^3</math></p>	<p>1</p> <p>1</p>

	<p><b>(iii)(a) radius of ball = 21 mm</b></p> <p><b>Total surface area exposed to surroundings</b></p> $= 4\pi(21)^2 - 315 \times \pi(2)^2 + 315 \times 2\pi(2)^2$ $= 4 \times \frac{22}{7} \times 21 \times 21 + \frac{22}{7} \times 315 \times 4$ $= 9504 \text{ mm}^2$ <p><b>OR</b></p> <p><b>(iii) (b) Volume of the golf ball = <math>\frac{4}{3}\pi(21)^3 - 315 \times \frac{2}{3}\pi(2)^3</math></b></p> $= 33528 \text{ mm}^3$	<p><b>1</b></p> <p><b>1</b></p> <p><b>1</b></p> <p><b>1</b></p>
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<p>37.</p>	<p>A middle school decided to run the following spinner game as a fund-raiser on Christmas Carnival.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center;">I <span style="margin-left: 200px;">II</span></p> <p><i>Making Purple</i> : Spin each spinner once. Blue and red make purple. So, if one spinner shows Red (R) and another Blue (B), then you 'win'. One such outcome is written as 'RB'.</p> <p>Based on the above, answer the following questions :</p> <p>(i) List all possible outcomes of the game.</p> <p>(ii) Find the probability of 'Making Purple'.</p> <p>(iii) (a) For each win, a participant gets ₹ 10, but if he/she loses, he/she has to pay ₹ 5 to the school. If 99 participants played, calculate how much fund could the school have collected.</p> <p style="text-align: center;"><b>OR</b></p> <p>(iii) (b) If the same amount of ₹ 5 has been decided for winning or losing the game, then how much fund had been collected by school ? (Number of participants = 99)</p>	
<p>Sol.</p>	<p>(i) All possible outcomes: RR, RG, RB, GR, GB, GG, YR, YB, YG</p> <p>(ii) Number of favourable outcome (RB) = 1</p>	<p>1</p>

<p><b>P (Making purple) = <math>\frac{1}{9}</math></b></p> <p><b>(iii)(a) As P(winning) = <math>\frac{1}{9}</math></b></p> <p><b>Therefore, number of people must win = <math>\frac{1}{9} \times 99 = 11</math></b></p> <p><b><math>\therefore</math> Game lost by 88 persons.</b></p> <p><b>Funds collected = <math>5 \times 88 - 10 \times 11 = ₹ 330</math></b></p> <p><b>OR</b></p> <p><b>(iii)(b) Number of participants = 99</b></p> <p><b>P(winning the game) = <math>\frac{1}{9}</math></b></p> <p><b>Number of persons won = 11</b></p> <p><b>Number of persons lost = 88</b></p> <p><b>Funds collected = <math>88 \times 5 - 11 \times 5 = ₹ 385</math></b></p>	<p><b>1</b></p> <p><b><math>\frac{1}{2}</math></b></p> <p><b><math>\frac{1}{2}</math></b></p> <p><b>1</b></p> <p><b><math>\frac{1}{2}</math></b></p> <p><b><math>\frac{1}{2}</math></b></p> <p><b>1</b></p>
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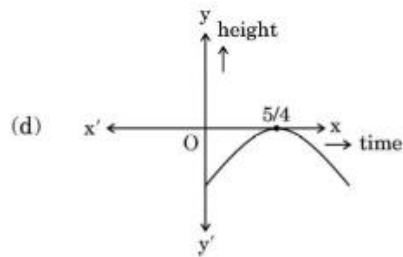
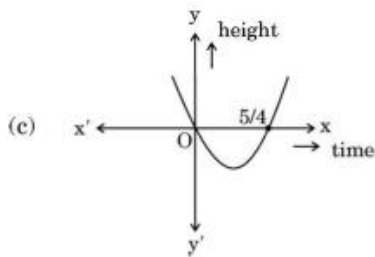
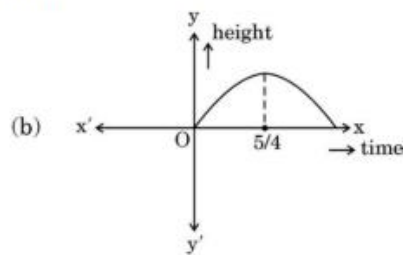
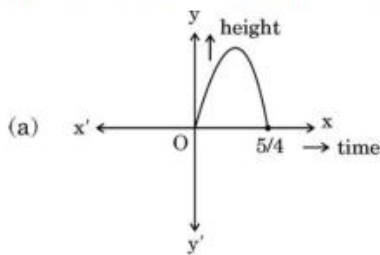
38.

In a pool at an aquarium, a dolphin jumps out of the water travelling at 20 cm per second. Its height above water level after  $t$  seconds is given by  $h = 20t - 16t^2$ .



Based on the above, answer the following questions :

- (i) Find zeroes of polynomial  $p(t) = 20t - 16t^2$ .  
 (ii) Which of the following types of graph represents  $p(t)$  ?



- (iii) (a) What would be the value of  $h$  at  $t = \frac{3}{2}$  ? Interpret the result.

**OR**

- (iii) (b) How much distance has the dolphin covered before hitting the water level again ?

<b>Sol.</b>	<p>(i) <math>-16t^2 + 20t = 0 \Rightarrow 4t(-4t + 5) = 0</math></p> <p><math>t = 0, t = \frac{5}{4}</math></p>	<b>1</b>
	(ii) (a)	<b>1</b>
	(iii)(a) At $t = \frac{3}{2}$ , $h = -16 \times \frac{9}{4} + 20 \times \frac{3}{2} = -36 + 30 = -6$	<b>1</b>
	It means after $\frac{3}{2}$ seconds, dolphin has reached 6 cm below water level.	<b>1</b>
	<b>OR</b>	
	(iii)(b) Speed of dolphin = 20 cm per second.	
	In one second, distance covered = 20 cm	
	In $\frac{5}{4}$ seconds, distance covered = $20 \times \frac{5}{4} = 25$ cm	<b>2</b>