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PAPER-2 (B. ARCH.) OF JEE (MAIN)

JEE (MAIN) 2017

TEST PAPER WITH SOLUTION & ANSWER KEY

Date: 02-04-2017 | Duration : 3 Hours | Max. Marks: 390

IMPORTANT INSTRUCTIONS / महत्वपूर्ण निर्देश

A. General :	A. सामान्य :
1. Immediately fill in the particulars on this page of the test booklet with black ball point pen.	1. परीक्षा पुस्तिका के इस पृष्ठ पर आवश्यक विवरण काले बॉल पाइंट पेन से तत्काल भरें।
2. This Test Booklet consists of three parts - Part I, Part II and Part III . Part I Aptitude Test has 50 objective type questions of consisting of FOUR(4) marks for each correct response. Part II Mathematics Test has 30 objective type questions consisting of FOUR(4) marks for each correct response. Mark your answers for these questions in the appropriate space against the number corresponding to the question in the Answer Sheet placed inside this Test Booklet. Use Black Ball Point Pen only for writing particulars/markings responses of Side-1 and Side-2 of the Answer Sheet. Part III consists of 2 questions carrying 70 marks which are to be attempted on a separate Drawing Sheet which is also placed inside the Test Booklet. Marks allotted to each question are written against each question. Use colour pencils or crayons only on the Drawing Sheet. Do not use water colours. For each incorrect response in Part I and Part II , one-fourth ($\frac{1}{4}$) of the total marks allotted to the question from the total score. No deduction from the total score, however, will be made if no response is indicated for an item in the Answer Sheet.	2. इस परीक्षा पुस्तिका के तीन भाग हैं— भाग I, भाग II, भाग III , पुस्तिका के भाग I में अभिरुचि परीक्षण में 50 वस्तुनिष्ठ प्रश्न हैं जिसमें प्रत्येक प्रश्न के सही उत्तर के लिये चार(4) अंक हैं। भाग II में गणित के 30 वस्तुनिष्ठ प्रश्न हैं जिनमें प्रत्येक सही उत्तर के लिए चार(4) अंक हैं। इन प्रश्नों का उत्तर इस परीक्षा पुस्तिका में रखे उत्तर पत्र में संगत क्रम संख्या के गोले में गहरा निशान लगाकर दीजिए। उत्तर पत्र के पृष्ठ-1 एवं पृष्ठ-2 पर वांछित विवरण लिखने एवं उत्तर अंकित करने हेतु केवल काले बॉल पाइंट पेन का ही प्रयोग करें। पुस्तिका के भाग III में 2 प्रश्न हैं जिनके लिए 70 अंक निर्धारित हैं। यह प्रश्न इसी परीक्षा पुस्तिका के अंदर रखी ड्राइंग शीट पर करने हैं। प्रत्येक प्रश्न हेतु निर्धारित अंक प्रश्न के सम्मुख अंकित हैं। ड्राइंग शीट पर केवल रंगीन पेंसिल अथवा क्रेयोन का ही प्रयोग करें। पानी के रंगों का प्रयोग न करें। भाग I और भाग II में प्रत्येक गलत उत्तर के लिए उस प्रश्न के लिए निर्धारित कुल अंकों में से एक-चौथाई ($\frac{1}{4}$) अंक कुल योग में से काट लिए जाएंगे। यदि उत्तर पत्र में किसी प्रश्न का कोई उत्तर नहीं दिया गया है, तो कुल योग में से कोई अंक नहीं काटें जाएंगे।
3. There is only one correct response for each question in Part I and Part II . Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 2 above.	3. इस परीक्षा पुस्तिका के भाग I और भाग II में प्रत्येक प्रश्न का केवल एक ही सही उत्तर है। एक से अधिक उत्तर देने पर उसे गलत उत्तर माना जायेगा और उपरोक्त निर्देश 2 के अनुसार अंक काट लिये जायेंगे।
4. The test is of 3 hours duration. The maximum marks are 390 .	4. परीक्षा की अवधि 3 घण्टे है। अधिकतम अंक 390 है।
5. On completion of the test, the candidates must hand over the Answer Sheet of Aptitude Test and Mathematics Part-I & II and the Drawing Sheet of Aptitude Test-Part III alongwith Test Booklet for Part III to the Invigilator in the Room/Hall. Candidates are allowed to take away with them the Test Booklet of Aptitude Test & Mathematics Part I & II .	5. परीक्षा समाप्त होने पर, अभ्यर्थी अभिरुचि परीक्षण एवं गणित भाग I एवं भाग II का उत्तर पत्र एवं अभिरुचि परीक्षण भाग III की ड्राइंग शीट एवं परीक्षा पुस्तिका भाग III हाल/कक्ष निरीक्षक को सौंपकर ही परीक्षा हाल/कक्ष छोड़ें। अभ्यर्थी अभिरुचि परीक्षण एवं गणित भाग I एवं भाग II की परीक्षा पुस्तिका अपने साथ ले जा सकते हैं।
6. The CODE for this Booklet is X . Make sure that the CODE printed on Side-2 of the Answer Sheet and on the Drawing Sheet (Part III) is the same as that on this booklet. Also tally the Serial Number of the Test Booklet, Answer Sheet and Drawing Sheet and ensure that they are same. In case of discrepancy in Code or Serial Number, the candidate should immediately report the matter to the Invigilator for replacement of the Test Booklet, Answer Sheet and the Drawing Sheet.	6. इस पुस्तिका का संकेत X है। यह सुनिश्चित कर लें कि इस पुस्तिका का संकेत, उत्तर पत्र के पृष्ठ-2 एवं ड्राइंग शीट (भाग-III) पर छपे संकेत से मिलता है। यह भी सुनिश्चित कर लें कि परीक्षा पुस्तिका, उत्तर पत्र एवं ड्राइंग शीट पर क्रम संख्या मिलती है। अगर संकेत या क्रम संख्या भिन्न हो, तो अभ्यर्थियों को निरीक्षक से दूसरी परीक्षा पुस्तिका, उत्तर पत्र एवं ड्राइंग शीट लेने के लिए उन्हें तुरन्त इस त्रुटि से अवगत कराएँ।
7. Do not fold or make any stray mark on the Answer Sheet.	7. उत्तर पत्र को न मोड़ें एवं न ही उस पर अन्य निशान लगाएँ।

Name of the Candidate (in Capital letters) : _____

Roll Number : in figures : in words : _____

Name of Examination Centre (in Capital letters) : _____

Candidate's Signature : _____ Invigilator's Signature : _____

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(YCCP: 18418 | DLP+eLP: 9875)

Selections @ 2016

5111

(YCCP: 3554 | DLP+eLP: 1557)

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Selections
(from 2009-2016)

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(YCCP: 20429 | DLP+eLP: 7661)

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Part-I / भाग-I

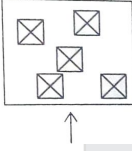
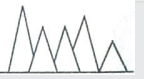
Aptitude Test / अभिरुचि परीक्षण

Direction : (For Q.No. 1 to 4). The problem figure shows the top view of objects. Looking in the direction of the arrow, identify the correct elevation, from amongst the answer figures.

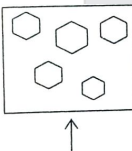
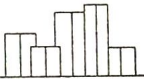
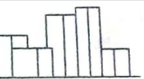
निर्देश : (प्र. 1 से 4 के लिए). प्रश्न आकृति में वस्तुओं का ऊपरी दृश्य दिखाया गया है। तीर की दिशा में देखते हुए उत्तर आकृतियों में से सही सम्मुख दृश्य पहचानिये।

Problem Figure / प्रश्न आकृति

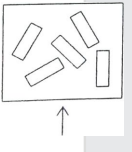
Answer Figures / उत्तर आकृतियाँ

1.     

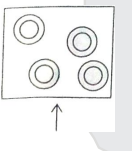
Ans. (3)

2.     

Ans. (3)

3.     

Ans. (4)

4.     

Ans. (2)

Direction : (For Q.No. 5 to 6). Which one of the answer figure will complete the sequence of the three problem figures ?

निर्देश : (प्र. 5 और 6 के लिए). उत्तर आकृतियों में से कौन-सी आकृति को तीन प्रश्न आकृतियों में लगाने से अनुक्रम (sequence) पूरा हो जायेगा ?

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Problem Figure / प्रश्न आकृति

Answer Figures / उत्तर आकृतियाँ

5.



(1)



(2)



(3)



(4)

Ans. (2)

6.



(1)



(2)



(3)



(4)

Ans. (3)

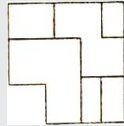
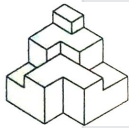
Direction : (For Q.No. 7 to 10). The 3-D figure shows the view of an object. Identify the correct top view from amongst the answer figures.

निर्देश : (प्र. 7 और 10 के लिए). 3-D प्रश्न आकृति में एक वस्तु के एक दृश्य को दिखाया गया है। इसका सही ऊपरी दृश्य, उत्तर आकृतियों में से पहचानिये।

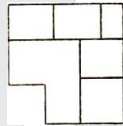
Problem Figure / प्रश्न आकृति

Answer Figures / उत्तर आकृतियाँ

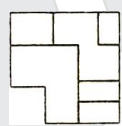
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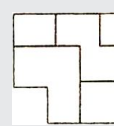
(1)



(2)



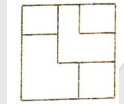
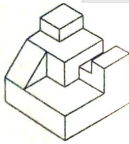
(3)



(4)

Ans. (4)

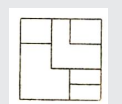
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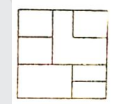
(1)



(2)



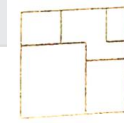
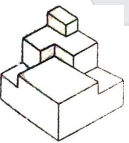
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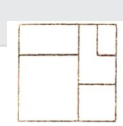
(4)

Ans. (3)

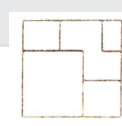
9.



(1)



(2)



(3)



(4)

Ans. (3)

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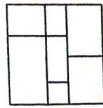
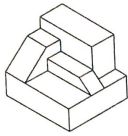
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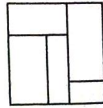
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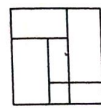
10.



(1)



(2)



(3)



(4)

Ans. (4)

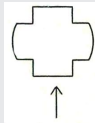
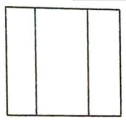
Direction : (For Q.No. 11 to 12). The problem figure shows the elevation of an object. Identify the correct top view from amongst the answer figures.

निर्देश : (प्र. 11 और 12 के लिए). प्रश्न आकृति में किसी वस्तु का सम्मुख दृश्य दिखाया गया है। उत्तर आकृतियों में से इसका सही ऊपरी दृश्य पहचानिये।

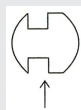
Problem Figure / प्रश्न आकृति

Answer Figures / उत्तर आकृतियाँ

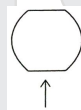
11.



(1)



(2)



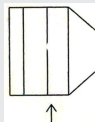
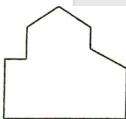
(3)



(4)

Ans. (1)

12.



(1)



(2)



(3)



(4)

Ans. (3)

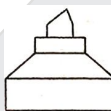
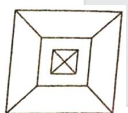
Direction : (For Q.No. 13 to 15). The problem figure shows the top view of an object. Identify the correct elevation from amongst the answer figure looking in the direction of the arrow.

निर्देश : (प्र. 13 और 15 के लिए). प्रश्न आकृति में किसी वस्तु का ऊपरी दृश्य दिखाया गया है। तीर की दिशा देखते हुए उत्तर आकृतियों में से इसका सही सम्मुख दृश्य पहचानिये।

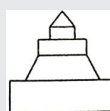
Problem Figure / प्रश्न आकृति

Answer Figures / उत्तर आकृतियाँ

13.



(1)



(2)



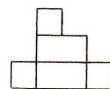
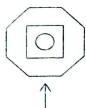
(3)



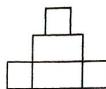
(4)

Ans. (3)

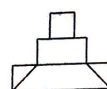
14.



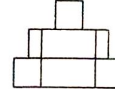
(1)



(2)



(3)



(4)

Ans. (2)

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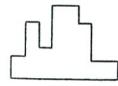
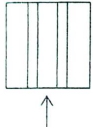
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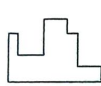
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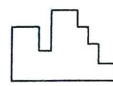
15.



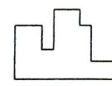
(1)



(2)



(3)



(4)

Ans. (4)

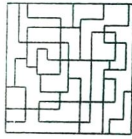
Direction : (For Q.No. 16). One the following answer figures is hidden in the problem figure in the same size and direction. Select the correct one

निर्देश : (प्र. 16 के लिए). नीचे दी गयी आकृतियों में से एक आकृति माप और दिशा में समान रूप से प्रश्न आकृति में छुपी है। कौन-सी सही है, चुनिए।

Problem Figure / प्रश्न आकृति

Answer Figures / उत्तर आकृतियाँ

16.



(1)



(2)



(3)



(4)

Ans. (3)

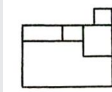
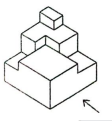
Direction : (For Q.No. 17 to 19). The 3-D problem figure shows a view of an object. Identify the correct front view, from amongst the answer figures, looking in the direction of arrow.

निर्देश : (प्र. 17 और 19 के लिए). 3-D प्रश्न आकृति में एक वस्तु के एक दृश्य को दिखाया गया है। तीर की दिशा में देखते हुए, इसके सही सम्मुख दृश्य को उत्तर आकृतियों में से पहचानिए।

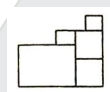
Problem Figure / प्रश्न आकृति

Answer Figures / उत्तर आकृतियाँ

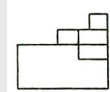
17.



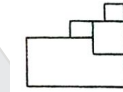
(1)



(2)



(3)



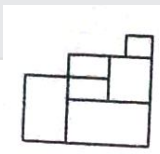
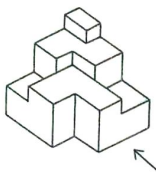
(4)

Ans. (4)

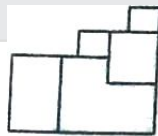
Problem Figure / प्रश्न आकृति

Answer Figure / उत्तर आकृति

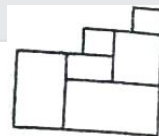
18.



(1)



(2)



(3)



(4)

Ans. (2)

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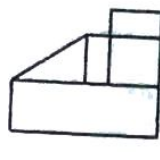
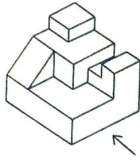
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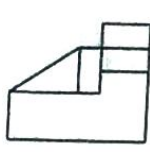
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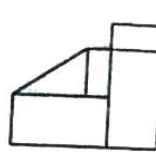
19.



(1)



(2)



(3)



(4)

Ans. (4)

Directions (For Q. No. 20 to 22)

Identify the correct 3-D figure from amongst the answer figure which has the same elevation, as given in the problem figure on the left.

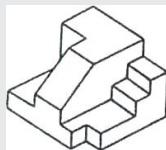
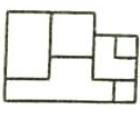
निर्देश (प्र. 20 No. 20 से 22)

3-D उत्तर आकृतियों में से उस आकृति को पहचानिये जिस का समान दृश्य प्रश्न आकृति से मिलती हो।

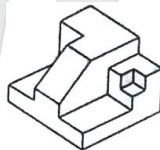
Problem Figure / प्रश्न आकृति

Answer Figure / उत्तर आकृति

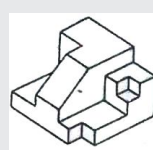
20.



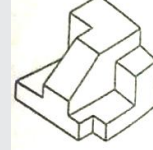
(1)



(2)



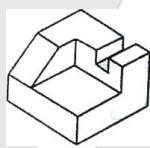
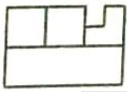
(3)



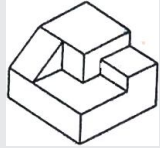
(4)

Ans. (3)

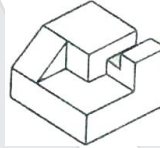
21.



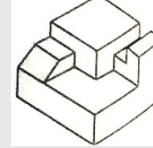
(1)



(2)



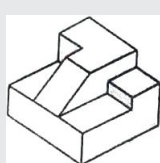
(3)



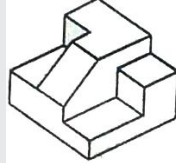
(4)

Ans. (3)

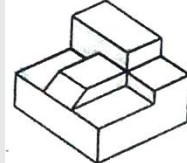
22.



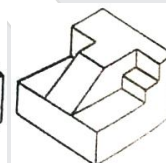
(1)



(2)



(3)



(4)

Ans. (1)

Directions (For Q. No. 23 to 25)

Which one of the answer figures shown the correct view of the 3-D problem figure after the problem figure is opened up ?

निर्देश (प्र. 23 No. 20 से 25)

3-D प्रश्न आकृति को खोलने पर, उत्तर आकृतियों में से सही दृश्य कौन-सा है ?

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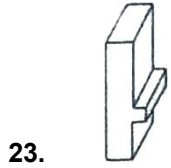
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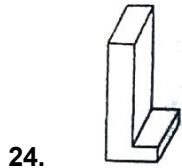
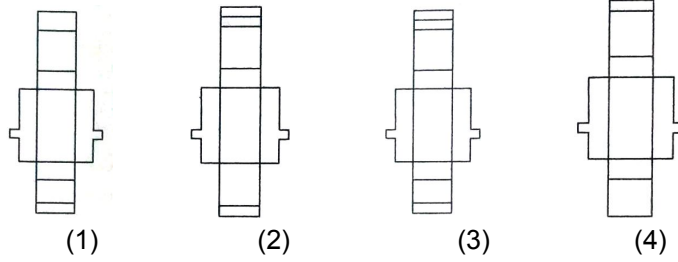
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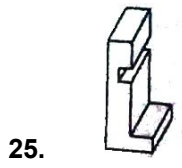
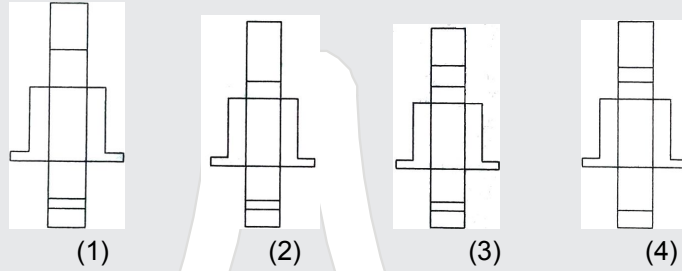
Problem Figure / प्रश्न आकृति Answer Figure / उत्तर आकृतियाँ



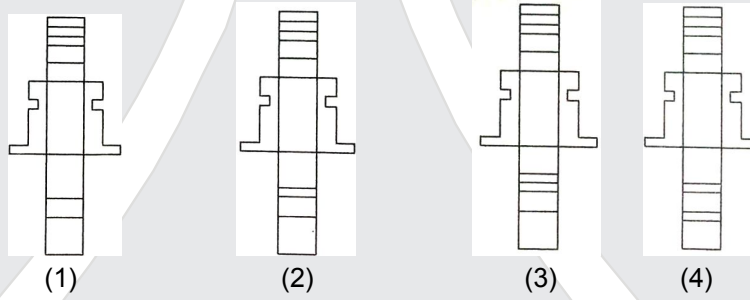
Ans. (3)



Ans. (2)

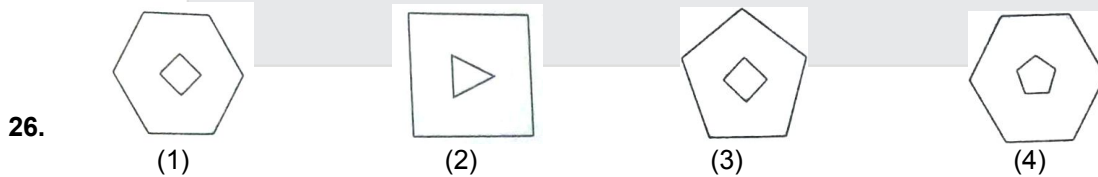


Ans. (2)



Directions (For Q. No. 26 and 27)
निर्देश (प्रश्न 26 और 27 के लिए) ।

Find the odd figure out of the problem figure given below
नीचे दी गयी आकृतियों में से विषम आकृति पहचानिये ।



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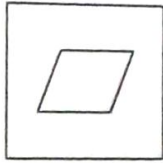
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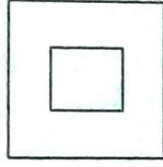
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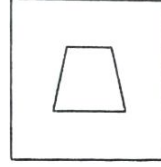
27.



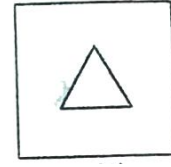
(1)



(2)



(3)



(4)

Directions (For Q. No. 28 to 31)

Which one of the answer figures is the correct mirror image of the problem figure with respect to X – X ?

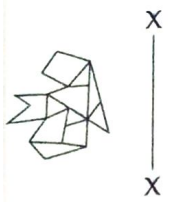
निर्देश (प्र. 28 से 31)

उत्तर आकृतियों में से कौन-सी आकृति दी गयी प्रश्न आकृति का X – X से सम्बंधित सही दर्पण प्रतिबिम्ब है ?

Problem Figure / प्रश्न आकृति

Answer Figure / उत्तर आकृतियाँ

28.



(1)



(2)

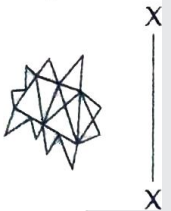


(3)



(4)

29.



(1)



(2)

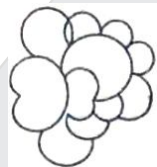
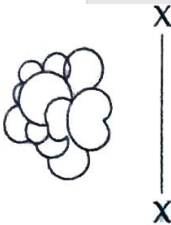


(3)



(4)

30.



(1)



(2)



(3)



(4)

31.



(1)



(2)



(3)



(4)

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Directions (For Q. No. 32 to 34)

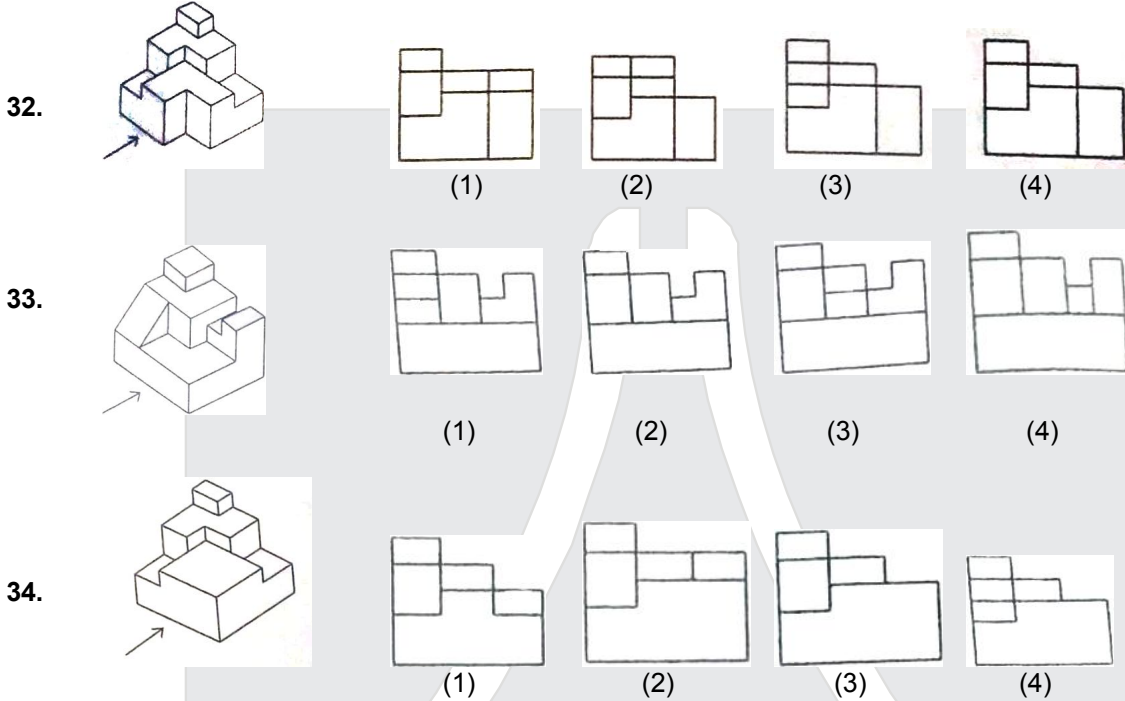
The 3 – D problem figure show a view of an Object. Identify the correct front view, from amongst the answer figures, looking in the direction of arrow.

निर्देश (प्र. 32 No. से 34)

3-D प्रश्न आकृति में एक वस्तु के एक दृश्य को दिखाया गया है। तीर की दिशा में देखते हुए, इसके सही सम्मुख दृश्य को उत्तर आकृतियों में से पहचानिये।

Problem Figure / प्रश्न आकृति

Answer Figure / उत्तर आकृतियाँ



Directions: (For Q. No. 35)

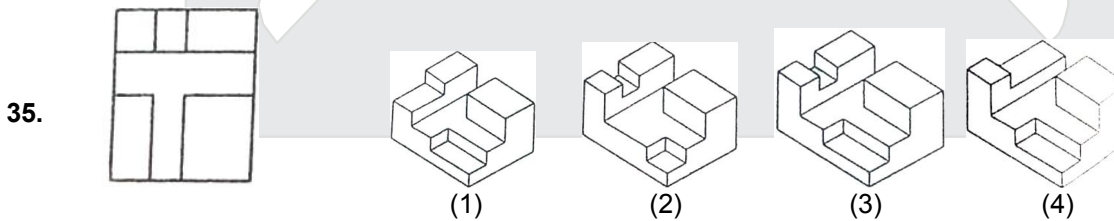
From the top view given in the problem figure identify the correct 3-D figure from amongst the answer figures.

निर्देश: (प्र. 35 के लिए)

दी गयी प्रश्न आकृति के ऊपरी दृश्य को सही 3-D उत्तर आकृतियों में से पहचानिये।

Problem Figure/प्रश्न आकृति

Answer Figures/उत्तर आकृतियाँ



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36. Which type of roof will provide maximum protection from heat radiation in a building?

- (1) Concrete slab, water proofed and covered with a roof garden
(2) Painted aluminium sheeting
(3) Concrete slab with plaster
(4) Concrete slab with mud and brick tiles

निम्नलिखित में कौन सी छत भवनों में गर्मी विकिरण से सबसे अधिक सुरक्षा देगी?

- (1) जल संरक्षित, उद्यानछत से ढकी हुई कंक्रीट पटिया
(2) रंगी एलुमिनियम चद्दर
(3) कंक्रीट पटिया प्लास्टर के साथ
(4) कंक्रीट पटिया मिट्टी एवं ईंटों की टाइल्स के साथ

Ans. (1)

37. What is Venice famous for?

- (1) Springs (2) Canals (3) Mountains (4) Valleys

वेनिस किस के लिए मशहूर है?

- (1) चश्में (2) नहरें (3) पर्वत (4) घाटियाँ

Ans. (2)

38. Gol Gumbaj of Bijapur is:

- (1) A Mosque (2) A Fort (3) A Mausoleum (4) A Palace

बीजापुर का गोल गुम्बज:

- (1) एक मस्जिद है (2) एक किला है (3) एक मकबरा है (4) एक महल है

Ans. (3)

39. Solar energy is converted to electrical energy by:

- (1) Rain water (2) Photovoltaic cells
(3) Electro magnetis (4) Bio technology

सूर्य ऊर्जा किस से बिजली में परिवर्तित होती है?

- (1) वर्षा का पानी (2) फोटोवोल्टाइक सेल्स (3) विद्युत चुम्बकों (4) जैव प्रौद्योगिकी

Ans. (2)

40. Buland Darwaza is located in:

- (1) Golconda (2) Fatehpur Sikri (3) Red Fort (4) Agra Fort

बुलंद दरवाजा किस में स्थित है?

- (1) गोलकोंडा (2) फतेहपुर सिकरी (3) लाल किला (4) आगरा का किला

Ans. (2)

41. Ellora temples are

- (1) Built in wood (2) Made in marble (3) Built in sandstone (4) Cut out of rock

एल्लोरा के मंदिर :

- (1) लकड़ी में बने हैं (2) संगमरमर से बने हैं
(3) लाल बलुआ पत्थर से बने हैं (4) चट्टान में से काएँ हुए हैं

Ans. (4)

42. Salim Chisti mosque is located in:

- (1) Delhi (2) Gwalior (3) Fatehpur Sikri (4) Hyderabad

स्लीम चिस्ती का मकबरा कहाँ स्थित है?

- (1) दिल्ली (2) ग्वालियर (3) फतेहपुर सिकरी (4) हैदराबाद

Ans. (3)

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- 43.** IGBC stands for:
(1) Indian Government Biological Center (2) International Great Beautiful City
(3) Indian Green Building Council (4) Indian Great Building Center
आई.जी.बी.सी. किस का प्रतीक है?
(1) भारतीय सरकारी जैविक केंद्र (2) अंतर्राष्ट्रीय बड़ा सुंदर शहर
(3) भारतीय हरित भवन परिषद् (4) भारतीय बड़ा भवन केन्द्र
Ans. (3)
- 44.** Big Ben is a:
(1) Temple (2) Clock Tower (3) Palace (4) Mosque
बिग बेन क्या है?
(1) मंदिर (2) घंटा घर (3) महल (4) मस्जिद
Ans. (2)
- 45.** Pyramids are located in :
(1) Ethiopia (2) Rome (3) Egypt (4) Greece
पिरामिड कहाँ स्थित है?
(1) ईथियोपिया (2) रोम (3) इजिप्ट (4) ग्रीस
Ans. (3)
- 46.** Vertical sun protectors over wall openings help in cutting off summer sun rays on:
(1) On all sides (2) South side (3) West side (4) North side
खिड़की के साथ लगे सूरज संरक्षक सूर्य किरणों को किस दिशा में काटते हैं?
(1) हर तरफ (2) दक्षिण की तरफ (3) पश्चिम की तरफ (4) उत्तर की तरफ
Ans. (4)
- 47.** Temperature of the Earth due to the 'Greenhouse Effect'
(1) Keeps increasing/decreasing (2) Increases
(3) Decreases (4) Remains constant
धरती का तापमान ग्रीन हाउस प्रभाव से:
(1) बढ़ता/घटता रहता है (2) बढ़ता है
(3) घटता है (4) एक समान रहता है
Ans. (2)
- 48.** Which one of the following is not a load bearing component in a building ?
निम्नलिखित में से कौन सा भवनों में भार उठाने वाला हिस्सा नहीं है ?
(1) Concrete floor slab (2) Column
(3) Beam (4) Partition wall
(1) कंक्रीट की फर्श पटिया (2) स्तम्भ (3) शहतीर (4) विभाजन दीवार
Ans. (4)
- 49.** Which color is obtained by mixing red and yellow colors ?
लाल एवं पीला रंग मिलाने से कौन सा रंग बनता है ?
(1) Brown (2) Purple (3) Pink (4) Orange
(1) भूरा (2) बैंगनी (3) गुलाबी (4) संतरी
Ans. (4)
- 50.** The ruins of Hampi are located in which state ?
(1) Tamil Nadu (2) Karnataka (3) Andhra Pradesh (4) Kerala
हम्पी के खंडहर किस राज्य में स्थित है ?
(1) तमिलनाडु (2) कर्नाटक (3) आंध्र प्रदेश (4) केरल
Ans. (2)

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Part-II / भाग-II
Mathematics / गणित

51. If A and B be two finite sets such that the total number of subsets of A is 960 more than the total number of subsets of B, then $n(A) - n(B)$ (where $n(X)$ denotes the number of elements in set X) is equal to :

यदि A तथा B दो परिमित समुच्चय ऐसे हैं कि A के कुल उपसमुच्चयों की संख्या, B के कुल उपसमुच्चयों की संख्या से 960 अधिक है, तो $n(A) - n(B)$ (जहाँ $n(X)$, समुच्चय X के अवयवों की संख्या दर्शाता है) बराबर है :

- (1) 6 (2) 2 (3) 3 (4) 4

Ans. (4)

Sol. $n(A) = a$
 $n(B) = b$
Given : $2^a - 2^b = 960 \Rightarrow a = 10, b = 6 \Rightarrow a - b = 4$

52. The order and the degree of the differential equation of all ellipses with centre at the origin, major axis along x-axis and eccentricity $\frac{\sqrt{3}}{2}$ are, respectively :

उन सभी दीर्घवृत्तों, जिनका केन्द्र मूल बिन्दु है, दीर्घ अक्ष, x-अक्ष की दिशा में है तथा उत्केन्द्रता $\frac{\sqrt{3}}{2}$ है, के अवकल

समीकरण की कोटि तथा घात क्रमशः हैं :

- (1) 2, 2 (2) 1, 1 (3) 2, 1 (4) 1, 2

Ans. (2)

Sol. $b^2 = a^2 (1 - e^2) = a^2 \left(1 - \frac{3}{4}\right) = \frac{a^2}{4}$

Equation of ellipse :

दीर्घवृत्त का समीकरण

$$\frac{x^2}{a^2} + \frac{y^2}{a^2/4} = 1 \Rightarrow x^2 + 4y^2 = a^2 \Rightarrow 2x + 8y \frac{dy}{dx} = 0$$

$\Rightarrow$ order कोटि = 1, degree घात = 1

53. If A and B are two independent events such that $P(A) = \frac{3}{10}$ and $P(A \cup B) = \frac{4}{5}$, then $P(A \cap B)$ is equal to :

यदि A तथा B दो स्वतंत्र घटनाएँ ऐसी हैं कि $P(A) = \frac{3}{10}$ तथा $P(A \cup B) = \frac{4}{5}$ है, तो $P(A \cap B)$ बराबर है :

- (1) $\frac{3}{35}$ (2) $\frac{1}{5}$ (3) $\frac{1}{10}$ (4) $\frac{3}{14}$

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Ans. (4)

Sol. A & B are independent events. A तथा B स्वतंत्र घटनाएँ हैं।

$$\Rightarrow P(A \cap B) = P(A) \cdot P(B)$$

$$\text{Now अब, } P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$\Rightarrow \frac{4}{5} = \frac{3}{10} + P(B) - \left(\frac{3}{10}\right)P(B) \quad \Rightarrow \frac{4}{5} - \frac{3}{10} = \left(\frac{7}{10}\right)P(B)$$

$$\Rightarrow \frac{5}{10} = \left(\frac{7}{10}\right)P(B) \quad \Rightarrow P(B) = \frac{5}{7}$$

$$\therefore P(A \cap B) = \frac{3}{10} \cdot \frac{5}{7} = \frac{3}{14}$$

54. Let S be the set of all real values of 'a' for which the following system of linear equations

$$ax + 2y + 5z = 1$$

$$2x + y + 3z = 1$$

$$3y + 7z = 1$$

is consistent. Then the set S is

(1) an empty set

(2) equal to R

(3) equal to $R - \{1\}$

(4) equal to $\{1\}$

माना S, 'a' के सभी वास्तविक मानों का समुच्चय है जिसके लिए रैखिक समीकरण निकाय

$$ax + 2y + 5z = 1$$

$$2x + y + 3z = 1$$

$$3y + 7z = 1$$

संगत (consistent) है, तो समुच्चय S :

(1) एक रिक्त समुच्चय है

(2) R के बराबर है

(3) $R - \{1\}$ के बराबर है

(4) $\{1\}$ के बराबर है

Ans. (2)

Sol. $ax + 2y + 5z = 1$

$$2x + y + 3z = 1$$

$$3y + 7z = 1$$

$$\Delta = \begin{vmatrix} a & 2 & 5 \\ 2 & 1 & 3 \\ 0 & 3 & 7 \end{vmatrix} = a(-2) - 2(14) + 5(6) = -2a + 2 = -2(a - 1)$$

$$\Delta_x = \begin{vmatrix} 1 & 2 & 5 \\ 1 & 1 & 3 \\ 1 & 3 & 7 \end{vmatrix} = 1(-2) - 2(4) + 5(2) = 0$$

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$$\Delta_y = \begin{vmatrix} a & 1 & 5 \\ 2 & 1 & 3 \\ 0 & 1 & 7 \end{vmatrix} = a(4) - 1(14) + 5(2) = 4a - 4$$

$$\Delta_z = \begin{vmatrix} a & 2 & 1 \\ 2 & 1 & 1 \\ 0 & 3 & 1 \end{vmatrix} = a(-2) - 2(2) + 1(6) = -2a + 2 = -2(a - 1)$$

∴ system is consistent (निकाय संगत है।)

∴ either या तो $a \neq 1 \Rightarrow$ unique solution अद्वितीय हल

Now अब, if यदि $a = 1$, system of equation becomes (समीकरण निकाय है)

$$x + 2y + 5z = 1$$

$$2x + y + 3z = 1$$

$$3y + 7z = 1$$

i.e. there are only two equations (अर्थात् केवल दो समीकरण हैं)

$$x + 2y + 5z = 1$$

$$3y + 7z = 1$$

which are not parallel (जो कि समान्तर नहीं है)

∴ system of equation is consistent. (समीकरण निकाय संगत है।)

55. If an equilateral triangle, having centroid at the origin, has a side along the line, $x + y = 2$, then the area (in sq. units) of this triangle is

एक समबाहु त्रिभुज, जिसका केन्द्रक मूल बिन्दु है, की एक भुजा रेखा $x + y = 2$ की दिशा में है, तो त्रिभुज का क्षेत्रफल (वर्ग इकाईयों में) है :

(1) $3\sqrt{6}$

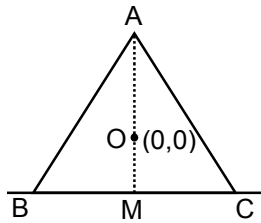
(2) 6

(3) $6\sqrt{3}$

(4) $\frac{9}{2}\sqrt{3}$

Ans. (3)

Sol.



$$OM = \frac{|2|}{\sqrt{2}} = \sqrt{2} \Rightarrow AM = 3\sqrt{2}$$

In $\triangle ABM$ में

$$AB^2 = AM^2 + BM^2 \Rightarrow a^2 = (3\sqrt{2})^2 + \left(\frac{a}{2}\right)^2 \Rightarrow \frac{3a^2}{4} = 18 \Rightarrow a^2 = 24$$

$$\therefore \text{Area क्षेत्रफल} = \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times 24 = 6\sqrt{3}$$

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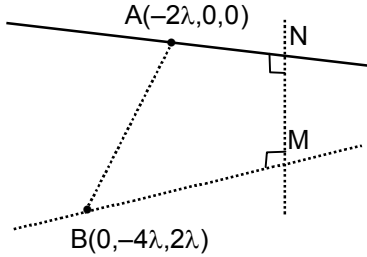
56. If the shortest distance between the lines $x + 2\lambda = 2y = -12z$, $x = y + 4\lambda = 6z - 12\lambda$ is $4\sqrt{2}$ units, then a value of λ is :

यदि रेखाओं $x + 2\lambda = 2y = -12z$, $x = y + 4\lambda = 6z - 12\lambda$ के बीच न्यूनतम दूरी $4\sqrt{2}$ इकाई है, तो λ का एक मान है :

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

Ans. (3)

Sol.



$$\begin{aligned} x + 2\lambda &= 2y = -12z \\ \Rightarrow \frac{x + 2\lambda}{1} &= \frac{y}{1/2} = \frac{z}{-1/12} \\ \Rightarrow \frac{x + 2\lambda}{12} &= \frac{y}{6} = \frac{z}{-1} \end{aligned}$$

$$\begin{aligned} &\& x = y + 4\lambda = 6z - 12\lambda \\ \Rightarrow \frac{x}{1} &= \frac{y + 4\lambda}{1} = \frac{z - 2\lambda}{1/6} \\ \Rightarrow \frac{x}{6} &= \frac{y + 4\lambda}{6} = \frac{z - 2\lambda}{1} \end{aligned}$$

$$\begin{aligned} \text{Vector normal to both lines दोनों रेखाओं का अभिलम्ब सदिश} &= \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 12 & 6 & -1 \\ 6 & 6 & 1 \end{vmatrix} \\ &= \mathbf{i}(12) - \mathbf{j}(18) + \mathbf{k}(36) = 12\mathbf{i} - 18\mathbf{j} + 36\mathbf{k} \end{aligned}$$

$$\text{or vector parallel to normal to both line} = 2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$$

$$\text{या दोनों रेखाओं के अभिलम्ब के समान्तर सदिश} = 2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$$

$$\text{Also इसलिए, } \overline{AB} = (2\lambda)\mathbf{i} - (4\lambda)\mathbf{j} + (2\lambda)\mathbf{k}$$

Shortest distance will be projection of $\overline{AB}$ on vector parallel to the perpendicular to both lines
न्यूनतम दूरी $\overline{AB}$ का दोनों रेखाओं के लम्बवत् समान्तर सदिश पर प्रक्षेप है।

$$\begin{aligned} \Rightarrow 4\sqrt{2} &= \frac{|\overline{AB} \cdot (2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k})|}{\sqrt{4 + 9 + 36}} = \frac{|4\lambda + 12\lambda + 12\lambda|}{7} = \frac{|28\lambda|}{7} \Rightarrow 4\sqrt{2} = 4\lambda \\ \lambda &= \pm \sqrt{2} \end{aligned}$$

57. If the digits at ten's and hundred's places in $(11)^{2016}$ are x and y respectively, then the ordered pair (x, y) is equal to :

यदि $(11)^{2016}$ में दहाई तथा सैकड़े के स्थान पर क्रमशः अंक x तथा y है, तो क्रमित युग्म (x, y) बराबर है :

- (1) (1, 8) (2) (1, 6) (3) (6, 1) (4) (8, 1)

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Ans. (3)

$$\begin{aligned}\text{Sol. } (11)^{2016} &= (10 + 1)^{2016} \\ &= {}^{2016}C_0 10^{2016} + \dots + {}^{2016}C_{2014} 10^2 + {}^{2016}C_{2015} 10 + {}^{2016}C_{2016} \\ &= 1000\lambda + 203112000 + 20160 + 1 = 1000\lambda + 203,132,161\end{aligned}$$

58. Which one of the following points does not lie on the normal to the hyperbola, $\frac{x^2}{16} - \frac{y^2}{9} = 1$ drawn at the point $(8, 3\sqrt{3})$?

निम्न में से कौन-सा बिन्दु अतिपरवलय $\frac{x^2}{16} - \frac{y^2}{9} = 1$ के बिन्दु $(8, 3\sqrt{3})$ पर खींचे गए अभिलम्ब पर स्थित नहीं है ?

- (1) $(10, \sqrt{3})$ (2) $\left(13, \frac{-1}{\sqrt{3}}\right)$ (3) $\left(12, \frac{1}{\sqrt{3}}\right)$ (4) $(11, \sqrt{3})$

Ans. (1)

$$\begin{aligned}\text{Sol. } \frac{x^2}{16} - \frac{y^2}{9} = 1 &\Rightarrow \frac{2x}{16} - \frac{2y}{9} \frac{dy}{dx} = 0 \\ \text{At } (8, 3\sqrt{3}), \text{ पर} \\ \frac{2 \times 8}{16} = \frac{2 \times 3\sqrt{3}}{9} \frac{dy}{dx} &\Rightarrow \frac{3}{2\sqrt{3}} = \frac{dy}{dx} \\ \text{Equation of normal at } (8, 3\sqrt{3}), \\ \text{बिन्दु } (8, 3\sqrt{3}) \text{ पर अभिलम्ब का समीकरण} \\ y - 3\sqrt{3} &= -\frac{2}{\sqrt{3}} (x - 8) \\ \text{Clearly, option (1) does not lie on it.} \\ \text{स्पष्टतया: विकल्प (1) इस पर स्थित नहीं है।}\end{aligned}$$

59. An urn contains 5 red, 4 black and 3 white marbles. Then the number of ways in which 4 marbles can be drawn from it so that at most 3 of them are red, is :

एक कलश में 5 लाल, 4 काले तथा 3 सफेद कंचे हैं। तो उन तरीकों, जिनमें कलश में से 4 कंचे निकाले जा सकते हैं कि उनमें से अधिक से अधिक 3 लाल हों, की संख्या है :

- (1) 495 (2) 455 (3) 460 (4) 490

Ans. (4)

$$\begin{aligned}\text{Sol. } \text{Required number of ways} &= {}^{12}C_4 - {}^5C_4 \\ (\text{अभिष्ट हलों की संख्या}) &= 495 - 5 = 490\end{aligned}$$

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60. If $(x + iy)^2 = 7 + 24i$, then a value of $\left(7 + \sqrt{-576}\right)^{\frac{1}{2}} - \left(7 - \sqrt{-576}\right)^{\frac{1}{2}}$ is :

यदि $(x + iy)^2 = 7 + 24i$ है, तो $\left(7 + \sqrt{-576}\right)^{\frac{1}{2}} - \left(7 - \sqrt{-576}\right)^{\frac{1}{2}}$ का एक मान है :

- (1) $-6i$ (2) $-3i$ (3) $2i$ (4) 6

Ans. (1)

Sol. $(x + iy)^2 = 7 + 24i$

$$\begin{aligned} x^2 - y^2 + i(2xy) &= 7 + 24i & \Rightarrow x^2 - y^2 = 7, xy = 12 & \Rightarrow \left(\frac{12}{y}\right)^2 - y^2 = 7 \\ \Rightarrow 144 - y^4 &= 7y^2 & \Rightarrow y^4 + 7y^2 - 144 = 0 & \Rightarrow y^2 = \frac{-7 \pm 25}{2} = -16 \text{ or } 9 \\ \Rightarrow y &= \pm 3 \end{aligned}$$

$$\text{Also इसलिए } \left(7 + \sqrt{-576}\right)^{1/2} - \left(7 - \sqrt{-576}\right)^{1/2} = (x + iy) - (x - iy) = 2iy = \pm 6i$$

61. The equation of the circle, which is the mirror image of the circle, $x^2 + y^2 - 2x = 0$, in the line, $y = 3 - x$ is :

उस वृत्त का समीकरण, जो वृत्त $x^2 + y^2 - 2x = 0$ का रेखा $y = 3 - x$ में दर्पण प्रतिबिम्ब है, है :

- (1) $x^2 + y^2 - 6x - 4y + 12 = 0$ (2) $x^2 + y^2 - 6x - 8y + 24 = 0$
(3) $x^2 + y^2 - 8x - 6y + 24 = 0$ (4) $x^2 + y^2 - 4x - 6y + 12 = 0$

Ans. (1)

Sol. Centre of circle $(1, 0)$, radius = 1

Image of $(1, 0)$ w.r.t. Line $x + y - 3 = 0$ is

$$\frac{x-1}{1} = \frac{y-0}{1} = \frac{-2(1+0-3)}{1+1} = 2 \Rightarrow x = 3, y = 2$$

Now circle with centre $(3, 2)$ and radius 1 is $(x-3)^2 + (y-2)^2 = 1$

$$\Rightarrow x^2 + 9 - 6x + y^2 + 4 - 4y = 1 \Rightarrow x^2 + y^2 - 6x - 4y + 12 = 0$$

Hindi. वृत्त का केन्द्र $(1, 0)$, त्रिज्या = 1

$(1, 0)$ का रेखा $x + y - 3 = 0$ के सापेक्ष प्रतिबिम्ब

$$\frac{x-1}{1} = \frac{y-0}{1} = \frac{-2(1+0-3)}{1+1} = 2 \Rightarrow x = 3, y = 2$$

केन्द्र $(3, 2)$ तथा त्रिज्या 1 वाला वृत्त $(x-3)^2 + (y-2)^2 = 1$

$$\Rightarrow x^2 + 9 - 6x + y^2 + 4 - 4y = 1 \Rightarrow x^2 + y^2 - 6x - 4y + 12 = 0$$

62. $\lim_{x \rightarrow 0} \frac{\log(\sin 7x + \cos 7x)}{\sin 3x}$ equals :

$\lim_{x \rightarrow 0} \frac{\log(\sin 7x + \cos 7x)}{\sin 3x}$ बराबर है:

- (1) $\frac{1}{3} \log 7$ (2) $\frac{7}{3}$ (3) $\frac{14}{3}$ (4) $\frac{1}{3}$

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Ans. (2)

Sol. $\lim_{x \rightarrow 0} \frac{\log(\sin 7x + \cos 7x)}{\sin 3x} = \frac{1}{2} \lim_{x \rightarrow 0} \frac{\log(1 + \sin 14x)}{\sin 3x}$
 $= \frac{1}{2} \lim_{x \rightarrow 0} \left\{ \frac{\log(1 + \sin 14x)}{\sin 14x} \cdot \frac{\sin 14x}{14x} \cdot \frac{14x}{3x} \cdot \frac{3x}{\sin 3x} \right\} = \frac{1}{2} \cdot \frac{14}{3} = \frac{7}{3}$

63. If the line, $y = mx$, bisects the area of the region $\{(x, y) : 0 \leq x \leq \frac{3}{2}, 0 \leq y \leq 1 + 4x - x^2\}$, then m equals

यदि रेखा $y = mx$, क्षेत्र $\{(x, y) : 0 \leq x \leq \frac{3}{2}, 0 \leq y \leq 1 + 4x - x^2\}$ को दो बराबर भागों में विभाजित करती है, तो

m का मान है :

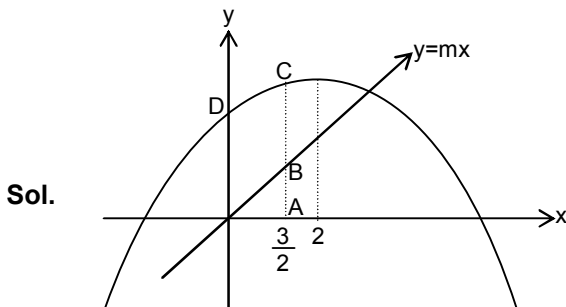
(1) $\frac{39}{16}$

(2) $\frac{9}{8}$

(3) $\frac{13}{3}$

(4) $\frac{13}{6}$

Ans. (4)



$y = -(x^2 - 4x - 1)$

As per the question given,

Area of OAB = Area of region OBCD = Area of OACD – Area of OAB

or

2(Area of region OAB) = (Area of OACD)

$\therefore 2 \left[\frac{1}{2} \times \frac{3}{2} \times \frac{3}{2} m \right] = \int_0^{3/2} (1 + 4x - x^2) dx$

$\therefore \frac{9}{4} m = \frac{3}{2} + 2 \left(\frac{3}{2} \right)^2 - \frac{1}{3} \left(\frac{3}{2} \right)^3$

$= \frac{3}{2} + \frac{9}{2} - \frac{9}{8} = 6 - \frac{9}{8} \quad \text{or} \quad \frac{9m}{4} = \frac{39}{8}$

$\Rightarrow m = \frac{39}{18} = \frac{13}{6}$

$\therefore m = \frac{13}{6}$

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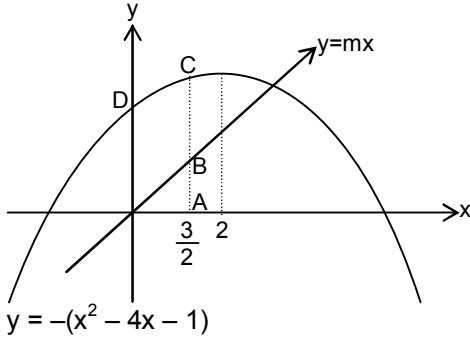
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Hindi.



$$y = -(x^2 - 4x - 1)$$

प्रश्नानुसार,

OAB का क्षेत्रफल = OBCD परिसर का क्षेत्रफल = OACD परिसर का क्षेत्रफल - OAB का क्षेत्रफल

or

2(OAB परिसर का क्षेत्रफल) = (OACD परिसर का क्षेत्रफल)

$$\therefore 2 \left[\frac{1}{2} \times \frac{3}{2} \times \frac{3}{2} m \right] = \int_0^{3/2} (1 + 4x - x^2) dx$$

$$\therefore \frac{9}{4} m = \frac{3}{2} + 2 \left(\frac{3}{2} \right)^2 - \frac{1}{3} \left(\frac{3}{2} \right)^3 = \frac{3}{2} + \frac{9}{2} - \frac{9}{8} = 6 - \frac{9}{8} \text{ या } \frac{9m}{4} = \frac{39}{8}$$

$$\Rightarrow m = \frac{39}{18} = \frac{13}{6}$$

$$\therefore m = \frac{13}{6}$$

64. The product of the perpendiculars drawn from the foci of the ellipse, $\frac{x^2}{9} + \frac{y^2}{25} = 1$ upon the tangent to it at the point $\left(\frac{3}{2}, \frac{5\sqrt{3}}{2} \right)$, is :

दीर्घवृत्त $\frac{x^2}{9} + \frac{y^2}{25} = 1$ की नाभियों से इसके बिंदु $\left(\frac{3}{2}, \frac{5\sqrt{3}}{2} \right)$ पर खींची गई स्पर्श रेखा पर डाले गये लंबों का

गुणनफल है :

(1) $3\sqrt{13}$

(2) 9

(3) $\frac{189}{13}$

(4) 18

Ans. (2)

Sol. Property : Product of the perpendicular drawn from foci of ellipse upon any tangent to it is square of semi minor axis.

ans = 9

Hindi. गुणधर्म : नाभियों से किसी स्पर्श रेखा पर डाले गये लम्बों की लम्बाइयों का गुणनफल अर्धलघुअक्ष के वर्ग के बराबर होता है।

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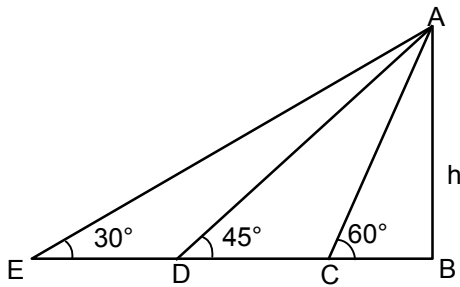
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65. An observer standing at a point P on the top of a hill near the sea-shore notices that the angle of depression of a ship moving towards the hill in a straight line at a constant speed is 30° . After 45 minutes, this angle becomes 45° . If T (in minutes) is the total time taken by the ship to move to a point in the sea where the angle of depression from P of the ship is 60° , then T is equal to :

एक प्रेक्षक समुद्र के पास स्थित एक पहाड़ी की चोटी P पर खड़ा होकर एक जहाज का अवनमन कोण 30° पाता है। जहाज एक समान चाल से एक सरल रेखा में पहाड़ी की ओर आ रहा है। 45 मिनट के बाद यह कोण 45° हो जाता है। यदि समुद्र में वह एक बिंदु जिसका बिंदु P से जहाज का अवनमन कोण 60° है, तक पहुँचने का कुल समय (मिनटों में) T है, तो T बराबर है:

- (1) $45\left(1 + \frac{1}{\sqrt{3}}\right)$ (2) $45(1 + \sqrt{3})$ (3) $45\left(1 + \frac{2}{\sqrt{3}}\right)$ (4) $45\left(2 + \frac{1}{\sqrt{3}}\right)$

Ans. (1)



Sol

Let height of hill is $h = AB$

$$BD = h, EB = h\sqrt{3}, CB = \frac{h}{\sqrt{3}}$$

$$\text{Now speed} = v = \frac{ED}{45} = \frac{(\sqrt{3} - 1)h}{45}$$

Now $DC = vT$,

$$\Rightarrow \left(h - \frac{h}{\sqrt{3}}\right) = \frac{(\sqrt{3} - 1)h}{45} \times T_1$$

$$T_1 = \frac{45}{\sqrt{3}}$$

$$\Rightarrow T = \frac{45}{\sqrt{3}} + 45$$

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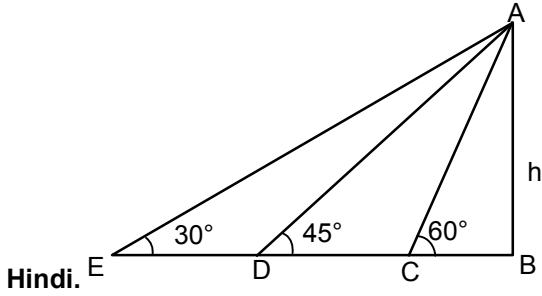
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Hindi.

माना पहाड़ी की ऊँचाई $h = AB$

$$BD = h, EB = h\sqrt{3}, CB = \frac{h}{\sqrt{3}}$$

$$\text{अतः वेग} = v = \frac{ED}{45} = \frac{(\sqrt{3}-1)h}{45}$$

अब $DC = vT_1$,

$$\Rightarrow \left(h - \frac{h}{\sqrt{3}} \right) = \frac{(\sqrt{3}-1)h}{45} \times T_1$$

$$T_1 = \frac{45}{\sqrt{3}}$$

$$\Rightarrow T = \frac{45}{\sqrt{3}} + 45$$

66. Two numbers are selected at random (without replacement) from the first six positive integers. If X denotes the smaller of the two numbers, then the expectation of X , is :

प्रथम छः धनपूर्णाकों में से दो संख्याएँ (बिना प्रतिस्थापना के) यादृच्छया चुनी गईं। यदि X दोनों में से छोटी संख्या को प्रदर्शित करता है, तो X की प्रत्याशा (Expectation) है :

(1) $\frac{5}{3}$

(2) $\frac{14}{3}$

(3) $\frac{13}{3}$

(4) $\frac{7}{3}$

Ans. (4)

Sol Possible pairs are (सम्भव युग्म)

(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 3), (2, 4), (2, 5), (2, 6), (3, 4), (3, 5), (3, 6), (4, 5), (4, 6), (5, 6)

Hence expectation of X will be (अतः X)

$$\frac{(1 \times 5) + (2 \times 4) + (3 \times 3) + (4 \times 2) + (5 \times 1)}{15} = \frac{5 + 8 + 9 + 8 + 5}{15} = \frac{35}{15} = \frac{7}{3}$$

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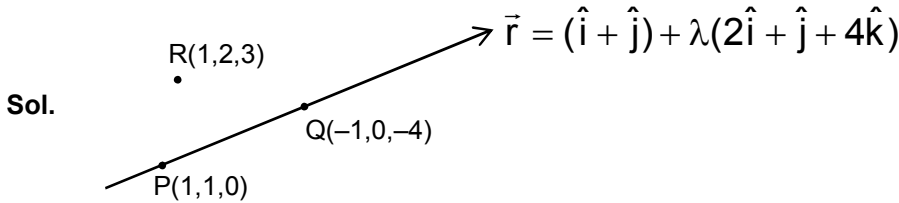
67. The perpendicular distance from the point (3, 1, 1) on the plane passing through the point (1, 2, 3) and containing the line, $\vec{r} = \hat{i} + \hat{j} + \lambda(2\hat{i} + \hat{j} + 4\hat{k})$, is :

बिंदु (3, 1, 1) से एक समतल, जो बिंदु (1, 2, 3) से होकर जाता है तथा जिस पर रेखा

$\vec{r} = \hat{i} + \hat{j} + \lambda(2\hat{i} + \hat{j} + 4\hat{k})$ स्थित है, पर डाले गए लंब की लंबाई है:

- (1) $\frac{3}{\sqrt{11}}$ (2) $\frac{1}{\sqrt{11}}$ (3) $\frac{4}{\sqrt{41}}$ (4) 0

Ans. (4)



Let equation of plane through P, Q & R be $a(x - 1) + b(y - 2) + c(z - 3) = 0$, where माना P, Q व R से जाने वाला समतल $a(x - 1) + b(y - 2) + c(z - 3) = 0$, जहाँ

$$a\hat{i} + b\hat{j} + c\hat{k} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 1 & 3 \\ 2 & 2 & 7 \end{vmatrix} = \hat{i} + 6\hat{j} - 2\hat{k}$$

$$\therefore (a, b, c) = (1, 6, -2)$$

$\therefore$ equation of plane will be (समतल का समीकरण)
 $x + 6 - 2z - 7 = 0$

$$\therefore \text{distance of } (3, 1, 1) \text{ from the plane, } d = \left| \frac{3 + 6 - 2 - 7}{\sqrt{1 + 36 + 4}} \right| = 0$$

$$(3, 1, 1) \text{ की समतल से दूरी, } d = \left| \frac{3 + 6 - 2 - 7}{\sqrt{1 + 36 + 4}} \right| = 0$$

68. The integral $\int \frac{x+2}{(x^2+3x+3)\sqrt{x+1}} dx$ is equal to

- (1) $\frac{1}{\sqrt{3}} \cot^{-1} \left[\frac{x\sqrt{3}}{\sqrt{x+1}} \right] + C$ (2) $\frac{1}{\sqrt{3}} \tan^{-1} \left[\frac{x}{\sqrt{3(x+1)}} \right] + C$
(3) $\frac{2}{\sqrt{3}} \tan^{-1} \left[\frac{x}{\sqrt{3(x+1)}} \right] + C$ (4) $\frac{2}{\sqrt{3}} \cot^{-1} \left[\frac{x}{\sqrt{x+1}} \right] + C$

(where C is a constant of integration)

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समाकल $\int \frac{x+2}{(x^2+3x+3)\sqrt{x+1}} dx$ बराबर है:

(1) $\frac{1}{\sqrt{3}} \cot^{-1} \left[\frac{x\sqrt{3}}{\sqrt{x+1}} \right] + C$

(2) $\frac{1}{\sqrt{3}} \tan^{-1} \left[\frac{x}{\sqrt{3(x+1)}} \right] + C$

(3) $\frac{2}{\sqrt{3}} \tan^{-1} \left[\frac{x}{\sqrt{3(x+1)}} \right] + C$

(4) $\frac{2}{\sqrt{3}} \cot^{-1} \left[\frac{x}{\sqrt{x+1}} \right] + C$

(जहाँ C एक समाकलन अचर है)

Ans. (3)

Sol $\int \frac{(x+2)dx}{(x^2+3x+3)\sqrt{x+1}}$
Let माना $x+1 = t^2 \Rightarrow dx = 2t dt$

$$\begin{aligned} \therefore \int \frac{2(t^2+1)t dt}{[(t^2-1)^2+3t^2].t} &= \int \frac{2(t^2+1)dt}{[(t^4+t^2+1)]} = \int \frac{2(t^2+1)dt}{[(t^2-t+1)(t^2+t+1)]} \\ &= \int \frac{(t^2-t+1)+(t^2+t+1)dt}{[(t^2-t+1)(t^2+t+1)]} = \int \frac{dt}{t^2+t+1} + \int \frac{dt}{t^2-t+1} \\ &= \frac{2}{\sqrt{3}} \left[\tan^{-1} \left(\frac{2}{\sqrt{3}} \left(t + \frac{1}{2} \right) \right) + \tan^{-1} \left(\frac{2}{\sqrt{3}} \left(t - \frac{1}{2} \right) \right) \right] = \frac{2}{\sqrt{3}} \tan^{-1} \left[\frac{\frac{4t}{\sqrt{3}}}{1 - \frac{4}{3} \left(t^2 - \frac{1}{4} \right)} \right] \\ &= \frac{2}{\sqrt{3}} \tan^{-1} \left[\frac{t\sqrt{3}}{1-t^2} \right] = \frac{2}{\sqrt{3}} \tan^{-1} \left(\frac{\sqrt{3(x+1)}}{-x} \right) \\ \therefore I &= \frac{2}{\sqrt{3}} \cot^{-1} \left(\frac{\sqrt{3(x+1)}}{x} \right) + c \end{aligned}$$

69. The value of $\frac{1}{\cos 285^\circ} + \frac{1}{\sqrt{3} \sin 255^\circ}$ is

$\frac{1}{\cos 285^\circ} + \frac{1}{\sqrt{3} \sin 255^\circ}$ का मान है—

(1) $\sqrt{3} - \sqrt{2}$

(2) $2\sqrt{2}$

(3) $\frac{4\sqrt{2}}{\sqrt{3}}$

(4) $\frac{2\sqrt{2}}{3}$

Ans. (3)

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Sol.
$$\frac{1}{\cos 285^\circ} + \frac{1}{\sqrt{3} \sin 255^\circ} = \frac{1}{\cos(270+15)^\circ} + \frac{1}{\sqrt{3} \sin(270-15)^\circ}$$
$$= \frac{1}{\sin 15^\circ} + \frac{1}{\sqrt{3}(-\cos 15^\circ)} = \frac{\sqrt{3} \cos 15^\circ - \sin 15^\circ}{\sqrt{3} \sin 15^\circ \cos 15^\circ} = \frac{2(\cos(30^\circ + 15^\circ))}{\frac{\sqrt{3}}{2} \times \sin 30^\circ}$$
$$= \frac{2 \cos 45^\circ}{(\sqrt{3}/4)} = \frac{8}{\sqrt{3}} \times \frac{1}{\sqrt{2}} = \frac{4\sqrt{2}}{\sqrt{3}}$$

70. Let a_1, a_2, a_3, a_4, a_5 be a G.P. of positive real numbers such that the A.M. of a_2 and a_4 is 117 and the G.M. of a_2 and a_4 is 108. Then the A.M. of a_1 and a_5 is

यदि a_1, a_2, a_3, a_4 तथा a_5 एक धनात्मक वास्तविक संख्याओं की ऐसी गुणोत्तर श्रेणी है कि a_2 तथा a_4 का समान्तर माध्य 117 है तथा a_2 तथा a_4 का गुणोत्तर माध्य (G.M.) 108 है, तो a_1 तथा a_5 का समान्तर माध्य है—

- (1) 145.5 (2) 108 (3) 117 (4) 144.5

Ans. (1)

Sol. a_1, a_2, a_3, a_4, a_5 are in G.P.
(a_1, a_2, a_3, a_4, a_5 गुणोत्तर श्रेणी में है)

$$a_2 + a_4 = 234 \quad \dots\dots(1)$$

$$a_2 a_4 = (108)^2 \quad \dots\dots(2)$$

Let माना $a_2 = a_1 r, a_3 = a_1 r^2, a_4 = a_1 r^3, a_5 = a_1 r^4$,

$$\therefore a_1 r (1 + r^2) = 234 \quad \dots\dots(3)$$

$$a_1^2 r^4 = (108)^2 \Rightarrow a_1 r^2 = 108 \quad \dots\dots(4)$$

(3)/(4)

$$\frac{(1+r^2)}{r} = \frac{234}{108} = \frac{117}{54} = \frac{39}{18} = \frac{13}{6}$$

$$\therefore 6 + 6r^2 = 13r$$

$$\text{or या } (2r-3)(3r-2) = 0$$

$$\therefore r = \frac{3}{2} \quad \text{or} \quad \frac{2}{3}$$

$$\therefore a_1 r^2 = 108 \Rightarrow a_1 \times \frac{9}{4} = 108 \quad \text{or या } a_1 = 48$$

$$\therefore a_5 = a_1 r^4 = 48 \times \frac{81}{16} = 243$$

$$\therefore \text{AM of } a_1 \text{ \& } a_5 \text{ का स.मा.} = \frac{48+243}{2} = \frac{291}{2} = 145.5$$

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71. The integral $\int_{\pi/24}^{5\pi/24} \frac{dx}{1+\sqrt[3]{\tan 2x}}$ is equal to

समाकल $\int_{\pi/24}^{5\pi/24} \frac{dx}{1+\sqrt[3]{\tan 2x}}$ बराबर है—

(1) $\frac{\pi}{18}$

(2) $\frac{\pi}{3}$

(3) $\frac{\pi}{12}$

(4) $\frac{\pi}{6}$

Ans. (3)

$$I = \int_{\pi/24}^{5\pi/24} \frac{dx}{1+\sqrt[3]{\tan 2x}}$$

$$I = \int_{\pi/24}^{5\pi/24} \frac{dx}{1+\sqrt[3]{\tan\left(2\left(\frac{\pi}{4}-x\right)\right)}} = \int_{\pi/24}^{5\pi/24} \frac{dx}{1+\sqrt[3]{\cot 2x}}$$

Adding above two integrals दोनों समाकलों का योग करने पर

$$2I = \int_{\pi/24}^{5\pi/24} dx = \frac{\pi}{6}$$

or या $I = \frac{\pi}{12}$

72. There vector $\vec{a}$, $\vec{b}$ and $\vec{c}$ are such that $|\vec{a}| = 1$, $|\vec{b}| = 2$, $|\vec{c}| = 4$ and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Then the value of $4\vec{a} \cdot \vec{b} + 3\vec{b} \cdot \vec{c} + 3\vec{c} \cdot \vec{a}$ is equal to

तीन सदिश $\vec{a}$, $\vec{b}$ तथा $\vec{c}$ ऐसे हैं कि $|\vec{a}| = 1$, $|\vec{b}| = 2$, $|\vec{c}| = 4$ तथा $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ है, तो $4\vec{a} \cdot \vec{b} + 3\vec{b} \cdot \vec{c} + 3\vec{c} \cdot \vec{a}$ का मान है—

(1) 27

(2) -68

(3) -26

(4) -34

Ans. (3)

Sol. $\vec{c} = -\vec{a} - \vec{b}$

$$\therefore 4(\vec{a} \cdot \vec{b}) + 3(\vec{b} \cdot \vec{c}) + 3(\vec{c} \cdot \vec{a}) = 4(\vec{a} \cdot \vec{b}) + 3\vec{b} \cdot (-\vec{a} - \vec{b}) + 3(\vec{a} \cdot (-\vec{a} - \vec{b}))$$

$$= 4(\vec{a} \cdot \vec{b}) - 3(\vec{a} \cdot \vec{b}) - 3|\vec{b}|^2 - 3|\vec{a}|^2 - 3(\vec{a} \cdot \vec{b}) - 2(\vec{a} \cdot \vec{b}) - 3(4) - 3(1) = -15 - 2(\vec{a} \cdot \vec{b})$$

$$\therefore \vec{a} + \vec{b} = -\vec{c}$$

$$\therefore (\vec{a} + \vec{b}) = |\vec{c}|$$

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$$\begin{aligned} \text{or या } \sqrt{1+4+2(\vec{a} \cdot \vec{b})} &= 4 \\ 2(\vec{a} \cdot \vec{b}) &= 11 \Rightarrow (\vec{a} \cdot \vec{b}) = \frac{11}{2} \\ -15 - 2(\vec{a} \cdot \vec{b}) &= -15 - 11 = -26 \end{aligned}$$

73. For all real numbers x, y and z, the determinant $\begin{vmatrix} 2x & xy - xz & y \\ 2x + z + 1 & xy - xz + yz - z^2 & 1 + y \\ 3x + 1 & 2xy - 2xz & 1 + y \end{vmatrix}$ is equal to

- (1) $(y - xz)(z - x)$ (2) zero (3) $(x - y)(y - z)(z - x)$ (4) $(x - yz)(y - z)$

x, y तथा z के सभी वास्तविक संख्याओं के लिए सारणिक $\begin{vmatrix} 2x & xy - xz & y \\ 2x + z + 1 & xy - xz + yz - z^2 & 1 + y \\ 3x + 1 & 2xy - 2xz & 1 + y \end{vmatrix}$ बराबर है—

- (1) $(y - xz)(z - x)$ (2) शून्य (3) $(x - y)(y - z)(z - x)$ (4) $(x - yz)(y - z)$

Ans. (3)

Sol. $\begin{vmatrix} 2x & xy - xz & y \\ 2x + z + 1 & xy - xz + yz - z^2 & 1 + y \\ 3x + 1 & 2xy - 2xz & 1 + y \end{vmatrix}$

$$= \begin{vmatrix} 2x & x(y - z) & y \\ z + 1 & z(y - z) & 1 \\ x + 1 & x(y - z) & 1 \end{vmatrix} \left\{ \begin{array}{l} \because R_2 \rightarrow R_2 - R_1 \\ R_3 \rightarrow R_3 - R_1 \end{array} \right\} = (y - z) \begin{vmatrix} 2x & x & y \\ z + 1 & z & 1 \\ x + 1 & x & 1 \end{vmatrix}$$

$$= (y - z) \begin{vmatrix} x & x & y \\ 1 & z & 1 \\ 1 & x & 1 \end{vmatrix} \left\{ \because C_1 \rightarrow C_1 - C_2 \right\} = (y - z) \begin{vmatrix} x & x & y \\ 0 & z - x & 0 \\ 1 & x & 1 \end{vmatrix} \{R_2 \rightarrow R_2 - R_3\}$$

$$\Rightarrow (x - y)(y - z)(z - x)$$

74. If λ_1 and λ_2 are the two values of λ such that the roots α and β of the quadratic equation,

$$\lambda(x^2 - x) + x + 5 = 0 \text{ satisfy } \frac{\alpha}{\beta} + \frac{\beta}{\alpha} + \frac{4}{5} = 0, \text{ then } \frac{\lambda_1}{\lambda_2^2} + \frac{\lambda_2}{\lambda_1^2} \text{ is equal to}$$

यदि λ_1 तथा λ_2 , λ के ऐसे दो मान हैं कि द्विघाती समीकरण $\lambda(x^2 - x) + x + 5 = 0$ के मूल α, β ऐसे हैं कि

$$\frac{\alpha}{\beta} + \frac{\beta}{\alpha} + \frac{4}{5} = 0 \text{ है, तो } \frac{\lambda_1}{\lambda_2^2} + \frac{\lambda_2}{\lambda_1^2} \text{ बराबर है—}$$

- (1) 488 (2) 536 (3) 512 (4) 504

Ans. (1)

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Sol. $\lambda x^2 + (1 - \lambda)x + 5 = 0$ $\begin{matrix} \alpha \\ \beta \end{matrix}$

$$\therefore \frac{\alpha}{\beta} + \frac{\beta}{\alpha} + \frac{4}{5} = 0$$

$$\therefore \frac{(\alpha + \beta)^2 - 2\alpha\beta}{\alpha\beta} + \frac{4}{5} = 0$$

$$= \frac{\left(\frac{\lambda-1}{\lambda}\right)^2 - \frac{10}{\lambda}}{(5/\lambda)} = -\frac{4}{5}$$

or या $\frac{\lambda^2 - 2\lambda + 1}{\lambda^2} - \frac{10}{\lambda} = -\frac{4}{\lambda}$

$$\lambda^2 - 2\lambda + 1 = 6\lambda$$

or $\lambda^2 - 8\lambda + 1 = 0$ $\begin{matrix} \lambda_1 \\ \lambda_2 \end{matrix}$

$$\text{Now, } \frac{\lambda_1}{\lambda_2^2} + \frac{\lambda_2}{\lambda_1^2} = \frac{\lambda_1^3 + \lambda_2^3}{(\lambda_1 \cdot \lambda_2)^2} = \frac{(\lambda_1 + \lambda_2)^3 - 3\lambda_1\lambda_2(\lambda_1 + \lambda_2)}{(\lambda_1 \cdot \lambda_2)^2} = 512 - 24 = 488$$

75. If the sum of the first 15 terms of the series $3 + 7 + 14 + 24 + 37 + \dots$ is $15k$, then k is equal to
यदि श्रेणी $3 + 7 + 14 + 24 + 37 + \dots$ के प्रथम 15 पदों का योग $15k$ है, तो k बराबर है—

- (1) 126 (2) 122 (3) 81 (4) 119

Ans. (2)

$$S_n = 3 + 7 + 14 + 24 + 37 + \dots + T_n$$

$$S_n = 3 + 7 + 14 + 24 + \dots + T_n$$

$$\therefore 0 = 3 + 4 + 7 + 10 + 13 + \dots - T_n$$

or या $T_n = \frac{3 + 4 + 7 + 10 + 13 + \dots}{r \text{ term}}$

$$\therefore T_n = 3 + \left(\frac{n-1}{2}\right)[8 + (n-2)3]$$

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

$$= 3 + \frac{3n^2(3n+2)}{2}$$

or या $T_n = \frac{3}{2}n^2 - \frac{n}{2} + 2$

$$\therefore S_n = \sum T_n$$

$$\therefore S_n = \frac{3}{2} \frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)}{4} + 2n$$

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$$\therefore S_n = \frac{3}{2} \left[\frac{15 \times 16 \times 31}{6} \right] - \left(\frac{15 \times 16}{4} \right) + (2 \times 15) = 1860 - 60 + 30$$

$$\therefore S_{15} = 1830 = 15k$$

$$\therefore k = 122$$

76. Water is running into an underground right circular conical reservoir, which is 10m deep and radius of its base is 5m. If the rate of change in the volume of water in reservoir is $\frac{3}{2} \pi \text{ m}^3/\text{min.}$, then the rate (in m/min) at which water rises in it, when the water level is 4m, is

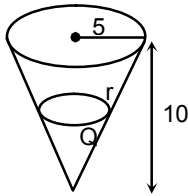
एक भूमिगत लम्ब वृत्तीय शंक्वाकार टंकी, जो 10 मीटर गहरी तथा जिसके आधार की त्रिज्या 5 मीटर है, में पानी

आ रहा है। यदि टंकी के पानी के आयतन में परिवर्तन की दर $\frac{3}{2} \pi \text{ मी}^3/\text{मि.}$ है, तो टंकी के स्तर में परिवर्तन की दर

(मी./मि. में) जबकि पानी का स्तर 4 मीटर है—

- (1) $\frac{3}{2}$ (2) $\frac{3}{8}$ (3) $\frac{1}{8}$ (4) $\frac{1}{4}$

Ans. (2)



$$v = \frac{1}{3} \pi r^2 h = \frac{1}{3} \pi h^3 \tan^2 \theta$$

$$\frac{dv}{dt} = \pi r^2 \frac{dh}{dt}$$

$$\text{Now अब } \frac{r}{4} = \frac{5}{10} \Rightarrow r = 2 \quad \Rightarrow \frac{3}{2} \pi = \pi (2)^2 \frac{dh}{dt} \quad \Rightarrow \frac{dh}{dt} = \frac{3}{8}$$

77. A bag contains three coins, one of which has head on both sides, another is a biased coin that shows up heads 90% of the time and the third one is an unbiased coin. A coin is taken out from the bag at random and tossed. If it shows up a head, then the probability that it is the unbiased coin, is

एक थैले में तीन सिक्के हैं, जिनमें से एक के दोनों ओर चित्त है, दूसरा सिक्का अभिनत (biased) है जिस पर चित्त 90% बार प्रकट होता है और तीसरा अनभिनत सिक्का है। थैले में से एक सिक्का यादृच्छया निकाल कर उछाला गया। यदि सिक्के पर चित्त प्रकट हो, तो उसके अनभिनत सिक्का होने की प्रायिकता है—

- (1) $\frac{3}{8}$ (2) $\frac{5}{12}$ (3) $\frac{5}{24}$ (4) $\frac{1}{3}$

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Ans. (3)

$$\text{Required Prob. अभीष्ट प्रायिकता} = \frac{\left(\frac{1}{3} \times \frac{1}{2}\right)}{\left(\frac{1}{3} \times 1\right) + \left(\frac{1}{3} \times \frac{9}{10}\right) + \left(\frac{1}{3} \times \frac{1}{2}\right)} = \frac{5}{10+9+5} = \frac{5}{24}$$

78. If the function $f : \mathbb{R} \rightarrow \mathbb{R}$, defined by $f(x) = \begin{cases} ax & x < 2 \\ ax^2 - bx + 3 & x \geq 2 \end{cases}$ is differentiable, then the value of

$f'(-3) + f'(3)$ is equal to

यदि फलन $f : \mathbb{R} \rightarrow \mathbb{R}$, जो $f(x) = \begin{cases} ax & x < 2 \\ ax^2 - bx + 3 & x \geq 2 \end{cases}$ द्वारा परिभाषित है, अवकलनीय है, तो

$f'(-3) + f'(3)$ का मान है—

- (1) 0 (2) 3 (3) 4 (4) $\frac{15}{2}$

Ans. (2)

$$f(x) = \begin{cases} ax & ; x < 2 \\ ax^2 - bx + 3 & ; x \geq 2 \end{cases}$$

$\therefore f(x)$ is differentiable function

$\therefore f(x)$ must be continuous

$\therefore f(2+h) = f(2-h) = f(2)$

$\therefore 4a - 2b + 3 = 2a$

or $2a - 2b + 3 = 0$ (1)

Also, $f'(2+h) = f'(2-h)$

$\therefore 2a(2) - b = a$

or $3a = b$ (2)

Solving equation (1) & (2) we get

$$a = \frac{3}{4} \quad \& \quad b = \frac{9}{4}$$

Now $f'(-3) = a$

& $f'(3) = 2a(3) - b = 6a - b$

$$\therefore f'(-3) + f'(3) = 7a - b = \frac{21}{4} - \frac{9}{4} = \frac{12}{4} = 3$$

Hindi. $f(x) = \begin{cases} ax & ; x < 2 \\ ax^2 - bx + 3 & ; x \geq 2 \end{cases}$

$\therefore f(x)$ एक अवकलनीय फलन है

$\therefore f(x)$ सतत होना चाहिए

$\therefore f(2+h) = f(2-h) = f(2)$

$\therefore 4a - 2b + 3 = 2a$

या $2a - 2b + 3 = 0$ (1)

तथा, $f'(2+h) = f'(2-h)$

$\therefore 2a(2) - b = a$

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या $3a = b$ (2)

समी. (1) तथा (2) से

$$a = \frac{3}{4} \text{ \& } b = \frac{9}{4}$$

अब $f'(-3) = a$

तथा $f'(3) = 2a(3) - b = 6a - b$

$$\therefore f'(-3) + f'(3) = 7a - b = \frac{21}{4} - \frac{9}{4} = \frac{12}{4} = 3$$

79. Which one of the following statements is a tautology ?

निम्न में से कौनसा कथन एक पुनरुक्ति (tautology) है ?

- (1) $p \rightarrow (p \rightarrow q)$ (2) $(p \vee q) \rightarrow q$ (3) $p \vee (p \rightarrow q)$ (4) $p \vee (q \rightarrow p)$

Ans. (3)

p	q	$p \rightarrow q$	$q \rightarrow p$	$p \vee q$	$p \rightarrow (p \rightarrow q)$	$(p \vee q) \rightarrow q$
T	T	T	T	T	T	T
T	F	F	T	T	F	F
F	T	T	F	T	T	T
F	F	T	T	F	T	T

$P \vee (p \rightarrow q)$	$p \vee (q \rightarrow q)$
T	T
T	T
T	F
T	T

$\Rightarrow p \vee (p \rightarrow q)$ is tautology

$\Rightarrow p \vee (p \rightarrow q)$ पुनरुक्ति है।

80. The sum of the abscissae of the points where the curves, $y = kx^2 + (5k + 3)x + 6k + 5$, ($k \in \mathbb{R}$), touch the x-axis, is equal to

उन बिन्दुओं के x-निर्देशांकों का योग, जहाँ वक्र $y = kx^2 + (5k + 3)x + 6k + 5$, ($k \in \mathbb{R}$), x-अक्ष को स्पर्श करती हैं, है—

- (1) $-\frac{4}{3}$ (2) $-\frac{19}{3}$ (3) $-\frac{10}{3}$ (4) $\frac{5}{3}$

Ans. (3)

Sol. $y = kx^2 + (5k + 3)x + (6k + 5)$

$\therefore$ curve touches x-axis

$\therefore D = 0$

$$\therefore (5k + 3)^2 = 4k(6k + 5)$$

$$\text{or } 25k^2 + 30k + 9 = 24k^2 + 20k \quad \text{or } k^2 + 10k + 9 = 0$$

$$\therefore k = -1 \text{ and } -9$$

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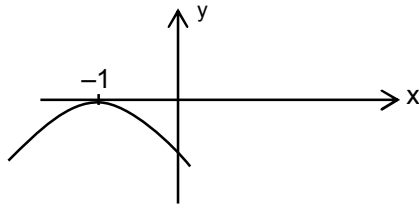
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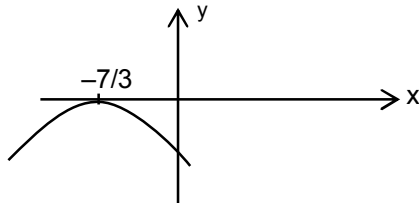
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∴ Curve can be,
 $y = -x^2 - 2x - 1 = -(x+1)^2$



or curve can be
 $y - 9x^2 - 42x - 49 = -(3x + 7)^2$



∴ Sum of abscissae = $-1 - \frac{7}{3} = -\frac{10}{3}$

Hindi. (3)

$$y = kx^2 + (5k + 3)x + (6k + 5)$$

∴ वक्र x-अक्ष को स्पर्श करता है।

$$\therefore D = 0$$

$$\therefore (5k + 3)^2 = 4k(6k + 5)$$

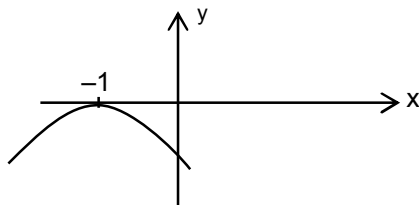
$$\text{या } 25k^2 + 30k + 9 = 24k^2 + 20k$$

$$\text{या } k^2 + 10k + 9 = 0$$

$$\therefore k = -1 \text{ तथा } -9$$

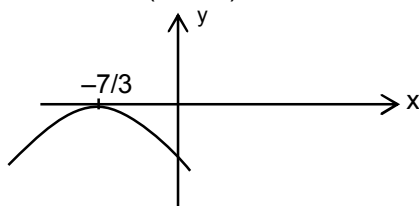
∴ वक्र हो सकता है,

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



या वक्र हो सकता है

$$y - 9x^2 - 42x - 49 = -(3x + 7)^2$$



∴ भुजों का योग = $-1 - \frac{7}{3} = -\frac{10}{3}$

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