

National Testing Agency

Notations :

- 1.Options shown in green color and with ✓ icon are correct.
- 2.Options shown in red color and with ✗ icon are incorrect.

Question Paper Name :	PHYSICAL SCIENCES 28th July 2025 Shift 2
Subject Name :	PHYSICAL SCIENCES
Creation Date :	2025-07-28 21:38:37
Duration :	180
Total Marks :	200
Display Marks:	Yes
Change Font Color :	No
Change Background Color :	No
Change Theme :	No
Help Button :	No
Show Reports :	No
Show Progress Bar :	No

PHYSICAL SCIENCES

Group Number :	1
Group Id :	5629541
Group Maximum Duration :	0
Group Minimum Duration :	180
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	200

PART - A

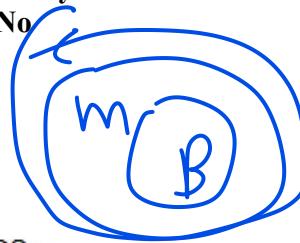
Section Id :	5629541
Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	15
Section Marks :	30
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	5629541
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 5629541 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

Consider the following statements:

Statement I: All Booklets are Manuals.

Statement II: All Manuals are Catalogues.



2

If Statements I and II are True, which one of the following conclusions can be conclusively drawn?

1. All Manuals are Booklets.
2. All Catalogues are Booklets.
3. All Booklets are Catalogues.
4. All Catalogues are Manuals.

Question Number : 1 Question Id : 5629541 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

निम्नलिखित कथनों पर विचार करें :

कथन I: सभी पुस्तकाएं नियमावलियां हैं

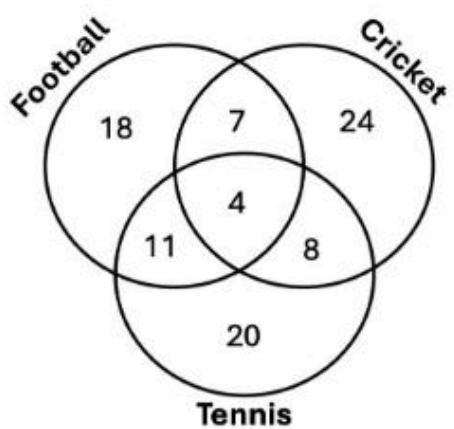
कथन II: सभी नियमावलियां सूचियां हैं

यदि कथन I और II सत्य हैं तो निम्न में से कौन सा निष्कर्ष निश्चित रूप से निकाला जा सकता है ?

1. सभी नियमावलियां, पुस्तकाएं हैं
2. सभी सूचियां पुस्तकाएं हैं
3. सभी पुस्तकाएं, सूचियां हैं
4. सभी सूचियां नियमावलियां हैं

Question Number : 2 Question Id : 5629542 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

The given Venn diagram shows numbers of players playing one or more than one sport.



$$\frac{26}{92}$$

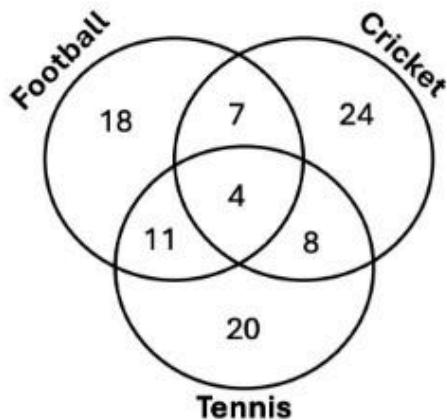
2

The percentage of players who play exactly two sports is closest to ____ %.

1. 5
2. 14
3. 28
4. 32

Question Number : 2 Question Id : 5629542 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
 N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
 to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 2 Wrong Marks : 0.5

दिए गए बेन आरेख में उन खिलाड़ियों की संख्या प्रदर्शित की गई है जो एक या उससे
अधिक खेलों को खेलते हैं।



उन खिलाड़ियों की प्रतिशतता जो ठीक दो खेल खेलते हैं % के निकटतम होगी

1. 5
2. 14
3. 28
4. 32

Question Number : 3 Question Id : 5629543 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
 N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
 to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

The value of a company is measured as the total value of its shares owned by different investors. Rakesh owns $\frac{2}{15}$ of the shares of a company. He sells $\frac{1}{3}$ of his shares for Rs. 75,000/- . What is the total value of the company at that time?

1. Rs. 15,75,800
2. Rs. 16,87,500
3. Rs. 17,75,800
4. Rs. 18,27,500

$$R = \frac{2}{15}$$

(2)

$$\begin{aligned}
 \frac{1}{3} \times \frac{2}{15} &= 75 \\
 &= \frac{75 \times 5}{2}
 \end{aligned}$$

**Question Number : 3 Question Id : 5629543 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

एक कंपनी का मूल्य, विभिन्न निवेशकों के स्वामित्व में इसके शेयरों के कुल मूल्य द्वारा मापा जाता है। राकेश के पास इस कंपनी के शेयरों का $\frac{2}{15}$ भाग है। वह अपने शेयरों के $\frac{1}{3}$ भाग को रु. 75,000/- में बेच देता है। इस कंपनी का कुल मूल्य उस समय क्या है?

1. रु. 15,75,800
2. रु. 16,87,500
3. रु. 17,75,800
4. रु. 18,27,500

**Question Number : 4 Question Id : 5629544 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

A car has wheels of diameter 36 cm. If it runs at a speed of 60 km/h, then the rotation per minute (RPM) will be closest to _____. .

1. 884
2. 898
3. 906
4. 986

**Question Number : 4 Question Id : 5629544 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

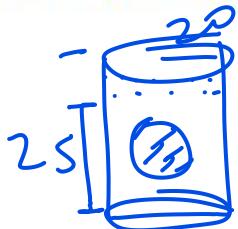
एक कार के पहियों का व्यास 36 सेमी है। यदि यह 60 किमी/घंटे की गति से चलती है तो इसके पहियों का प्रति मिनट रोटेशन (RPM) _____ के निकटतम होगा।

1. 884
2. 898
3. 906
4. 986

Question Number : 5 Question Id : 5629545 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 2 Wrong Marks : 0.5

A cylindrical container of radius 20 cm was filled with water up to 25 cm height. A solid spherical ball of radius 7 cm was then immersed in the water. What would be the approximate increase in water level in the container after the ball was fully immersed?

1. 1.14 cm
2. 2.28 cm
3. 5.50 cm
4. 7.00 cm



$$\frac{4}{3} \pi r^3 = \pi (20)^2 \times h \times 70 \times h$$

$$h = \frac{r^3}{350 \times 3} =$$

Question Number : 5 Question Id : 5629545 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

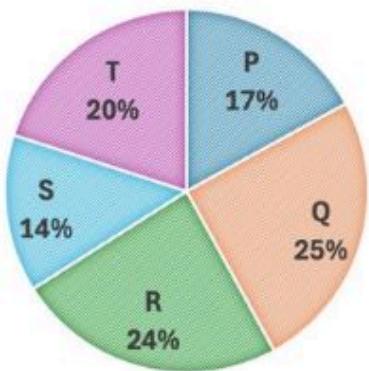
एक बेलनाकार पात्र जिसकी विज्या 20 सेमी है में 25 सेमी ऊंचाई तक जल भरा गया। तत्पश्चात इसमें 7 सेमी विज्या के एक ठोस गोलाकार गेंद को डाला गया। इस गेंद के पानी में पूरी तरह झूबने के पश्चात पात्र में जल के स्तर में लगभग कितनी वृद्धि होगी?

1. 1.14 सेमी
2. 2.28 सेमी
3. 5.50 सेमी
4. 7.00 सेमी

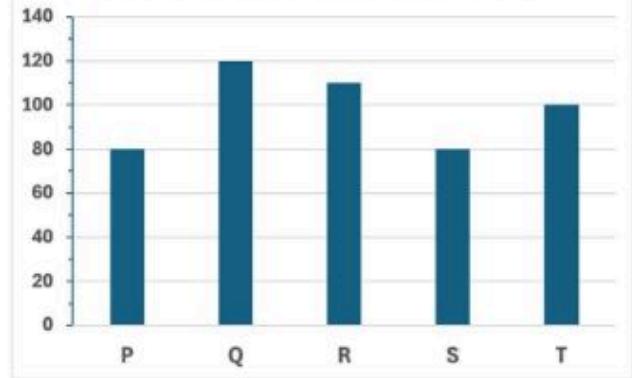
Question Number : 6 Question Id : 5629546 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 2 Wrong Marks : 0.5

The market share (%) and annual production of scooters from five automobile companies P, Q, R, S, and T are shown in graphs.

MARKET SHARE (%)



PRODUCTION (Thousands of Scooters)



If the profit of a company is directly proportional to the ratio of market share to production, then which of the following statements is/are CORRECT?

Statement X: Companies T and P have same profit X

Statement Y: Company R has the maximum profit

Statement Z: Company S has the minimum profit

1. X and Y
2. X and Z
3. Y and Z
4. Only Z

$$\frac{20X}{100} = \frac{X}{S}$$

$$\frac{24X}{115}$$

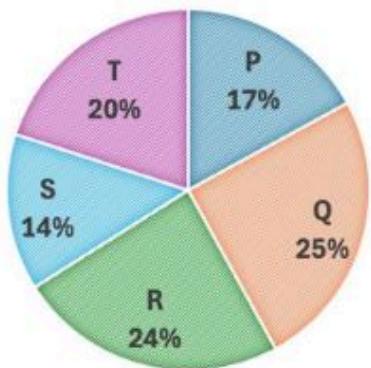
$$\frac{17\cancel{2}X}{80} = \frac{X}{S} \dots$$

$$\frac{14X}{80}$$

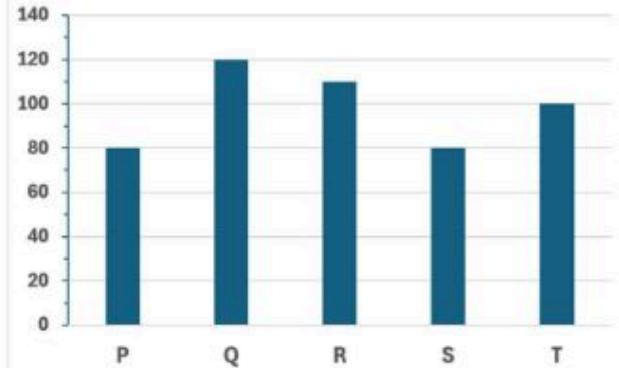
Question Number : 6 Question Id : 5629546 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

नीचे दिए गए ग्राफ में P, Q, R, S और T नामक ऑटोमोबाइल कंपनियों के मार्केट शेयर
(%) और स्कूटरों के वार्षिक उत्पादन को प्रदर्शित किया गया है।

MARKET SHARE (%)



PRODUCTION (Thousands of Scooters)



यदि किसी कंपनी का लाभ इसके बाजार हिस्सेदारी व उत्पादन के अनुपात के सीधे समानुपाती हो तो निम्नलिखित में से कौन सा/से कथन सही है/हैं ?

कथन X: T और P कंपनी का लाभ एकसमान है

कथन Y: R कंपनी का लाभ सर्वाधिक है

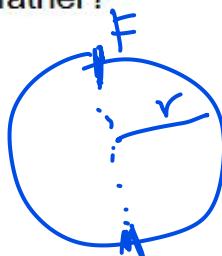
कथन Z: S कंपनी का लाभ न्यूनतम है

1. X एवं Y
2. X एवं Z
3. Y एवं Z
4. केवल Z

Question Number : 7 Question Id : 5629547 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

Rahul and his father started jogging on a circular track of radius 'r' ($r > 2$). Rahul completed one round and stopped. His father got tired half way into the first round and returned to his starting point along a straight line. What is the ratio of the distances covered by Rahul and his father?

1. $\pi r / (\pi + 2)$
2. $2\pi / (\pi + 2)$
3. 1
4. 2



$$F = \pi r + 2r$$
$$R = 2\pi r$$
$$\frac{2\pi r}{\pi r + 2r}$$

2

Question Number : 7 Question Id : 5629547 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

राहुल और उसके पिता ने 'r' ($r > 2$) क्रिया के एक वृत्ताकार ट्रैक पर दौड़ना प्रारंभ किया। राहुल ने एक चक्कर पूरा किया और रुक गया। उसके पिता पहले चक्कर के आधे रास्ते पे थक जाने के कारण एक सीधी रेखा में अपने प्रारंभिक बिंदु पर वापस आ गए। पिता के सापेक्ष राहुल द्वारा तय की गई दूरी का अनुपात क्या है?

1. $\pi r / (\pi + 2)$
2. $2\pi / (\pi + 2)$
3. 1
4. 2

**Question Number : 8 Question Id : 5629548 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

Kavita starts from her house and walks 200 m northward, then turns 45° right and walks 70 m. After that, she turns 90° right and walks 70 m. Which of the following is the closest value of the shortest distance between Kavita's current location and her house?

1. 296 m
2. 240 m
3. 200 m
4. 223 m

**Question Number : 8 Question Id : 5629548 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

कविता अपने घर से चलना प्रारंभ करती है और 200 मीटर उत्तर की ओर चलती है और उसके बाद 45° पर दाएं मुड़कर 70 मीटर चलती है। तत्पश्चात वह 90° पर दाएं मुड़कर 70 मीटर चलती है। कविता के वर्तमान स्थान और उसके घर के बीच की न्यूनतम दूरी का निकटतम मान निम्नलिखित में से क्या होगा?

1. 296 मीटर
2. 240 मीटर
3. 200 मीटर
4. 223 मीटर

Question Number : 9 Question Id : 5629549 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 2 Wrong Marks : 0.5

The initial monthly salaries of employees John, Riya, and Sunil were in the proportion 4:3:5. After an increase of Rs 10000 monthly to all, the new proportion becomes 6:5:7. What was the initial salary of Sunil?

1. Rs 20000
2. Rs 25000
3. Rs 30000
4. Rs 35000

$$\begin{aligned}
 T &= 12K \\
 12K + 30 &= 18K \\
 6K &= 30,000 \\
 K &= 5K
 \end{aligned}$$

2

Question Number : 9 Question Id : 5629549 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

जॉन, रिया और सुनील नामक कर्मचारियों के प्रारंभिक मासिक वेतन का अनुपात 4:3:5 है। सबके वेतन में रु. 10000 की वृद्धि होने पर नया अनुपात 6:5:7 हो जाता है। तो सुनील का प्रारंभिक वेतन क्या था?

1. रु. 20000
2. रु. 25000
3. रु. 30000
4. रु. 35000

Question Number : 10 Question Id : 56295410 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

Numbers of Rose, Lotus, and Marigold plants in a garden are in the proportion 8:5:7. Later, 75%, 40% and 50% more plants of their respective categories were added. What will be the new proportion of plants, in the same order?

1. 5:3:4
2. 4:2:3
3. 5:4:3
4. 7:4:5

$$\begin{aligned}
 X &+ \frac{3}{4}X & Y &+ \frac{2}{5}Y & Z &+ \frac{1}{2}Z \\
 \frac{7}{5}X &, \frac{7}{5}Y & \frac{7}{5}Z & & & \\
 15T &, 7T & 2\frac{1}{2}T & & &
 \end{aligned}$$

3 : 2 : 2.5

**Question Number : 10 Question Id : 56295410 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

एक बगीचे में गुलाब, कमल और गेंदा के पौधों की संख्या का अनुपात 8:5:7 है। बाद में उनकी श्रेणी के क्रमशः 75%, 40% और 50% और पौधों को शामिल किया गया। उसी क्रम में पौधों का नया अनुपात क्या होगा?

1. 5:3:4
2. 4:2:3
3. 5:4:3
4. 7:4:5

**Question Number : 11 Question Id : 56295411 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

What will be the digit at the unit's place of $1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3$?

1. 0
2. 5
3. 7
4. 9

**Question Number : 11 Question Id : 56295411 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

$1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3$ के इकाई स्थान पर क्या आएगा?

1. 0
2. 5
3. 7
4. 9

Question Number : 12 Question Id : 56295412 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

Suresh asked Ramesh to identify the person in a photo that the latter is holding. Ramesh responds, "I have no brothers or sisters. However, that man's father is my father's son." Who is the person in the photo?

1. Suresh
2. Ramesh
3. Ramesh's son
4. Ramesh's cousin

Question Number : 12 Question Id : 56295412 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

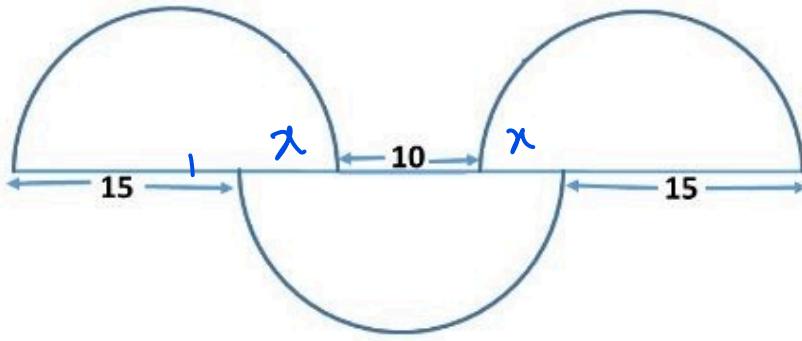
सुरेश ने रमेश से रमेश के पास स्थित फोटो में दिख रहे व्यक्ति की पहचान करने को कहा। रमेश ने कहा कि “मेरा कोई भी भाई या बहिन नहीं है। हालांकि उस व्यक्ति का पिता मेरे पिता का पुत्र है।” फोटो में दिख रहा व्यक्ति कौन है ?

1. सुरेश
2. रमेश
3. रमेश का पुत्र
4. रमेश का चचेरा भाई

Question Number : 13 Question Id : 56295413 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 2 Wrong Marks : 0.5

2

Three identical semi-circles are arranged as shown. What is the diameter of the semi-circles?

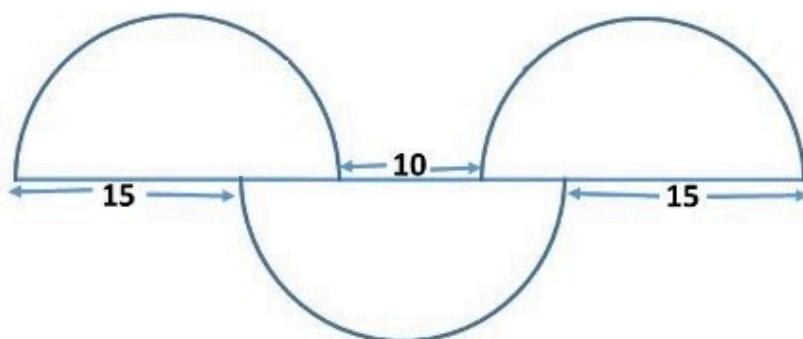


$$\begin{aligned}
 10 + 2R &= 2R \\
 30 + 2R &= 4R + 10 \\
 20 &= 2R \\
 R &= 10
 \end{aligned}$$

1. 5π
2. 20 ✓
3. $15\pi/2$
4. 25

Question Number : 13 Question Id : 56295413 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 2 Wrong Marks : 0.5

तीन समान अर्ध-वृत्तों को दर्शाए गए क्रम में रखा गया है। अर्ध-वृत्तों का व्यास क्या होगा?



1. 5π
2. 20
3. $15\pi/2$
4. 25

Question Number : 14 Question Id : 56295414 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

A number is mistakenly divided by 2 instead of being multiplied by 2. What is the
change in the result caused by this mistake?

1. 25%
2. 50%
3. 75%
4. 100%

$$\begin{array}{r} \cancel{2x} - \cancel{\frac{x}{2}} \\ \hline \cancel{2x} \end{array}$$

$$\frac{1 - \frac{1}{2}}{2} = \frac{1}{4}$$

2

Question Number : 14 Question Id : 56295414 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No

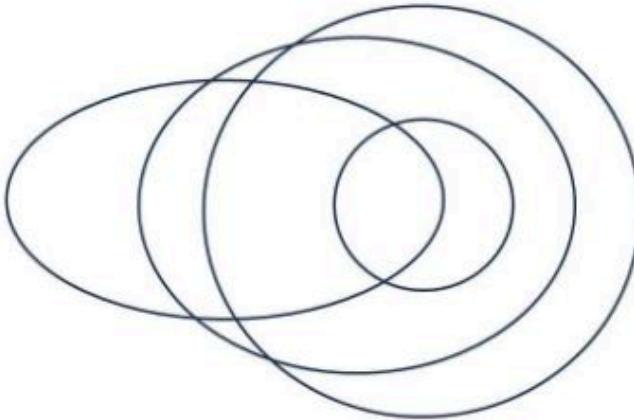
Correct Marks : 2 Wrong Marks : 0.5

एक संख्या को 2 से गुणा करने के बजाय गलती से 2 से भाग दे दिया गया। इस गलती
से परिणाम में कितना परिवर्तन होगा?

1. 25%
2. 50%
3. 75%
4. 100%

**Question Number : 15 Question Id : 56295415 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

The following diagram represents the relationship between four categories.

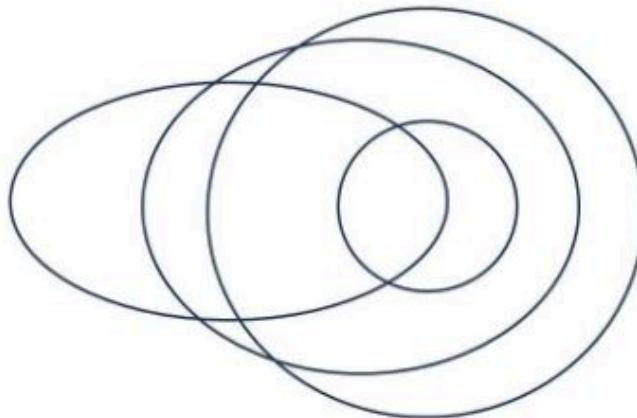


The categories could be

1. Rivers, water bodies, oceans, sources of evaporation
2. Parliamentarians, celebrities, elected persons, professional politicians
3. Monkeys, four-legged animals, pet animals, land animals
4. Furniture, chairs, seats, wooden objects

Question Number : 15 Question Id : 56295415 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

नीचे दिए गए चित्र में चार श्रेणियों के बीच संबंध को अभिव्यक्त किया गया है।



ये श्रेणियां हो सकती हैं

1. नदियां, जल निकाय, सागर, वाष्पीकरण के स्रोत
2. सांसद, प्रसिद्ध व्यक्ति, निर्वाचित व्यक्ति, पेशेवर राजनीतिज्ञ
3. बंदर, चार पांव वाले पशु, पालतू पशु, भू पर रहने वाले पशु
4. फर्नीचर, कुर्सियां, सीट, लकड़ी का सामान

Question Number : 16 Question Id : 56295416 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

In a code, the word DELTOID is written as 3152893. Then LOTION could be written as

1. 582986
2. 582981
3. 198396
4. 198392

L O . T I O N
5 8 2 9 8

D → 3 | I → 9
E → 1 | b → 3
L → 5
T → 2
O → 8

Question Number : 16 Question Id : 56295416 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

एक कोड भाषा में DELTOD शब्द को 3152893 में लिखा गया है तो LOTION शब्द को कैसे लिखा जाएगा ?

1. 582986
2. 582981
3. 198396
4. 198392

Question Number : 17 Question Id : 56295417 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

Sum of the digits of a two-digit number 'ab' is subtracted from the number and the result is divided by 9. Then the result of this will be

1. always a ✓
2. always b
3. neither a nor b
4. either a or b depending on a+b

$$21 - 3 = \frac{18}{9} = 2$$
$$46 - 10 = \frac{36}{9} = 4$$

Question Number : 17 Question Id : 56295417 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

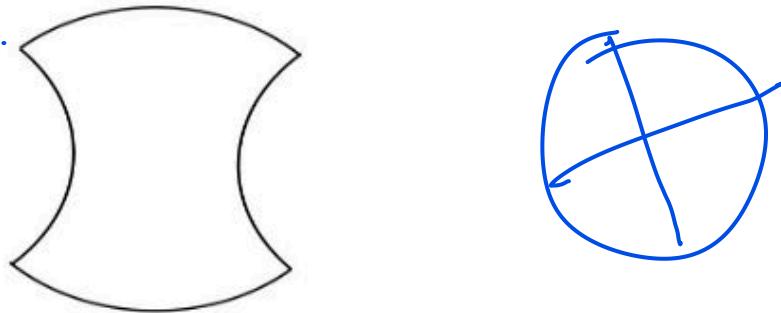
Correct Marks : 2 Wrong Marks : 0.5

दो अंकों की संख्या 'ab' से इसके अंकों के योग को घटा कर प्राप्त अंक को 9 से विभाजित किया गया। इसका परिणाम होगा

1. सदैव a
2. सदैव b
3. न तो a और न b
4. या तो a या b जो a+b पर निर्भर करेगा

Question Number : 18 Question Id : 56295418 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

A circle of radius 1 unit is divided into four quarters and rejoined as shown below.

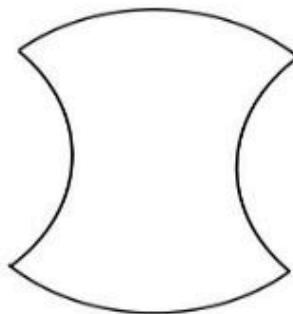


What is the area of this shape?

1. π
2. 1
3. 2
4. 4

Question Number : 18 Question Id : 56295418 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5

एक इकाई वाली त्रिज्या के एक वृत्त को चार एक-चौथाई हिस्सों में विभाजित करके नीचे
दर्शाए गए रूप में पुनः जोड़ा गया।



इस आकार का क्षेत्रफल क्या होगा ?

1. π
2. 1
3. 2
4. 4

Question Number : 19 Question Id : 56295419 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 2 Wrong Marks : 0.5

A stock market trader has lost two thirds of her investment on a day. Next day she recovered one third of the previous day's loss. What fraction of her initial investment is she left with?

1. $\frac{1}{3}$
2. $\frac{2}{3}$
3. $\frac{2}{9}$
4. $\frac{5}{9}$

$$\frac{2}{3} T = L$$
$$\frac{1}{3} L = R$$

$$\frac{T - L + R}{T}$$
$$\cancel{\frac{2}{3} \cdot \frac{1}{3} T} + \frac{1}{3} \cdot \frac{2}{3} R$$

$\frac{5}{9}$

**Question Number : 19 Question Id : 56295419 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

एक स्टॉक मार्केट व्यापारी को एक दिन अपने निवेश के दो तिहाई भाग का नुकसान हुआ। अगले दिन उसने अपने पहले दिन के नुकसान के एक तिहाई भाग की अरपाई (पुनर्प्राप्ति) कर ली। उसके प्रारंभिक निवेश का कितना भाग उसके पास बचा?

1. $\frac{1}{3}$
2. $\frac{2}{3}$
3. $\frac{2}{9}$
4. $\frac{5}{9}$

**Question Number : 20 Question Id : 56295420 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No**

Correct Marks : 2 Wrong Marks : 0.5

Three friends, Mr. Rahman, Mr. George and Mr. Vedant, met after a long time. They were wearing red, green and violet colour shirts. Mr. Rahman and the person wearing violet shirt noticed that none of the three is wearing a colour that starts with same letter as his name. Which one of the following is the correct match of the persons with the colour of their shirts?

1. Rahman-Violet, George-Red, Vedant-Green
2. Rahman-Green, George-Violet, Vedant-Red
3. Rahman-Green, George-Red, Vedant-Violet X
4. Rahman-Red, George-Violet, Vedant-Green X

Rh Ge Vc
x R x G x v

**Question Number : 20 Question Id : 56295420 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 2 Wrong Marks : 0.5**

Mr. Rahman, Mr. George and Mr. Vedant नाम के तीन मित्र बहुत लंबे समय पश्चात
मिले। वे लाल (red), हरी (green) और बैंगनी (violet) रंग की कमीजें पहने हुए थे।
Mr. Rahman और बैंगनी कमीज पहने व्यक्ति ने देखा कि उन तीन में से किसी ने भी
उस रंग की कमीज नहीं पहनी है जो कि उनके नाम के पहले अक्षर से मिलती है।
निम्नलिखित में से कौन सा कथन व्यक्तियों के नामों का उनकी कमीज के रंग से सही
मेल को बताता है?

1. Rahaman-Violet, George-Red, Vedant-Green
2. Rahaman-Green, George-Violet, Vedant-Red
3. Rahaman-Green, George-Red, Vedant-Violet
4. Rahaman-Red, George-Violet, Vedant-Green

PART - B

Section Id :	5629542
Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	25
Number of Questions to be attempted :	20
Section Marks :	70
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	5629542
Question Shuffling Allowed :	Yes

Question Number : 21 Question Id : 56295421 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

The solutions of the differential equation

3.5

$$\frac{dy}{dx} = -\frac{x}{y+1}$$

are a family of

1. ellipses with different eccentricities
2. circles with different centres
3. circles with different radii
4. ellipses with different foci

$$\begin{aligned}
 x^2 + y^2 &= -2y \\
 (y+1)dy &= \int x dx \\
 \frac{y^2}{2} + y &= -\frac{x^2}{2} \\
 \frac{x^2}{2} + \frac{y^2}{2} &= -y
 \end{aligned}$$

Question Number : 21 Question Id : 56295421 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

निम्न अवकल समीकरण

$$\frac{dy}{dx} = -\frac{x}{y+1}$$

के हल निम्न का परिवार हैं

1. विभिन्न उत्केन्द्रताओं वाले दीर्घवृत्त
2. विभिन्न केंद्रों वाले वृत्त
3. विभिन्न त्रिज्याओं वाले वृत्त
4. विभिन्न नाभियों वाले दीर्घवृत्त

Question Number : 22 Question Id : 56295422 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

For the function $f(z) = \exp\left[z - 1 + \frac{1}{z-1}\right]$

$$\text{let } w = z - 1$$

$$f = \exp(w + \frac{1}{w})$$

$$= e^w \times e^{1/w}$$

$$e^{1/w} = 1 + \frac{1}{w} + \frac{1}{z! \cdot w^2} + \frac{1}{z! \cdot w^3} + \dots$$

intinitely many negative power

$\rightarrow z=1$ is essential singularity

Question Number : 22 Question Id : 56295422 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

फलन $f(z) = \exp\left[z - 1 + \frac{1}{z-1}\right]$ के लिए

1. $z = 1$ कोटि (order) 1 का ध्रुव है।
2. $z = 1$ एक अनिवार्य विचित्रता है।
3. $z = 1$ कोटि (order) 2 का ध्रुव है।
4. $z = 1$ एक अपनेय विचित्र बिन्दु है।

Question Number : 23 Question Id : 56295423 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

For the matrix $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 3 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, which of the following is true?

1. $A^3 = 5A^2 - 4A - 2$
2. $A^3 = 4A^2 - 6A + 3$
3. $A^3 = 5A^2 - 5A - 1$
4. $A^3 = 8A^2 + 3A - 4$

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

Question Number : 23 Question Id : 56295423 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

$$-5A + 5A^2 - 2$$

आव्यूह $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 3 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ के लिए, निम्न में से कौन सा सत्य है?

1. $A^3 = 5A^2 - 4A - 2$
2. $A^3 = 4A^2 - 6A + 3$
3. $A^3 = 5A^2 - 5A - 1$
4. $A^3 = 8A^2 + 3A - 4$

Question Number : 24 Question Id : 56295424 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

The value of the integral

$$\int \delta(g(x)) f(x) dx = \frac{f(x_0)}{g'(x_0)}$$

$$\int_1^e dy \int_0^5 dx \delta(x^2 - y^2) \ln(xy)$$

non-zero at x=4

is

1. $\frac{1}{2}$ ✓
2. $\frac{1}{3}$
3. $\frac{1}{e}$
4. $\frac{e}{5}$

$$\int_0^5 dx \delta(x^2 - y^2) \ln(xy) = \frac{\ln(y^2)}{2y}$$

let $u = \ln y$
 $du = \frac{1}{y} dy$

$$\int y du = \frac{y^2}{2} \Big|_0^1 = \boxed{\frac{1}{2}}$$

Question Number : 24 Question Id : 56295424 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

निम्न समाकल

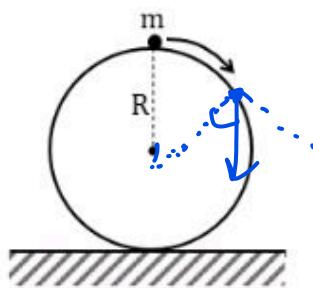
$$\int_1^e dy \int_0^5 dx \delta(x^2 - y^2) \ln(xy)$$

का मान है

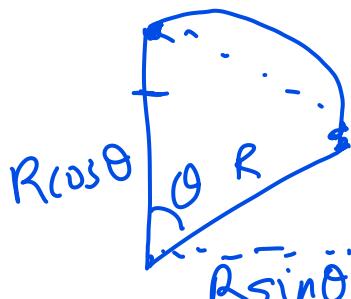
1. $\frac{1}{2}$
2. $\frac{1}{3}$
3. $\frac{1}{e}$
4. $\frac{e}{5}$

Question Number : 25 Question Id : 56295425 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

A sphere of radius R is held fixed on the horizontal ground. A point particle of mass m slides without friction from the top under the action of earth's gravity, as shown in the figure. The speed of the particle when it leaves the surface of the sphere is



1. $\sqrt{\frac{2}{3} gR}$
2. $\sqrt{\frac{3}{4} gR}$
3. $\sqrt{2gR}$
4. \sqrt{gR}



$$mg \cos \theta = \frac{mv^2}{R}$$

$$v^2 = Rg \cos \theta$$

L ①

Energy conservation,

$$\cancel{mgh(2\pi)} = mg(R + R \cos \theta)$$

$$+ \frac{1}{2} m v^2 (R \cos \theta)$$

$$2 = 1 + \cos \theta + \frac{\cos \theta}{2} \Rightarrow \frac{3}{2} \cos \theta = 1$$

$$\cos \theta = \frac{2}{3}$$

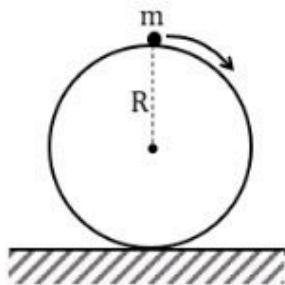
Put in ①,

$$v^2 = Rg \times \frac{2}{3} \Rightarrow \boxed{v = \sqrt{\frac{2}{3} Rg}}$$

L ②

Question Number : 25 Question Id : 56295425 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 3.5 Wrong Marks : 0.875

त्रिज्या R का एक गोला क्षैतिज धरातल पर स्थिर रखा जाता है। चित्रानुरूप द्रव्यमान m का बिन्दु कण पृथ्वी के गुरुत्वाकर्षण के प्रभाव में शीर्ष से बिना घर्षण सरकता है। गोले की सतह से पृथक होते समय कण की गति निम्न होगी

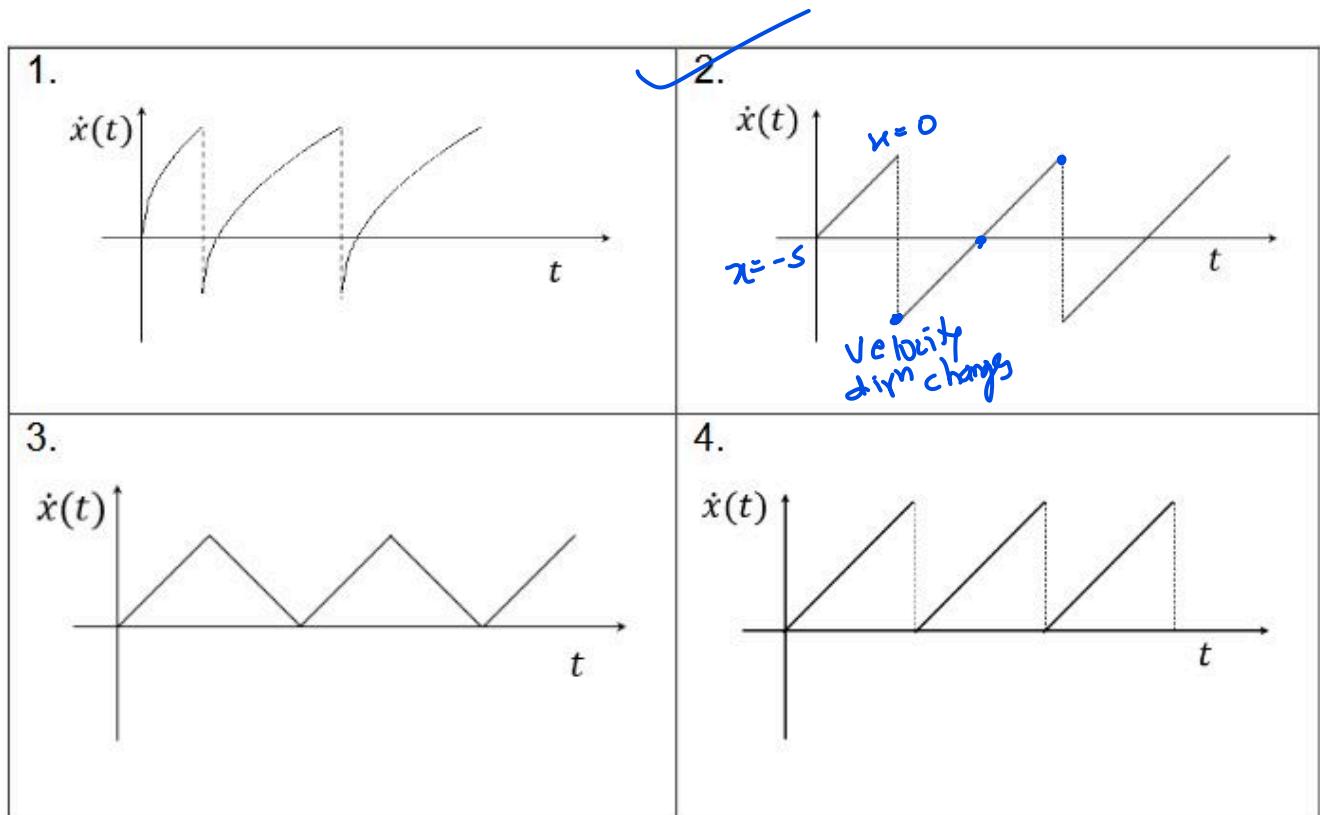


1. $\sqrt{\frac{2}{3} gR}$
2. $\sqrt{\frac{3}{4} gR}$
3. $\sqrt{2gR}$
4. \sqrt{gR}

not straightforward

Question Number : 26 Question Id : 56295426 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

A particle of mass m is subjected to a potential $V(x) = V_0\Theta(x) - kx$, where V_0 and k are positive constants and V_0 is much larger than the energy of the particle. The function $\Theta(x) = 1$ for $x \geq 0$ and equals 0 otherwise. The particle starts from rest at $t = 0$ and $x = -5$. In the limit $V_0 \rightarrow \infty$, the graph for $\dot{x}(t)$ is best represented by



$$V(x) = \begin{cases} -Kx & ; x \leq 0 \\ V_0 - Kx & ; x > 0 \end{cases} \quad t=0, x=-5 \quad V_0 \rightarrow \infty$$

(at $x>0$ initial barrier)

$$F = -\frac{dV}{dx} = -\frac{d}{dx}(-Kx) = +K$$

accelerates the particle towards the wall, but constant force so, velocity increases linearly with time.

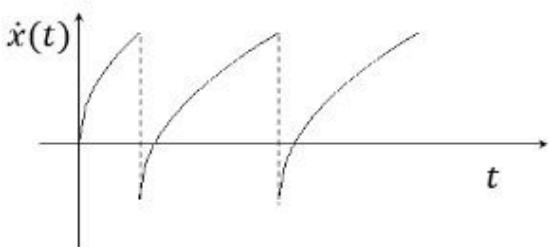
→ Until, it hits the wall, then it bounces back and particle moves away from the wall, but force is still towards the wall so, it decelerates the particle.

→ eventually it comes to rest then climbs back to the wall

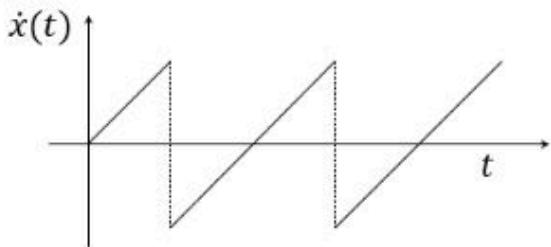
Question Number : 26 Question Id : 56295426 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

द्रव्यमान m का कण विभव $V(x) = V_0\theta(x) - kx$ के प्रभाव में है, जहाँ V_0 तथा k धनात्मक अचर हैं तथा V_0 कण की ऊर्जा से बहुत अधिक है। $x \geq 0$ के लिए फलन $\theta(x) = 1$, अन्यथा 0 के बराबर है। कण विरामावस्था से $t = 0$ पर तथा $x = -5$ से आरंभ करता है। $V_0 \rightarrow \infty$ की सीमा में $\dot{x}(t)$ को निम्न ग्राफ सर्वश्रेष्ठतः प्रदर्शित करता है

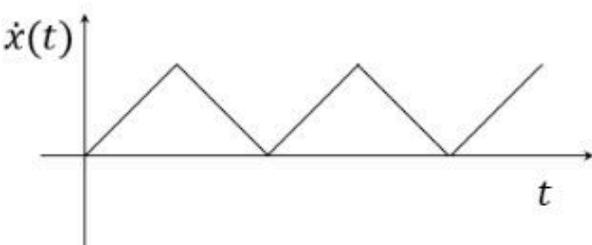
1.



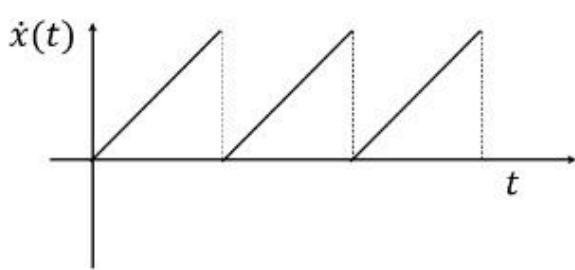
2.



3.



4.



Question Number : 27 Question Id : 56295427 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

(C) The Hamiltonian of a system is given by $H(x, p) = -[p^2 + V^2(x)]^{1/2}$, where x and p are generalized co-ordinate and momentum respectively and $V(x) \geq 0$. The corresponding Lagrangian is

1. $-V(x)\sqrt{1 - \dot{x}^2}$
2. $-V(x)/\sqrt{1 - \dot{x}^2}$
3. $V(x)\sqrt{1 - \dot{x}^2}$
4. $V(x)/\sqrt{1 - \dot{x}^2}$

$$\begin{aligned} \dot{x} &= \frac{\partial H}{\partial p} = \frac{\partial}{\partial p} \left(-(p^2 + V^2)^{1/2} \right) = \frac{-1}{2} (p^2 + V^2)^{-1/2} (2p) \\ &\Rightarrow \dot{x} = \frac{p}{\sqrt{p^2 + V^2}} \\ &\Rightarrow \dot{x}^2 (p^2 + V^2) = p^2 \\ &\Rightarrow p^2 (1 - \dot{x}^2) = V^2 \dot{x}^2 \\ &\Rightarrow p^2 = \frac{V^2 \dot{x}^2}{(1 - \dot{x}^2)} \quad \text{--- (1)} \end{aligned}$$

Question Number : 27 Question Id : 56295427 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

किसी निकाय का हैमिल्टनी $H(x, p) = -[p^2 + V^2(x)]^{1/2}$ दिया गया है, जहाँ x तथा p क्रमशः व्यापकीकृत निर्देशांक तथा संवेग हैं, तथा $V(x) \geq 0$. संगत लगान्जी है

1. $-V(x)\sqrt{1 - \dot{x}^2}$
2. $-V(x)/\sqrt{1 - \dot{x}^2}$
3. $V(x)\sqrt{1 - \dot{x}^2}$
4. $V(x)/\sqrt{1 - \dot{x}^2}$

$$\begin{aligned} L &= p \dot{x} - H \\ &= \frac{-V \dot{x}^2}{\sqrt{1 - \dot{x}^2}} + \sqrt{\frac{V^2 \dot{x}^2}{(1 - \dot{x}^2)} + V^2} \end{aligned}$$

$$= \frac{-V \dot{x}^2 + \sqrt{V^2 \dot{x}^2}}{\sqrt{1 - \dot{x}^2}}$$

$$\boxed{\sqrt{V^2 \dot{x}^2}} = \frac{\sqrt{V^2 (1 - \dot{x}^2)}}{\sqrt{1 - \dot{x}^2}} = \frac{\sqrt{V^2 - V^2 \dot{x}^2}}{\sqrt{1 - \dot{x}^2}} =$$

Question Number : 28 Question Id : 56295428 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 3.5 Wrong Marks : 0.875

(C)

Consider the earth to be a free rigid body symmetric about its north-south (z) axis. If the principal moments of inertia satisfy $I_z = 1.003 I_x$, then its angular velocity (in the body fixed frame) would precess about the z-axis with a period of nearly

1. 167 days
2. 333 days
3. 556 days
4. 667 days

$$\omega_{\text{precession}} = \omega \frac{I_z - I_x}{I_x} = \omega \times 0.003$$

$$\frac{2\pi}{T_{\text{precession}}} = \frac{2\pi}{(1 \text{ day})} \times 0.003$$
$$T_{\text{precession}} = 333 \text{ days}$$

Question Number : 28 Question Id : 56295428 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

पृथ्वी को उसकी उत्तर-दक्षिण (z) अक्ष के सापेक्ष सममित स्वतंत्र दृढ़ पिंड मानें। यदि मुख्य जड़त्व आधूर्ण $I_z = 1.003 I_x$ को संतुष्ट करें, तब उसका कोणीय वेग (पिंडस्थ फ्रेम) z-अक्ष के इर्द-गिर्द लगभग निम्न आवर्तकाल से पुरस्सरण करेगा

1. 167 दिन
2. 333 दिन
3. 556 दिन
4. 667 दिन

Question Number : 29 Question Id : 56295429 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

The energy eigenstates of a one-dimensional harmonic oscillator are denoted by $|i\rangle$, where $i = 0, 1, 2, 3 \dots$. If the momentum operator \hat{p} satisfies

$$\frac{\langle n+1 | \hat{p} | n \rangle}{\langle 2 | \hat{p} | 1 \rangle} = \sqrt{2}, \text{ then the value of } n \text{ is}$$

1. 0 $\hat{p}|n\rangle = -i\sqrt{\frac{mw\hbar}{2}}(a - a^\dagger)|n\rangle$
2. 1 $|n+1\rangle = -i\sqrt{\frac{mw\hbar}{2}}[\sqrt{n}|n-1\rangle - \sqrt{n+1}|n+1\rangle]$
3. 2
4. 3

Question Number : 29 Question Id : 56295429 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

किसी एक-विमीय आवर्ती दोलक की ऊर्जा अभिलक्षणिक अवस्थायें $|i\rangle$ से निरूपित होती हैं, जहाँ $i = 0, 1, 2, 3 \dots$ । यदि संवेग संकारक \hat{p} द्वारा $\frac{\langle n+1 | \hat{p} | n \rangle}{\langle 2 | \hat{p} | 1 \rangle} = \sqrt{2}$ संतुष्ट होता है, तब n का मान है

1. 0 $num = -\sqrt{n+1} \left(-i\sqrt{\frac{mw\hbar}{2}} \right)$
 2. 1 $mw \text{ denominator,}$
 3. 2
 4. 3 $\hat{p}|1\rangle = -i\sqrt{\frac{mw\hbar}{2}}(a - a^\dagger)|1\rangle$
- $$\langle 2 | \hat{p} | 1 \rangle = \langle 2 | -i\sqrt{\frac{mw\hbar}{2}} [1|0\rangle - \sqrt{2}|2\rangle]$$
- $$den = -i\sqrt{\frac{mw\hbar}{2}} \times (-\sqrt{2})$$
- squaring on both sides
- $$\frac{num}{den} = \sqrt{2} \Rightarrow \frac{-\sqrt{n+1} \left(-i\sqrt{\frac{mw\hbar}{2}} \right)}{-\sqrt{2} \left(-i\sqrt{\frac{mw\hbar}{2}} \right)} = \sqrt{2} \quad n+1 = 4$$
- $n = 3$

Question Number : 30 Question Id : 56295430 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

A system consists of two non-interacting identical spin- $\frac{1}{2}$ particles. The spatial wave functions for the individual particles are given by $\varphi_1(x)$ and $\varphi_2(x)$. Let x_1 and x_2 denote the positions of the particles respectively. The total wave function of the system (not necessarily normalized) can be

1. $[\varphi_1(x_1)\varphi_2(x_2) - \varphi_2(x_1)\varphi_1(x_2)] [|\uparrow\rangle_1 |\downarrow\rangle_2 + |\downarrow\rangle_1 |\uparrow\rangle_2]$

2. $[\varphi_1(x_1)\varphi_1(x_2) + \varphi_2(x_1)\varphi_2(x_2)] |\uparrow\rangle_1 |\uparrow\rangle_2$

3. $\varphi_1(x_1)\varphi_2(x_2) |\uparrow\rangle_1 |\uparrow\rangle_2 \rightarrow$ parts

4. $[\varphi_1(x_1)\varphi_2(x_2) - \varphi_2(x_1)\varphi_1(x_2)] [|\uparrow\rangle_1 |\downarrow\rangle_2 - |\downarrow\rangle_1 |\uparrow\rangle_2]$

$\text{symm} = \text{anti-symm}$

total w.f must be antisymmetric under particle exchange

$\Psi(1,2) = -\Psi(2,1)$

Question Number : 30 Question Id : 56295430 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

किसी निकाय में दो अन्योन्यक्रिया-विहीन सर्वथासम प्रचक्रण - $\frac{1}{2}$ वाले कण हैं। कणों के लिए स्थानिक तरंग फलन $\varphi_1(x)$ तथा $\varphi_2(x)$ हैं। मानें कि कणों की स्थितियां क्रमशः x_1 तथा x_2 हैं। निकाय का कुल तरंग फलन (जरूरी नहीं कि प्रसामान्यीकृत हो) निम्न हो सकता है

1. $[\varphi_1(x_1)\varphi_2(x_2) - \varphi_2(x_1)\varphi_1(x_2)] [|\uparrow\rangle_1 |\downarrow\rangle_2 + |\downarrow\rangle_1 |\uparrow\rangle_2]$

2. $[\varphi_1(x_1)\varphi_1(x_2) + \varphi_2(x_1)\varphi_2(x_2)] |\uparrow\rangle_1 |\uparrow\rangle_2$

3. $\varphi_1(x_1)\varphi_2(x_2) |\uparrow\rangle_1 |\uparrow\rangle_2$

4. $[\varphi_1(x_1)\varphi_2(x_2) - \varphi_2(x_1)\varphi_1(x_2)] [|\uparrow\rangle_1 |\downarrow\rangle_2 - |\downarrow\rangle_1 |\uparrow\rangle_2]$

Question Number : 31 Question Id : 56295431 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

A spin- $\frac{1}{2}$ system is prepared in the initial state $|\varphi\rangle = \frac{\sqrt{3}}{2} |\uparrow\rangle + \frac{1}{2} |\downarrow\rangle$ where $|\uparrow\rangle$ & $|\downarrow\rangle$ are eigenstates of \hat{S}_z with eigenvalues $+\frac{\hbar}{2}$ & $-\frac{\hbar}{2}$ respectively. A measurement of \hat{S}_z is followed by a measurement of \hat{S}_x on the system. What is the probability that the measurement of \hat{S}_x yields a value $+\frac{\hbar}{2}$?

1. $\frac{1}{2}$ S_z measurement

2. $\frac{2+\sqrt{3}}{4}$ $-\frac{\hbar}{2}$

3. $\frac{2-\sqrt{3}}{4}$ $\frac{\hbar}{2}$

4. $\frac{3}{8}$ prob - $\frac{3}{4}$

after $|\uparrow\rangle$ $|\downarrow\rangle$

S_x basis :- $|\rightarrow\rangle + \frac{|\leftarrow\rangle}{\sqrt{2}}$ $\frac{|\rightarrow\rangle - |\leftarrow\rangle}{\sqrt{2}}$

S_x measurement prob :- $\frac{1}{2}$ $\frac{1}{2}$
of getting $+\frac{\hbar}{2}$

Question Number : 31 Question Id : 56295431 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

किसी प्रचक्रण - $\frac{1}{2}$ निकाय को प्रारंभिक अवस्था $|\varphi\rangle = \frac{\sqrt{3}}{2} |\uparrow\rangle + \frac{1}{2} |\downarrow\rangle$ में तैयार किया जाता है जहाँ $|\uparrow\rangle$ तथा $|\downarrow\rangle$ क्रमशः $+\frac{\hbar}{2}$ तथा $-\frac{\hbar}{2}$ अभिलक्षणिक मानों वाले \hat{S}_z की अभिलक्षणिक अवस्थायें हैं। \hat{S}_z के मापन के उपरांत निकाय पर \hat{S}_x का मापन किया जाता है। \hat{S}_x को मापने पर $+\frac{\hbar}{2}$ मिलने की प्रायिकता क्या है ?

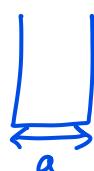
1. $\frac{1}{2}$
2. $\frac{2+\sqrt{3}}{4}$
3. $\frac{2-\sqrt{3}}{4}$
4. $\frac{3}{8}$

Question Number : 32 Question Id : 56295432 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

A particle of mass m is in the third energy eigenstate of an infinite potential well of width a . The time interval in which the phase of this wave function changes by 2π is

1. $\frac{4ma^2}{3\pi\hbar}$
2. $\frac{4ma^2}{9\pi\hbar}$
3. $\frac{8ma^2}{3\pi\hbar}$
4. $\frac{8ma^2}{9\pi\hbar}$



$$E_3 = \frac{9\pi^2\hbar^2}{2ma^2} = \hbar\omega$$

$$\Rightarrow \omega = \frac{9\pi^2\hbar}{2ma^2}$$

$$\Rightarrow \omega = \frac{2\pi}{T} = \frac{9\pi\hbar}{2ma^2}$$

$T = \frac{4ma^2}{9\pi\hbar}$

Question Number : 32 Question Id : 56295432 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

द्रव्यमान m का एक कण, चौड़ाई a के अनंत विभव कूप की तृतीय ऊर्जा अभिलक्षणिक अवस्था में है। वह समयान्तराल जिसमें इस तरंग फलन की कला 2π से बदल जाए, है

$$1. \frac{4ma^2}{3\pi\hbar}$$

$$2. \frac{4ma^2}{9\pi\hbar}$$

$$3. \frac{8ma^2}{3\pi\hbar}$$

$$4. \frac{8ma^2}{9\pi\hbar}$$

Question Number : 33 Question Id : 56295433 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

The Hamiltonian of the 1-dimensional quantum harmonic oscillator is given by

$H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2x^2$. The expectation value of $[D, H]$ in the ground state, where

$D = \frac{1}{2\hbar}(xp + px)$, is (in units of $\hbar\omega$)

$$1. i \quad [x, p] = i\hbar \Rightarrow xp - px = i\hbar$$

$$2. \frac{1}{2} \quad H = \hbar\omega(a^\dagger a + \frac{1}{2}) \quad [a, a^\dagger] = 1$$

$$3. \frac{-3i}{2} \quad x = \sqrt{\frac{\hbar}{2m\omega}}(a + a^\dagger) \quad aa^\dagger - a^\dagger a = 1$$

$$4. 0 \quad p = -i\sqrt{\frac{m\hbar\omega}{2}}(a^\dagger - a)$$

$$xp = \frac{i}{2i}(a + a^\dagger)(a^\dagger - a) = \frac{i}{2i}[a^\dagger a - a a^\dagger + a^\dagger a^\dagger - a a^\dagger] \quad \cancel{a^\dagger a - a a^\dagger}$$

$$px = \frac{i}{2i}(a^\dagger - a)(a + a^\dagger) = \frac{i}{2i}[a^\dagger a + a^\dagger a^\dagger - a a^\dagger - a^\dagger a] \quad \cancel{a^\dagger a + a^\dagger a^\dagger}$$

$$xp + px = \frac{i}{2i}[a^\dagger a^\dagger - a a^\dagger] \Rightarrow D = \frac{1}{2\pi}\times \frac{i}{2i}[a^\dagger a^\dagger - a a^\dagger]$$

Question Number : 33 Question Id : 56295433 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

किसी एक-विमीय क्वांटम आवर्ती दोलक का हैमिल्टनी $H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2x^2$ से दिया

जाता है। जब $D = \frac{1}{2\hbar}(xp + px)$ हो, निम्नतम ऊर्जा में, $[D, H]$ का प्रत्याशा मान है

($\hbar\omega$ की इकाइयों में)

$$H = \hbar\omega(a^\dagger a + \frac{1}{2})$$

$$1. \quad i \quad [D, H] = \left[\frac{1}{2\hbar}(a a^\dagger - a^\dagger a), \hbar\omega(a^\dagger a) \right]$$

$$2. \quad \frac{1}{2}$$

$$3. \quad \frac{-3i}{2} \quad = -i\frac{\hbar\omega}{2}([a^\dagger a^\dagger, a a^\dagger] - [a a, a a^\dagger])$$

$$4. \quad 0 \quad \text{Using, Now, } [AB, C] = A[B, C] + [A, C]B$$

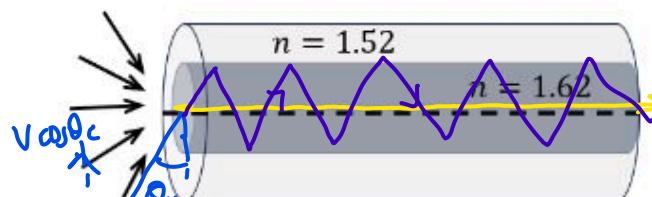
$$\text{and } [A, BC] = B[A, C] + [A, B]C$$

$$\begin{aligned} & \text{simplify, } \\ & [D, H] = i\hbar\omega[a^\dagger a^\dagger + a a^\dagger] \\ & \text{now } \\ & a|0\rangle = 0 \\ & \langle 0|a^\dagger = 0 \\ & \text{therefore,} \\ & \langle 0|[D, H]|0\rangle = 0 \end{aligned}$$

Question Number : 34 Question Id : 56295434 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

A 1 km long optical fiber of core and clad refractive indices 1.62 and 1.52, respectively, is laid in a straight line. Several identical light pulses are launched simultaneously from air on the entrance of this fiber from different angles about its axis, as shown below. The diameter of the fiber is small compared to its length. The maximum time difference between the pulses emerging at the other end of the fiber would be closest to



$$\sin\theta_c = \frac{n_2}{n_1} = \frac{1.62}{1.52}$$

1. 355 ns
2. 317 ns
3. 5.40 μ s
4. 5.75 μ s

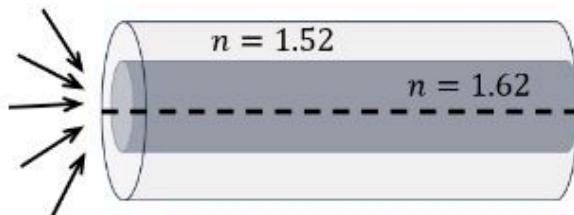
$$t_B = \frac{\text{dist}}{\text{speed}} = \left(\frac{1000}{\frac{v \sin \theta_c}{n}} \right) = \frac{1000}{\frac{3 \times 10^8 \times 1.62}{1.62}} = \frac{1000}{c} \times 1.52$$

$$\Delta t = \frac{1000}{c} \times 0.1 = \frac{100}{3 \times 10^8} = \frac{10^2}{3 \times 10^8} = 0.33 \times 10^{-6}$$

$$\boxed{333 \text{ ns}}$$

Question Number : 34 Question Id : 56295434 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

क्रोड तथा बाह्य आवरण के लिए क्रमशः 1.62 तथा 1.52 अपवर्तनांक वाला 1 km लंबा प्रकाशिक तंतु सीधी रेखा में बिछाया जाता है। अनेक सर्वथासम प्रकाश स्पंद वायु में से इस तंतु के प्रवेश वाले सिरे पर इसके अक्ष से विभिन्न कोणों पर डाले जाते हैं जैसा चित्र में प्रदर्शित है। तंतु का व्यास उसकी लंबाई की तुलना में कम है। तंतु के दूसरे सिरे से निर्गत स्पंदों के बीच अधिकतम समयान्तराल निम्न के निकटतम होगा



1. 355 ns
2. 317 ns
3. $5.40 \mu\text{s}$
4. $5.75 \mu\text{s}$

Question Number : 35 Question Id : 56295435 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

A plane electromagnetic wave $\vec{E}_I \cos(k_z z + \omega t)$ is incident normally on a perfectly reflecting mirror in vacuum. If the permittivity of free space is ϵ_0 , the force exerted on an area A of the mirror would be

1. $A\epsilon_0 |\vec{E}_I|^2 \hat{z}$ time-averaged electric energy density $u_E = \frac{1}{2} \epsilon_0 |\vec{E}_I|^2 \langle b^2 \rangle = \frac{1}{2} \epsilon_0 |\vec{E}_I|^2$
2. $-\frac{A\epsilon_0}{2} |\vec{E}_I|^2 \hat{z}$ $|u_E| = |u_B|$
3. $\frac{A\epsilon_0}{2} |\vec{E}_I|^2 \hat{z}$ $u_{\text{total}} = u_I + u_B = 2u_I = \frac{1}{2} \epsilon_0 |\vec{E}_I|^2$
4. $-A\epsilon_0 |\vec{E}_I|^2 \hat{z}$ momentum density = $\frac{u}{c}$ and momentum flux = $\frac{u}{c} \times c = u$
 Now, incident wave gets reflected, so $Dp = 2p = 2u \Rightarrow F = 2u_{\text{total}} \times A = \boxed{\epsilon_0 |\vec{E}_I|^2 A}$

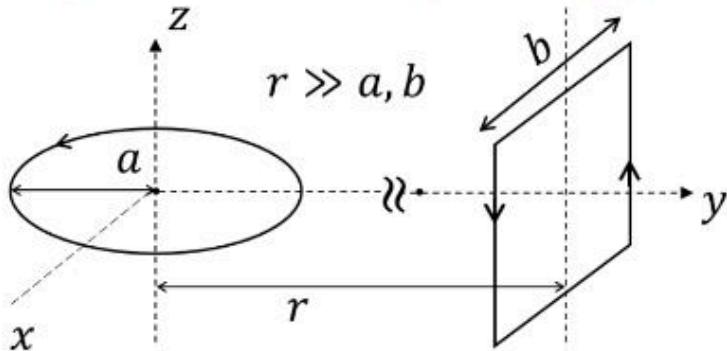
Question Number : 35 Question Id : 56295435 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 3.5 Wrong Marks : 0.875

एक समतल विद्युत-चुंबकीय तरंग $\vec{E}_I \cos(k_z z + \omega t)$ निर्वात में पूर्णतः परावर्ती दर्पण पर लम्बवत आपतित होती है। यदि मुक्त आकाश की विद्युतशीलता (permittivity) ϵ_0 है, दर्पण के क्षेत्र A पर लगा बल होगा

1. $A\epsilon_0 |\vec{E}_I|^2 \hat{z}$
2. $-\frac{A\epsilon_0}{2} |\vec{E}_I|^2 \hat{z}$
3. $\frac{A\epsilon_0}{2} |\vec{E}_I|^2 \hat{z}$
4. $-A\epsilon_0 |\vec{E}_I|^2 \hat{z}$

Question Number : 36 Question Id : 56295436 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

A circular loop of radius a (in the $x-y$ plane) and a square loop of side b (in the $x-z$ plane) are kept at a distance r . Both carry current I as shown in the figure. If $r \gg a, b$, the torque exerted on the square loop by the circular loop is



1. $-\frac{\mu_0}{4\pi} \frac{1}{r^3} \pi a^2 b^2 I^2 \hat{z}$
 2. 0
 3. $\frac{\mu_0}{4\pi} \frac{1}{r^3} \pi a^2 b^2 I^2 \hat{x}$
 4. $-\frac{\mu_0}{4\pi} \frac{1}{r^3} \pi a^2 b^2 I^2 \hat{x}$
- $B_{\text{dipole}}^{\text{equatorial}} = \frac{\mu_0}{4\pi} \frac{m}{r^3}$
- $$B = \frac{\mu_0 I a^2}{4r^3} \hat{j}$$

$$\vec{T} = \vec{m} \times \vec{B} = Ib^2 \left(\frac{\mu_0 I a^2}{4r^3} \right) (\hat{j} \times (-\hat{r}))$$

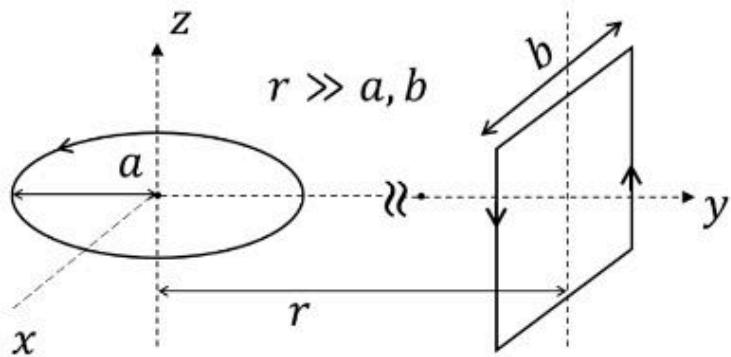
$$\vec{T} = -\frac{\mu_0}{4\pi} \frac{1}{r^3} \pi a^2 b^2 I^2 \hat{x}$$

\vec{B} due to dipole moment m ,

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{m}{r^3} (2 \cos \theta \hat{r} + \sin \theta \hat{\theta})$$

Question Number : 36 Question Id : 56295436 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

त्रिज्या a का एक वृत्तीय पाश ($x-y$ तल में) तथा भुजा b का एक वर्गाकार पाश ($x-z$ तल में) दूरी r पर रखे जाते हैं। चित्रानुसार दोनों में धारा I बहती है। यदि $r \gg a, b$, वृत्तीय पाश द्वारा वर्गाकार पाश पर लगा बलआघूर्ण है



1. $-\frac{\mu_0}{4\pi} \frac{1}{r^3} \pi a^2 b^2 I^2 \hat{z}$
2. 0
3. $\frac{\mu_0}{4\pi} \frac{1}{r^3} \pi a^2 b^2 I^2 \hat{x}$
4. $-\frac{\mu_0}{4\pi} \frac{1}{r^3} \pi a^2 b^2 I^2 \hat{x}$

Question Number : 37 Question Id : 56295437 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

In a particular inertial frame, electric field \vec{E} and magnetic field \vec{B} are

$$\vec{E} = E_0 \hat{x}, \quad \vec{B} = \frac{E_0}{2c} \hat{x}.$$

Lorentz invariant remains same in all inertial frame, here

Which of the following statements is true?

1. There exists an inertial frame where $\vec{E} = 0, \vec{B} \neq 0$
2. There exists no inertial frame where either $\vec{E} = 0$ or $\vec{B} = 0$
3. There exists an inertial frame where $\vec{B} = 0, \vec{E} \neq 0$
4. There exists an inertial frame where both $\vec{E} = 0$ and $\vec{B} = 0$

$$I_2 = \vec{E} \cdot \vec{B} = \frac{E_0^2}{2c}$$

i.e $I_2 \neq 0$

If E or B is zero this is violated which is not allowed

Question Number : 37 Question Id : 56295437 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

किसी जड़त्वीय फ्रेम में, वैयुत क्षेत्र \vec{E} है तथा चुंबकीय क्षेत्र \vec{B} हैं

$$\vec{E} = E_0 \hat{x}, \quad \vec{B} = \frac{E_0}{2c} \hat{x}.$$

निम्न वक्तव्यों में से कौन सा सत्य है?

1. ऐसा कोई जड़त्वीय फ्रेम है जहाँ $\vec{E} = 0, \vec{B} \neq 0$
2. ऐसा कोई जड़त्वीय फ्रेम नहीं है जहाँ या तो $\vec{E} = 0$ या $\vec{B} = 0$
3. ऐसा कोई जड़त्वीय फ्रेम है जहाँ $\vec{B} = 0, \vec{E} \neq 0$
4. ऐसा कोई जड़त्वीय फ्रेम है जहाँ $\vec{E} = 0$ तथा $\vec{B} = 0$

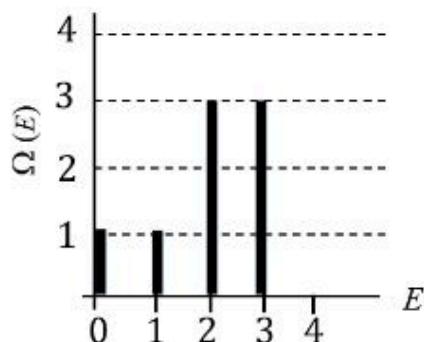
Question Number : 38 Question Id : 56295438 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

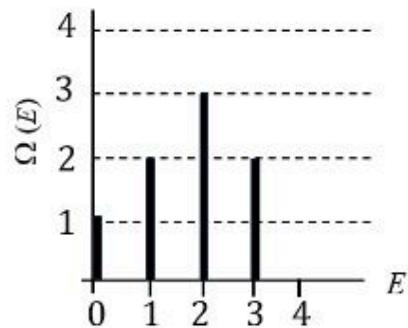
Colours lets say R, G, B

There are two boxes, one at the ground level, and the other at a fixed height h . There are three balls of different colours, each having mass m and radius $r \ll h$. There is no restriction on the number of balls that can be simultaneously put in a given box. For a given value of the total energy E (in units of mgh , g being the acceleration due to gravity), the number of accessible microstates is $\Omega(E)$. The plot of $\Omega(E)$ vs E is

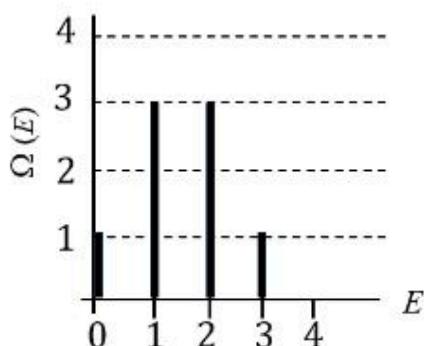
1.



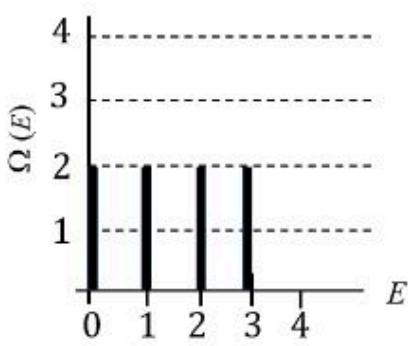
2.



3.



4.



1 ball in upper box $\rightarrow E = 1$

2 ball in " $\rightarrow E = 2$

3 ball in " $\rightarrow E = 3$

IL 0 ball in " $\rightarrow E = 0$

Accessible microstates means which combinations are allowed for each of these energy levels

$\bar{E} = 0$

\rightarrow only 1

$\bar{E} = 1$

\rightarrow either R, G, B so total = 3

$\bar{E} = 2$

\rightarrow RG, RB, GB so total = 3

$\bar{E} = 3$

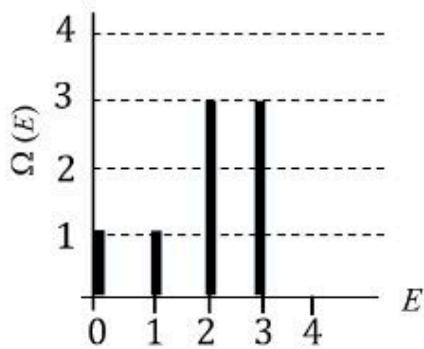
\rightarrow RGB only 1 comb.

1
3
3
1

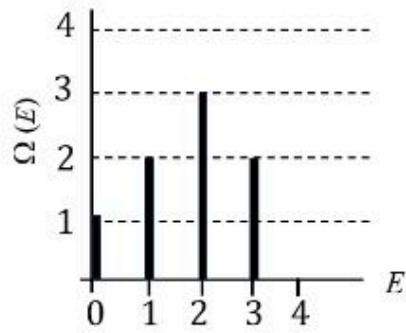
Question Number : 38 Question Id : 56295438 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

दो बक्से हैं, एक धरातल पर, तथा दूसरा निश्चित ऊँचाई h पर। अलग -अलग रंगों की तीन गेंदें हैं, प्रत्येक का द्रव्यमान m तथा त्रिज्या $r \ll h$ है। इस पर कोई प्रतिबंध नहीं है कि एक बक्से में एक साथ कितनी गेंदें रखी जा सकती हैं। कुल ऊर्जा E (mgh की इकाइयों में, जहाँ g गुरुत्वायी त्वरण है) के दिए मान के लिए, अभिगम्य सूक्ष्मावस्थाओं की संख्या $\Omega(E)$ है। E के विरुद्ध $\Omega(E)$ का आलेख निम्न है

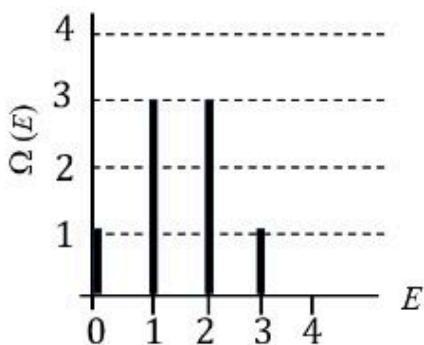
1.



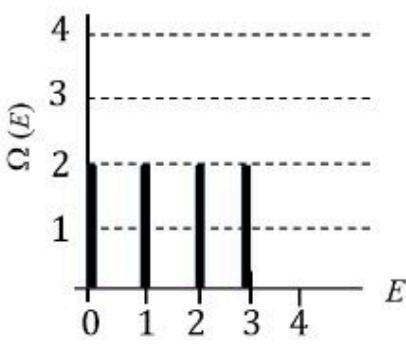
2.



3.



4.



Question Number : 39 Question Id : 56295439 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

The internal energy of a system is given by $U = g(N)V^{-\frac{2}{3}} \exp\left[\frac{2S}{3NR}\right]$, where V

is the volume, S is the entropy, N is the number of molecules and R is a constant. The function $g(N)$ is proportional to

- 1. $N^{5/3}$
- 2. $N^{1/3}$
- 3. $N^{2/3}$
- 4. N

$S, V, N \rightarrow$ extensive quantities

that mean if doubled or scaled the quantity U will also also double or scale

$$U(\lambda S, \lambda V, \lambda N) = \lambda U(S, V, N)$$

Question Number : 39 Question Id : 56295439 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

किसी निकाय की आंतरिक ऊर्जा $U = g(N)V^{-\frac{2}{3}} \exp\left[\frac{2S}{3NR}\right]$ से देते हैं, जहाँ V आयतन है, S एन्ट्रॉपी है, N अणुओं की संख्या है तथा R स्थिरांक है। फलन $g(N)$ निम्न के आनुपातिक है

- 1. $N^{5/3}$
- 2. $N^{1/3}$
- 3. $N^{2/3}$
- 4. N

$$g(\lambda N) \lambda^{-2/3} \cancel{\exp\left[\frac{2 \times S}{3 \times N \times R}\right]} = \lambda g(N) \lambda^{2/3} \exp\left[\frac{2S}{3NR}\right]$$

$$g(\lambda N) \lambda^{-2/3} = \lambda g(N)$$

$$g(\lambda N) = \lambda^{5/3} g(N)$$

this implies

$$g(N) \propto N^{5/3}$$

Question Number : 40 Question Id : 56295440 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

Consider one mole of an ideal diatomic gas molecule at temperature T such that $k_B T \gg h\nu$, where ν is the frequency of its vibrational mode. If C_p and C_v are specific heats of this gas at constant pressure and volume respectively, then the ratio $\gamma = \frac{C_p}{C_v}$, is

1. 2
2. $\frac{7}{5}$
3. $\frac{5}{3}$
4. $\frac{9}{7}$

T is very high \rightarrow vibrational modes present

$$\begin{aligned}\gamma &= 1 + \frac{2}{f} \\ &= 1 + \frac{2}{7} = \boxed{\frac{9}{7}}\end{aligned}$$

Question Number : 40 Question Id : 56295440 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

ताप T पर, किसी आदर्श द्विपरमाणिक गैस अणुओं के एक ग्रामअणु पर विचार करें, जब $k_B T \gg h\nu$, जहाँ ν इसके कंपन मोड की आवृत्ति है। यदि C_p तथा C_v इस गैस की क्रमशः स्थिर दाब तथा स्थिर आयतन पर विशिष्ट उष्माएँ हैं, तब अनुपात $\gamma = \frac{C_p}{C_v}$ है

1. 2
2. $\frac{7}{5}$
3. $\frac{5}{3}$
4. $\frac{9}{7}$

Question Number : 41 Question Id : 56295441 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875 *refrigerator → reversible engine*

A refrigerator can be thought to be a reversible engine operating between $T_2 = 20^\circ\text{C}$ and $T_1 = -10^\circ\text{C}$. The work needed to run this is supplied by another engine, that takes in energy at the rate of 500 W and runs with 50% efficiency. If the refrigerator freezes 5 kg of water at 0°C (latent heat $Q_L = 334 \text{ kJ/kg}$ for ice) in n hours, then n is closest to

1. 0.4 *(coefficient of performance = $\frac{T_{\text{cold}}}{T_{\text{hot}} - T_{\text{cold}}}$ = $\frac{263}{30}$)*
2. 0.3
3. 0.1 *(COP = $\frac{\text{Heat removed (freezing of ice)}}{\text{Work Input (W)}}$)*
4. 0.2

Question Number : 41 Question Id : 56295441 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 3.5 Wrong Marks : 0.875

रेफ्रिजरेटर को $T_2 = 20^\circ\text{C}$ तथा $T_1 = -10^\circ\text{C}$ के बीच कार्य कर रहा एक उत्क्रमणीय इंजन माना जा सकता है। इसको चलाने के लिए आवश्यक कार्य एक अन्य इंजन द्वारा उपलब्ध कराया जाता है, जो ऊर्जा को 500 W की दर से लेता है एवं 50% दक्षता से काम करता है। यदि रेफ्रिजरेटर 0°C पर 5 kg पानी को n घंटों में जमाता है (बर्फ के लिए गुप्त ऊष्मा $Q_L = 334 \text{ kJ/kg}$), तब n निम्न के निकटतम है

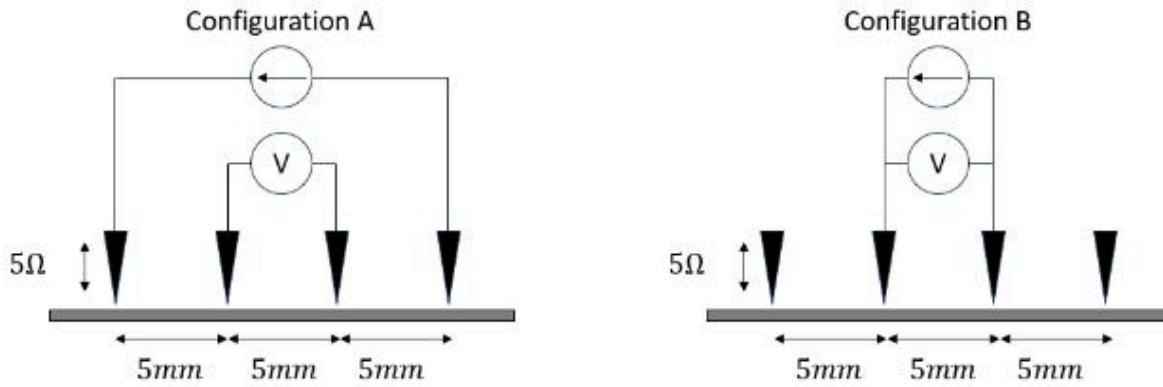
1. 0.4
2. 0.3
3. 0.1 *$\frac{263}{30} = \frac{m L}{\text{Power provided} \times \text{time}} = \frac{5 \times 334 \times 1000}{250 \times t}$*
4. 0.2

$$t = \frac{20 \times 334 \times 30}{263} \approx 760 \text{ s}$$

$$t(\text{in hrs}) = \frac{760}{3600} \approx \boxed{0.2}$$

Question Number : 42 Question Id : 56295442 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

Let R_A and R_B be the resistances of a channel determined (by taking the ratio of the voltage measured and current flowing) using configurations A and B respectively, as shown in the figure. In both configurations, each lead resistance is 5Ω and each contact resistance is 10Ω . The channel has a resistivity of $20\Omega/\text{mm}$. Considering the voltmeter and the current source as ideal devices, the ratio R_B/R_A is:

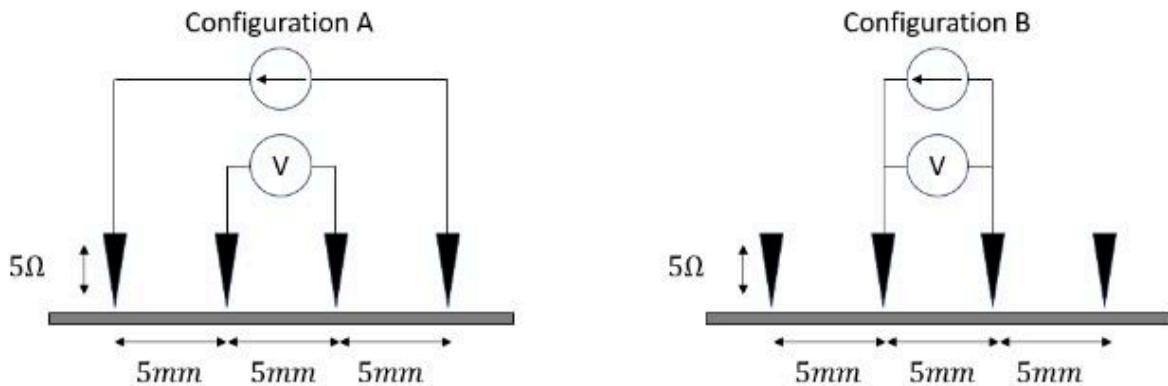


1. 1.1
2. 1.2
3. 1.3
4. 1.5

* mistake in question

Question Number : 42 Question Id : 56295442 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

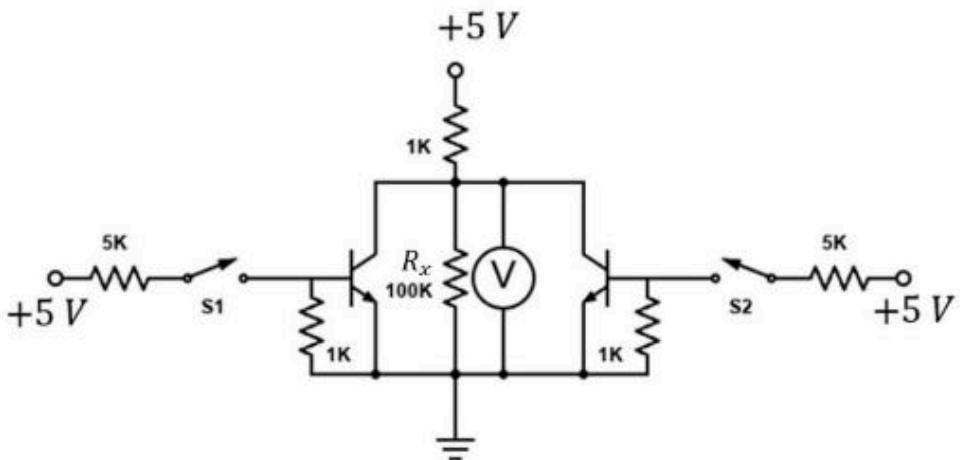
R_A तथा R_B को विन्यास A तथा विन्यास B का उपयोग करके मापे गए चैनल के प्रतिरोध मानें (जिनको मापित वोल्टता एवं बहने वाली धारा के अनुपात को लेकर निर्धारित किया), जैसा चित्र में प्रदर्शित है। दोनों विन्यासों में प्रत्येक अग्र प्रतिरोध 5Ω तथा प्रत्येक संस्पर्श प्रतिरोध 10Ω है। चैनल की प्रतिरोधकता $20\Omega/\text{mm}$ है। वोल्टमापी तथा धारा स्रोत को आदर्श उपकरण मानते हुए अनुपात R_B/R_A है:



1. 1.1
2. 1.2
3. 1.3
4. 1.5

Question Number : 43 Question Id : 56295443 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

The circuit, composed of npn transistors of high β , resistors and switches, is shown in the figure. The biasing is sufficient to turn on the transistors when respective switches S1 and S2 are closed.



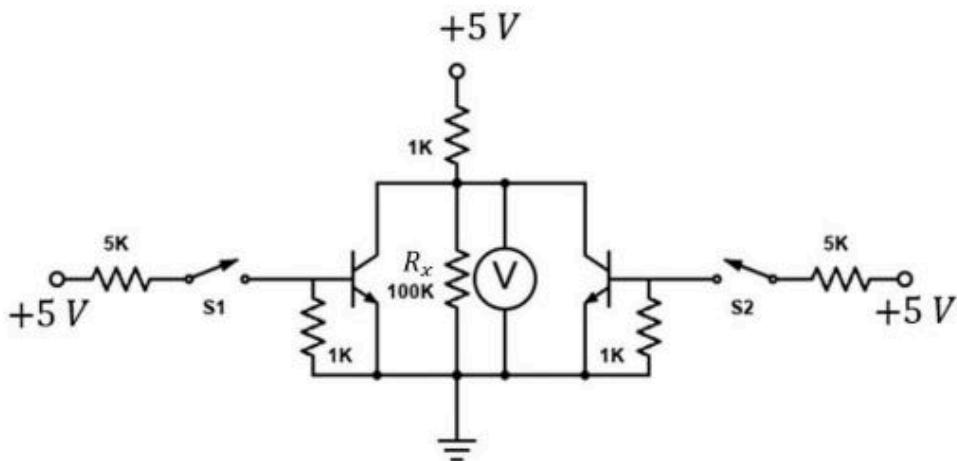
The voltage across the resistor $R_x = 100 \text{ k}\Omega$ is

1. $\sim 5 \text{ V}$ when both S1 and S2 are closed
2. $\sim 5 \text{ V}$ when either S1 or S2 are closed
3. $\sim 5 \text{ V}$ when both S1 and S2 are open
4. $\sim 0 \text{ V}$ when both S1 and S2 are open

- when S1 or S2 is closed, the corresponding npn turns ON and pulls the top of Rx down to $\sim 0\text{V}$
- The top of Rx rises to $\sim 5\text{V}$ only when both transistors are OFF (both switches open) because then the 1k Ω pull-up is the only active path

Question Number : 43 Question Id : 56295443 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

चित्र में उच्च β के npn ट्रांजिस्टर, प्रतिरोधक तथा स्विच से बना परिपथ प्रदर्शित है। स्विच S1 तथा S2 बंद करने से संगत ट्रांजिस्टर चालू करने के लिए बायसिंग पर्याप्त है।



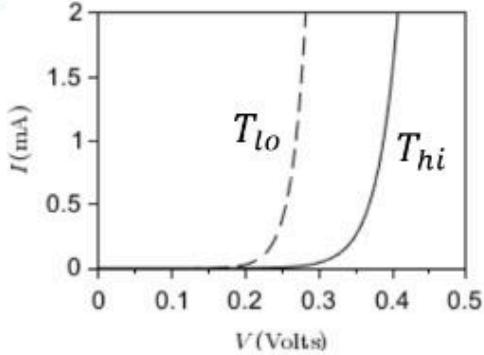
प्रतिरोधक $R_x = 100 \text{ k}\Omega$ पर वोल्टता है

1. $\sim 5 \text{ V}$ जब S1 तथा S2 बंद हैं
2. $\sim 5 \text{ V}$ जब या तो S1 या S2 बंद हैं
3. $\sim 5 \text{ V}$ जब S1 तथा S2 दोनों खुले हैं
4. $\sim 0 \text{ V}$ जब S1 तथा S2 दोनों खुले हैं

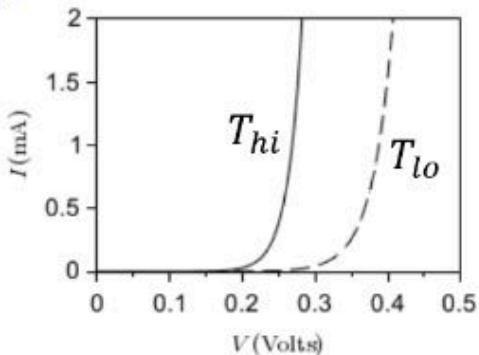
Question Number : 44 Question Id : 56295444 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

A Silicon p-n junction diode is operated under forward bias at two temperatures $T_{hi} \approx 300$ K, (shown by solid line) and $T_{lo} \approx 200$ K, (shown by dotted line). Which of the following plots best represents the I - V characteristics of the diode?

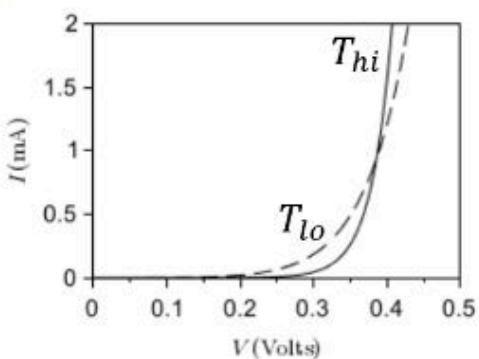
1.



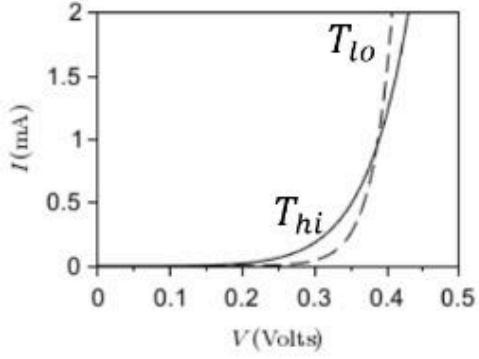
2



3.



4.



diode eqn -

$$I = I_s (e^{\frac{V}{nV_T}} - 1)$$

as temperature increases

$I_s \propto T^3 e^{-E_g/KT}$ (this increases exponentially)

and

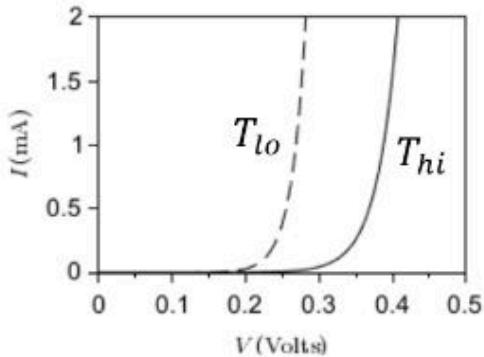
$$V = nV_T \ln\left(\frac{I}{I_s}\right) \text{ decreases due to this.}$$

that means forward Voltage decreases

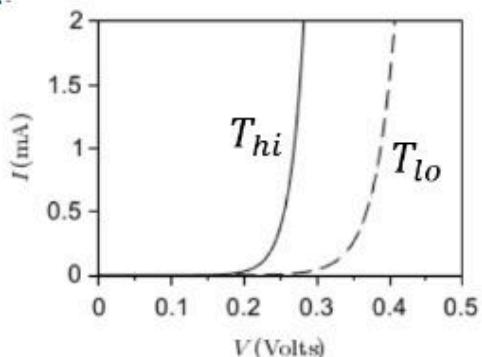
Question Number : 44 Question Id : 56295444 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

किसी सिलिकॉन p-n जंक्शन डायोड को दो तापमानों $T_{hi} \approx 300\text{ K}$ (संतत रेखा द्वारा प्रदर्शित) तथा $T_{lo} \approx 200\text{ K}$ (असंतत रेखा द्वारा प्रदर्शित) पर अग्रदिशिक बायस के साथ चलाया जाता है। निम्न आलेखों में से कौन सा आलेख सर्वश्रेष्ठः डायोड के I-V अभिलक्षणों को प्रदर्शित करता है?

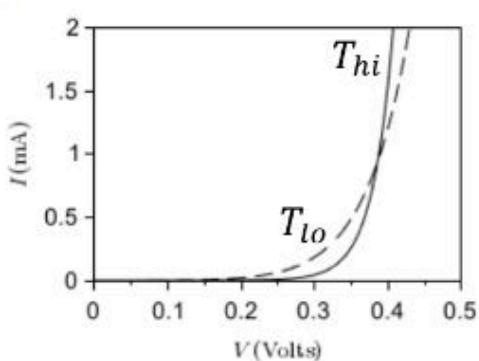
1.



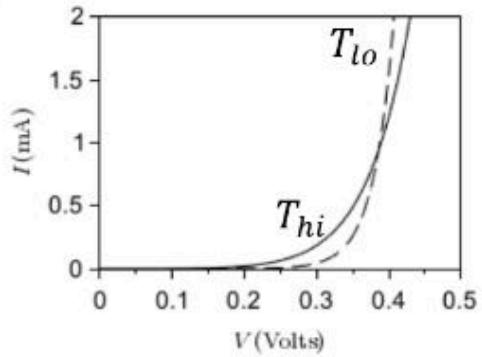
2.



3.



4.

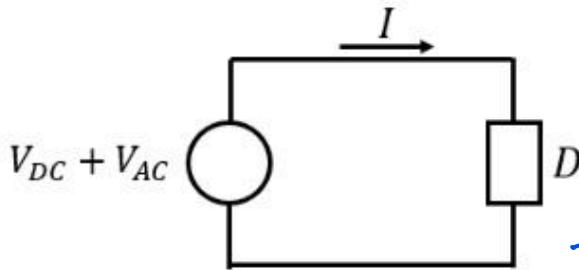


Question Number : 45 Question Id : 56295445 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

Consider the device D shown in the figure below. Its current-voltage characteristic is given by $I = aV + bV^2$, where I is the current, V is the input voltage, and a and b are constants. The device is used to mix a voltage signal $V = V_{DC} + V_{AC}$, where $V_{AC} = V_0 \cos \omega t$. V_{DC} and V_0 are constants.

$$\cos^2 \theta = 1 - \frac{\cos 2\theta}{2}$$

$$I = aV + bV^2$$



$$V = V_{DC} + V_0 \cos \omega t$$

$$I = aV_{DC} + V_0 a \cos \omega t + b(V_{DC} + V_0 \cos \omega t)^2$$

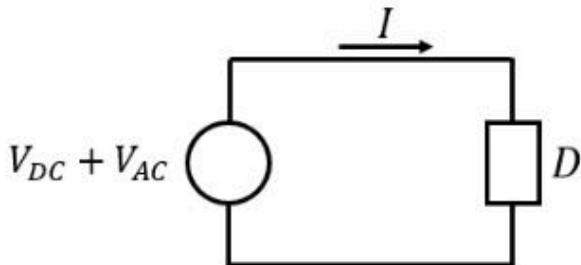
The frequency components present in the current I are

- 1. 0 and ω
- 2. 0, ω and 2ω
- 3. 0 and 2ω
- 4. ω and 2ω

$$= \underbrace{aV_{DC}}_0 + V_0 \underbrace{a \cos \omega t}_\omega + bV_0^2 + 2bV_0 V_0 \cos \omega t + bV_0^2 \left(1 - \frac{\cos 2\omega t}{2}\right)$$

Question Number : 45 Question Id : 56295445 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 3.5 Wrong Marks : 0.875

नीचे प्रदर्शित उपकरण D पर विचार करें। इसका धारा-वोल्टता अभिलक्षण $I = aV + bV^2$ से दिया जाता है, जहाँ I धारा, V निवेश वोल्टता, तथा a एवं b स्थिरांक हैं। उपकरण का उपयोग वोल्टता सिग्नल $V = V_{DC} + V_{AC}$ को मिश्रित करने में किया जाता है, जहाँ $V_{AC} = V_0 \cos \omega t$. V_{DC} तथा V_0 स्थिरांक हैं।



धारा I में उपस्थित आवृति के घटक निम्न हैं

1. 0 तथा ω
2. 0, ω तथा 2ω
3. 0 तथा 2ω
4. ω तथा 2ω

PART - C

Section Id :	5629543
Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	20
Section Marks :	100
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	5629543
Question Shuffling Allowed :	Yes

Question Number : 46 Question Id : 56295446 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

(6)

56 X 3

Let $P_n(x)$ be a polynomial of degree n with real coefficients, where

$n = 0, 1, 2, 3, \dots$. If $\int_2^4 P_n(x)P_m(x)dx = \delta_{mn}$, then

1. $P_1(x) = \pm \sqrt{\frac{3}{2}}(3 - x)$

Put this here and solve

2. $P_1(x) = \pm \sqrt{\frac{3}{2}}(2 - x)$

You will get a
equality.

3. $P_1(x) = \pm \sqrt{\frac{3}{2}}(1 - x)$

"easiest way to solve is to check
the options here"

4. $P_1(x) = \pm \sqrt{3}(3 + x)$

Question Number : 46 Question Id : 56295446 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

मानें कि $P_n(x)$ वास्तविक गुणांकों वाला n घात का बहुपद है, जहाँ $n = 0, 1, 2, 3, \dots$.

यदि $\int_2^4 P_n(x)P_m(x)dx = \delta_{mn}$, तब

1. $P_1(x) = \pm \sqrt{\frac{3}{2}}(3 - x)$

2. $P_1(x) = \pm \sqrt{\frac{3}{2}}(2 - x)$

3. $P_1(x) = \pm \sqrt{\frac{3}{2}}(1 - x)$

4. $P_1(x) = \pm \sqrt{3}(3 + x)$

Question Number : 47 Question Id : 56295447 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25 "Residue theorem"

The value of the integral $\int_0^\infty \frac{\cos ax}{1+x^2} dx$, where a is a positive real number, is

1. $\frac{\pi}{2} e^{-\alpha}$

2. $\pi e^{-\alpha}$

3. $\frac{\pi}{2} e^{-(\alpha/2)}$

4. $\pi e^{-(\alpha/2)}$

$$\text{Res} = \lim_{x \rightarrow i} (x-i) \frac{e^{ian}}{1+x^2} = \lim_{x \rightarrow i} \frac{(x-i)e^{ian}}{(x-i)(x+i)} = \frac{e^{-a}}{2i}$$

$$\int_0^\infty \frac{\cos ax}{1+x^2} dx = \frac{1}{2} \Re \int_{-\infty}^\infty \frac{e^{ian}}{1+x^2} dx = \frac{1}{2} \Re \left(2\pi i \times \frac{e^{-a}}{2i} \right) = \frac{\pi}{2} e^{-a}$$

Question Number : 47 Question Id : 56295447 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

समाकल $\int_0^\infty \frac{\cos ax}{1+x^2} dx$ का मान, जहाँ a धनात्मक वास्तविक संख्या है,

निम्न है

1. $\frac{\pi}{2} e^{-\alpha}$

2. $\pi e^{-\alpha}$

3. $\frac{\pi}{2} e^{-(\alpha/2)}$

4. $\pi e^{-(\alpha/2)}$

Question Number : 48 Question Id : 56295448 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

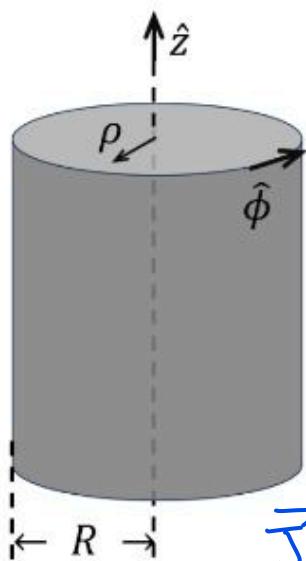
A long cylinder of radius R carries a magnetization $\vec{M} = k \rho^2 \hat{\phi}$, where k is a constant, ρ is the radial distance from the axis and $\hat{\phi}$ is the azimuthal unit vector (see in the figure). The magnetic field inside and outside the cylinder would be

Volume bound current

$$\vec{J}_b = \vec{\nabla} \times \vec{m}$$

Surface bound current

$$\vec{K}_b = \vec{M} \times \hat{n}$$



$$\vec{M} = K s^2 \hat{\phi}$$

$$m_s = 0$$

$$m_\phi = K s^2$$

$$m_z = 0$$

$$\vec{\nabla} \times \vec{m} = \frac{1}{s} \begin{vmatrix} \hat{s} & \hat{s}\hat{\phi} & \hat{z} \\ \frac{\partial}{\partial s} & \frac{\partial}{\partial \phi} & \frac{\partial}{\partial z} \\ 0 & K s^3 & 0 \end{vmatrix}$$

$$= \frac{1}{s} \left[\hat{s}(0) - s\hat{\phi}(0) + \hat{z}(3Ks^2) \right]$$

$$\vec{J}_b = 3Ks \hat{z} \quad \text{--- (1)}$$

$$\vec{K}_b = K s^2 (\hat{\phi} \times \hat{s})$$

$$\vec{K}_b = -K s^2 \hat{z} \quad \text{--- (2)}$$

1. $\vec{B}_{inside} = 0, \vec{B}_{outside} = \mu_0 k \rho^2 \hat{\phi}$

2. $\vec{B}_{inside} = \mu_0 k \rho^2 \hat{\phi}, \vec{B}_{outside} = 0$

3. $\vec{B}_{inside} = \vec{B}_{outside} = \mu_0 k \rho^2 \hat{\phi}$

4. $\vec{B}_{inside} = \vec{B}_{outside} = 0$

$$I_{vol}^{inside} = \int_0^s \vec{J}_b \cdot \hat{z} 2\pi s ds$$

$$= 2\pi \int_0^s 3Ks^2 ds$$

$$I_{vol}^{inside} = 2\pi K s^3$$

$$I_{vol}^{outside} = 2\pi K R^3$$

$$B_{outside} = 0$$

$$I_{surf} = -2\pi K R^3$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$$

$$B_{inside}(2\pi s) = \mu_0 \times 2\pi K s^3$$

$$B_{inside} = \mu_0 K s^2 \hat{\phi}$$

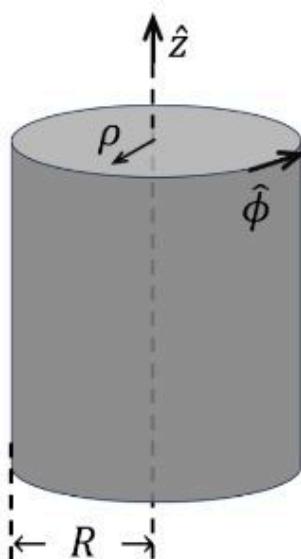
$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$$

$$B_{outside}(2\pi R) = \mu_0 (2\pi K R^3 - 2\pi K R^3)$$

Question Number : 48 Question Id : 56295448 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

त्रिज्या R के किसी लंबे बेलन का चुंबकन $\vec{M} = k \rho^2 \hat{\phi}$ है, जहाँ k स्थिरांक है, ρ अक्ष से रेडियल दूरी तथा $\hat{\phi}$ दिगंश मात्रक सदिश है (चित्र में देखें)। बेलन के अंदर तथा बाहर चुंबकीय क्षेत्र निम्न होगा



1. $\vec{B}_{inside} = 0, \vec{B}_{outside} = \mu_0 k \rho^2 \hat{\phi}$
2. $\vec{B}_{inside} = \mu_0 k \rho^2 \hat{\phi}, \vec{B}_{outside} = 0$
3. $\vec{B}_{inside} = \vec{B}_{outside} = \mu_0 k \rho^2 \hat{\phi}$
4. $\vec{B}_{inside} = \vec{B}_{outside} = 0$

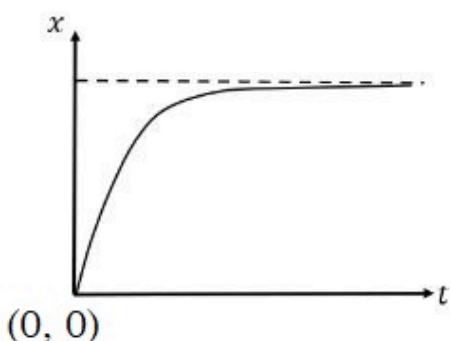
Question Number : 49 Question Id : 56295449 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

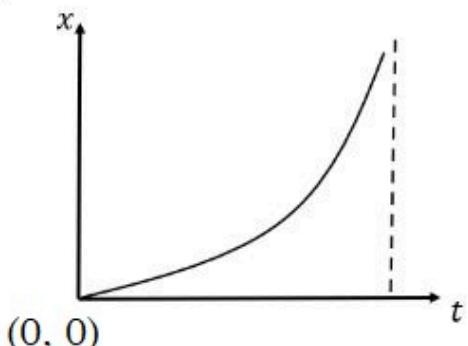
Which one of the following curves best represents the solution of the differential

equation $\frac{dx}{dt} + x = 1$, with the initial condition $x(0) = 0$?

1.



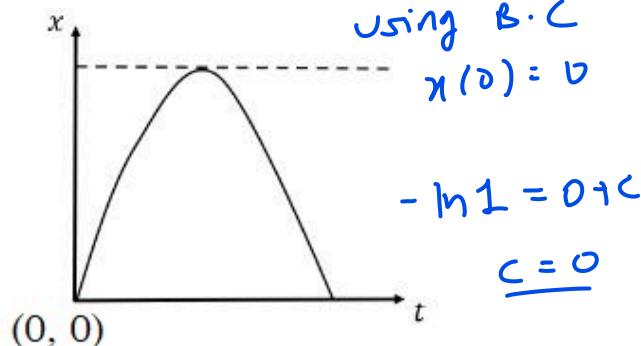
2.



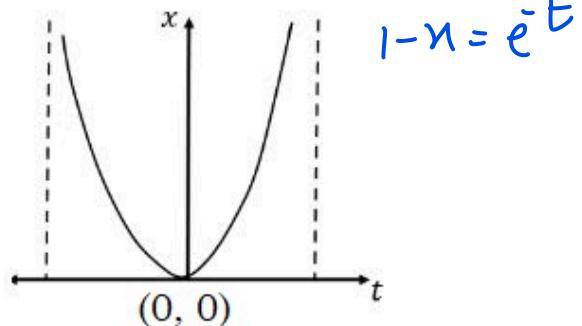
$$\int \frac{dx}{1-x} = \int dt \Rightarrow \frac{u}{du} = -\frac{dx}{x} \quad 3. \quad \int -\frac{du}{u} = \int dt$$

$$- \ln|1-x| = t + C$$

3.



4.



$$x = 1 - e^{-t}$$

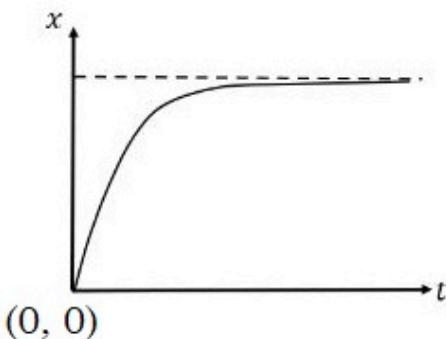
Question Number : 49 Question Id : 56295449 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

प्रारम्भिक स्थिति $x(0) = 0$ के होने पर निम्न वक्रों में से कौन सा अवकल समीकरण

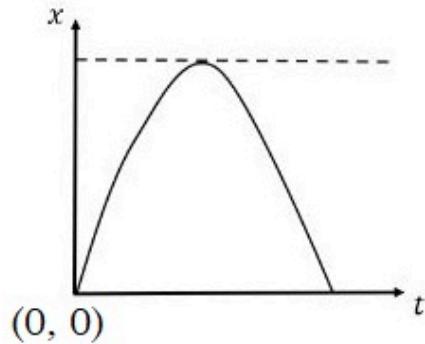
$$\frac{dx}{dt} + x = 1$$

को सर्वश्रेष्ठः निरूपित करता है?

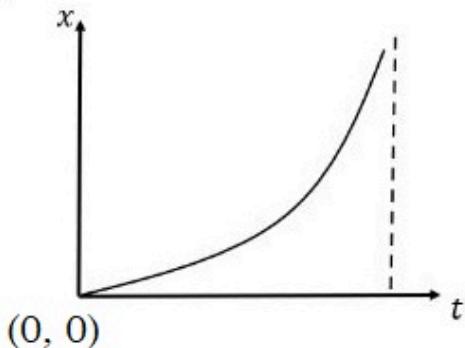
1.



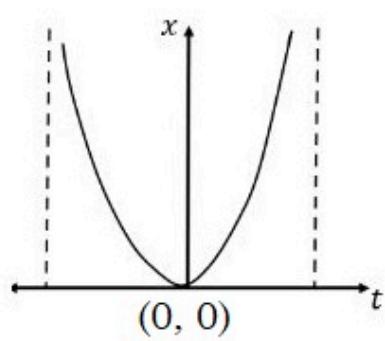
3.



2.



4.



Question Number : 50 Question Id : 56295450 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

From a straight-line segment of unit length, three points are chosen at random, one after another. The probability that they are in increasing order is

1. $\frac{1}{3}$
 $x_1 < x_2 < x_3$
2. $\frac{1}{8}$
 $x_1 < x_3 < x_2$
3. $\frac{1}{9}$
 $x_2 < x_1 < x_3$
4. $\frac{1}{6}$
 $x_2 < x_3 < x_1$
 $x_3 < x_1 < x_2$
 $x_3 < x_2 < x_1$

$x_1 < x_2 < x_3$
 $x_1 < x_3 < x_2$
 $x_2 < x_1 < x_3$
 $x_2 < x_3 < x_1$
 $x_3 < x_1 < x_2$
 $x_3 < x_2 < x_1$

6

$\frac{1}{6}$

Question Number : 50 Question Id : 56295450 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

एकांक लंबाई के सरल रेखीय खंड से, तीन बिन्दु यादचिक छाँटे जाते हैं। उनके वर्धमान क्रम में होने की प्रायिकता निम्न है

1. $\frac{1}{3}$
2. $\frac{1}{8}$
3. $\frac{1}{9}$
4. $\frac{1}{6}$

Question Number : 51 Question Id : 56295451 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

For a free particle of mass m , consider the following time dependent quantity in phase space

$$Q = \frac{qp}{m} - \frac{p^2 t}{m^2},$$

where q and p are the canonically conjugate position and momentum coordinates respectively. Then $\frac{dQ}{dt}$ is given by

1. 0
2. $\frac{p^2}{m^2}$
3. $-\frac{p^2}{m^2}$
4. $\frac{qp}{mt}$

Here,

$$H = \frac{p^2}{2m} \text{ (for free particle)}$$

$$\boxed{\frac{dQ}{dt} = \frac{\partial Q}{\partial t} + \{Q, H\}}$$

$$\frac{\partial Q}{\partial t} = -\frac{p^2}{m^2} \quad \textcircled{1}$$

$$\begin{aligned} \{Q, H\} &= \frac{\partial Q}{\partial q} \frac{\partial H}{\partial p} - \frac{\partial Q}{\partial p} \frac{\partial H}{\partial q} \\ &= \left(\frac{p}{m}\right) \left(\frac{p}{m}\right) - \left(\frac{q}{m} - \frac{2pt}{m^2}\right) (0) \end{aligned}$$

$$\frac{dQ}{dt} = -\frac{p^2}{m^2} + \frac{p^2}{m^2} = \boxed{0}$$

$$= \frac{p^2}{m^2}$$

The above equation is the result of using chain rule and Hamilton's eqn. Let me show, here $Q(q, p, t)$, using chain rule

$$\frac{dQ}{dt} = \frac{\partial Q}{\partial q} \dot{q} + \frac{\partial Q}{\partial p} \dot{p} + \frac{\partial Q}{\partial t}, \quad \text{Hamilton's eqn we know,}$$

$$\dot{q} = \frac{\partial H}{\partial p}, \quad \dot{p} = -\frac{\partial H}{\partial q}$$

$$= \underbrace{\frac{\partial Q}{\partial q} \frac{\partial H}{\partial p} + \frac{\partial Q}{\partial p} \left(-\frac{\partial H}{\partial q}\right)}_{\text{this is a poisson bracket}} + \frac{dQ}{dt}$$

this is a poisson bracket

$$\frac{dQ}{dt} = \{Q, H\} + \frac{\partial Q}{\partial t}$$

Question Number : 51 Question Id : 56295451 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

द्रव्यमान m के किसी मुक्त कण के लिए, प्रावस्था समष्टि में निम्न कालाश्रित राशि पर
विचार करें

$$Q = \frac{qp}{m} - \frac{p^2 t}{m^2},$$

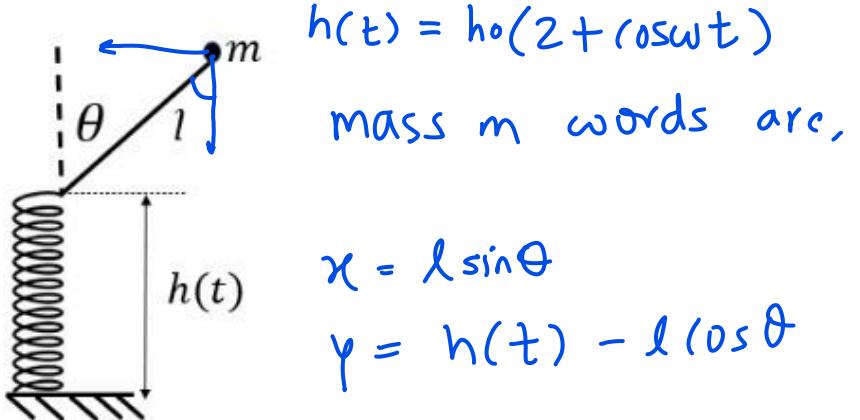
जहाँ q तथा p क्रमशः विहित संयुग्मी स्थिति तथा संवेग निर्देशांक हैं। तब $\frac{dQ}{dt}$ को
निम्नवत दिया जाता है

1. 0
2. $\frac{p^2}{m^2}$
3. $-\frac{p^2}{m^2}$
4. $\frac{qp}{mt}$

Question Number : 52 Question Id : 56295452 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

A massless rod of length l is hinged at the extreme end of a vertical spring whose other end is fixed to the ground. A point mass m is fixed at end of the rod, as shown in the figure.

Better to leave such questions



Assume harmonic motion of the spring given by $h(t) = h_0(2 + \cos \omega t)$, where $h_0 > l$. The equation of motion of the mass (confined to the plane of the figure) is given by

$$1. \quad l\ddot{\theta} + \omega^2 h_0 \sin \theta \sin \omega t - g \sin \theta = 0$$

$$\checkmark 2. \quad l\ddot{\theta} + \omega^2 h_0 \sin \theta \cos \omega t - g \sin \theta = 0$$

$$3. \quad l\ddot{\theta} + \omega^2 h_0 \sin \theta \cos \omega t + g \sin \theta = 0$$

$$4. \quad l\ddot{\theta} - \omega^2 h_0 \sin \theta \sin \omega t + g \sin \theta = 0$$

$$\ddot{x} = l \cos \theta \dot{\theta}$$

$$\dot{y} = \frac{d}{dt}(h_0[2 + \cos \omega t] - l \cos \theta)$$

$$\ddot{y} = -h_0 \omega \sin \omega t + l \sin \theta \dot{\theta}$$

$$T = \frac{1}{2} m(\ddot{x}^2 + \ddot{y}^2) = \frac{1}{2} m \left[l^2 \omega^2 \dot{\theta}^2 + h_0^2 \omega^2 \sin^2 \omega t - 2h_0 \omega l \sin \omega t \sin \theta \dot{\theta} + l^2 \sin^2 \theta \dot{\theta}^2 \right]$$

$$V = mg y = mg [2h_0 + h_0 \cos \omega t - l \cos \theta]$$

$$L = T - V = \frac{1}{2} m l^2 \dot{\theta}^2 + \frac{1}{2} m h_0^2 \omega^2 \sin^2 \omega t - m h_0 \omega l \sin \omega t \sin \theta \dot{\theta} - 2mg h_0 \cancel{+ m^2 g h_0 \omega^2 \sin^2 \theta} + mg l \cos \theta$$

eqn of motion,

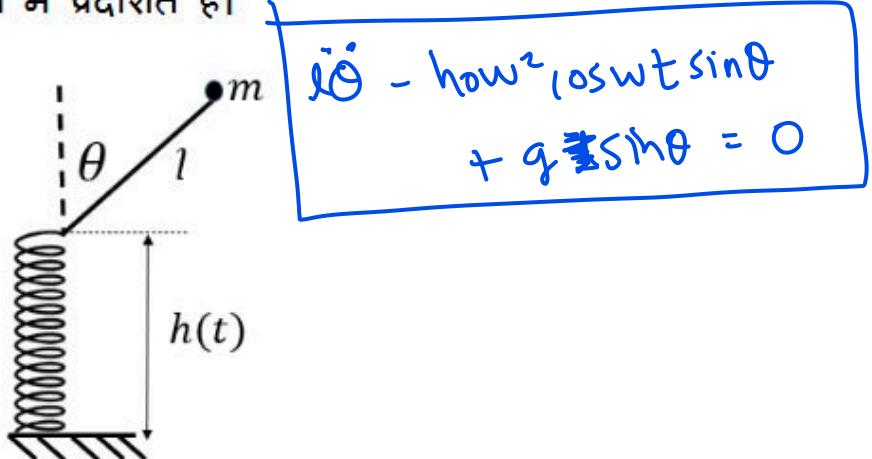
$$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{\theta}} \right) = \frac{\partial L}{\partial \theta} \Rightarrow \frac{d}{dt} (m l^2 \dot{\theta} - m h_0 \omega l \sin \omega t \sin \theta) = -m h_0 \omega \sin \omega t \cos \theta \dot{\theta}$$

$$\Rightarrow l^2 \ddot{\theta} - h_0 \omega l \sin \omega t \cos \theta \dot{\theta} - h_0 \omega^2 l \sin \theta \cos \omega t \sin \theta = -h_0 \omega l \sin \theta \cos \theta \dot{\theta} - g l \sin \theta$$

Question Number : 52 Question Id : 56295452 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

लंबाई l की कोई द्रव्यमान-रहित छड़ी किसी ऊर्ध्वाधर कमानी के अंतिम सिरे पर अटकी हुई है। कमानी का दूसरा सिरा धरातल से जुड़ा है। द्रव्यमान m का एक बिंदु छड़ी के सिरे पर जुड़ा है, जैसा कि चित्र में प्रदर्शित है।



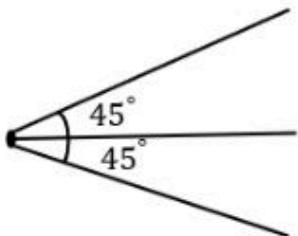
मानें कि कमानी की आवर्त गति $h(t) = h_0 (2 + \cos \omega t)$ से दी जाती है, जहाँ $h_0 > l$ । द्रव्यमान की गति का समीकरण (चित्र के तल में सीमित) निम्न से दी जाती है।

1. $l\ddot{\theta} + \omega^2 h_0 \sin \theta \sin \omega t - g \sin \theta = 0$
2. $l\ddot{\theta} + \omega^2 h_0 \sin \theta \cos \omega t - g \sin \theta = 0$
3. $l\ddot{\theta} + \omega^2 h_0 \sin \theta \cos \omega t + g \sin \theta = 0$
4. $l\ddot{\theta} - \omega^2 h_0 \sin \theta \sin \omega t + g \sin \theta = 0$

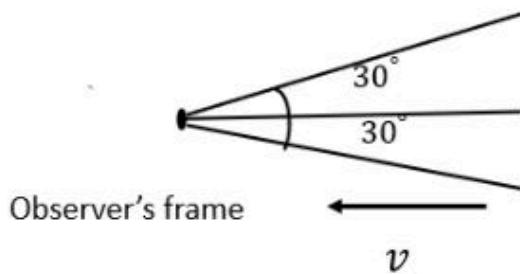
Question Number : 53 Question Id : 56295453 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

In its rest frame, a source emits light in a conical beam of width -45° to 45° . An observer is moving towards the source with a speed v . For the observer, the beam width appears to be -30° to 30° . The speed of the observer is closest to

relativistic aberration,



Rest frame



1. $0.62 c$
2. $0.50 c$
3. $0.82 c$
4. $0.41 c$

$$\cos \theta' = \frac{\cos \theta + \beta}{1 + \beta \cos \theta}$$

$$\frac{\sqrt{3}}{2} = \frac{\frac{1}{\sqrt{2}} - \beta}{1 - \frac{\beta}{\sqrt{2}}} = \frac{1 - \sqrt{2}\beta/\sqrt{2}}{\sqrt{2} - \beta/\sqrt{2}}$$

$$\sqrt{6} - \beta\sqrt{3} = 2 - 2\sqrt{2}\beta$$

$$2\sqrt{2}\beta - \sqrt{3}\beta = 2 - \sqrt{6}$$

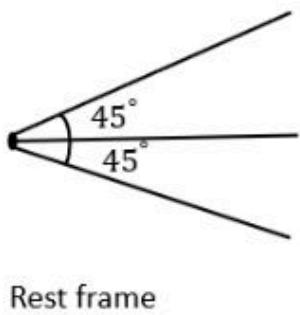
$$\beta = \frac{2 - \sqrt{6}}{2\sqrt{2} - \sqrt{3}} = -\frac{0.449}{1.096}$$

0.449

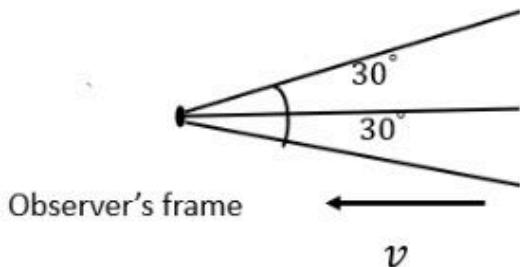
Question Number : 53 Question Id : 56295453 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

अपने विराम-फ्रेम में कोई स्रोत -45° से 45° के शंक्वाकार किरण पुंज में प्रकाश उत्सर्जित करता है। कोई प्रेक्षक v गति से स्रोत की ओर बढ़ रहा है। प्रेक्षक के लिए, किरण पुंज की चौड़ाई -30° से 30° प्रतीत होती है। प्रेक्षक की गति निम्न के निकटतम है



Rest frame



Observer's frame

1. $0.62 c$
2. $0.50 c$
3. $0.82 c$
4. $0.41 c$

Question Number : 54 Question Id : 56295454 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

$|n\rangle$ denotes the eigenvector of the number operator for a particle of mass m in a one-dimensional potential $V = \frac{1}{2}m\omega^2x^2$ ($n = 0, 1, 2, \dots$). For the state vector

$$|\varphi(x, t=0)\rangle = \frac{1}{\sqrt{3}}|1\rangle + \sqrt{\frac{2}{3}}|2\rangle, \langle \hat{x}(t) \rangle$$

1. $\frac{2\sqrt{2}}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos \omega t$
2. $\frac{4}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos \omega t$
3. $\frac{2\sqrt{2}}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos 2\omega t$
4. $\frac{4}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos 2\omega t$
- $x = \sqrt{\frac{\hbar}{2m\omega}}(a + a^\dagger)$
- $|\Psi(0)\rangle = \frac{1}{\sqrt{3}}|1\rangle + \sqrt{\frac{2}{3}}|2\rangle$
- $|\Psi(t)\rangle = \frac{1}{\sqrt{3}}e^{-i\frac{E_1 t}{\hbar}}|1\rangle + \sqrt{\frac{2}{3}}e^{-i\frac{E_2 t}{\hbar}}|2\rangle$
- $\langle x(t) \rangle = \sum_{n,m} c_n^* c_m e^{i(E_n - E_m)t/\hbar} \langle n | x | m \rangle$

Skip

Question Number : 54 Question Id : 56295454 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

$|n\rangle$ किसी एक-विमीय विभव $V = \frac{1}{2}m\omega^2x^2$ ($n = 0, 1, 2, \dots$) में द्रव्यमान m के कण के संख्या संकारक का अभिलक्षणिक सदिश निरूपित करता है। अवस्था-सदिश $|\varphi(x, t = 0)\rangle = \frac{1}{\sqrt{3}}|1\rangle + \sqrt{\frac{2}{3}}|2\rangle$ के लिए, $\langle \hat{x}(t) \rangle$ है

1. $\frac{2\sqrt{2}}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos \omega t$

2. $\frac{4}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos \omega t$

3. $\frac{2\sqrt{2}}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos 2\omega t$

4. $\frac{4}{3} \sqrt{\frac{\hbar}{2m\omega}} \cos 2\omega t$

**Question Number : 55 Question Id : 56295455 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

The ground state wavefunction for the hydrogen atom is

$$\psi_0 = \sqrt{\frac{1}{\pi a_0^3}} e^{-\frac{r}{a_0}}, \text{ where } a_0 \text{ is the Bohr radius.}$$

Considering an additional potential H' as a perturbation to the hydrogen atom Hamiltonian, given by

$$H' = \begin{cases} \frac{e^2}{4\pi\epsilon_0} \left[\frac{1}{r} - \frac{1}{R} \right] & \text{for } 0 < r < R \\ 0 & \text{for } r > R \end{cases},$$

where R is the radius of the proton, $R \ll a_0$. The shift in the ground state energy due to H' is

1. $\left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{4R^2}{3a_0^2}$
2. $\left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{R}{a_0}$
3. $-\left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{2R^2}{a_0^2}$
4. $\left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{2R^2}{3a_0^2}$

Question Number : 55 Question Id : 56295455 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

हाइड्रोजन परमाणु का निम्नतम अवस्था तरंग फलन

$$\psi_0 = \sqrt{\frac{1}{\pi a_0^3}} e^{-\frac{r}{a_0}} \text{ है, जहाँ } a_0 \text{ बोर त्रिज्या है।}$$

हाइड्रोजन परमाणु के हैमिल्टनी को दिए गए एक अतिरिक्त विभव H' को क्षोभ मारें

$$H' = \begin{cases} \frac{e^2}{4\pi\epsilon_0} \left[\frac{1}{r} - \frac{1}{R} \right] & 0 < r < R \text{ के लिए} \\ 0 & r > R \text{ के लिए} \end{cases}$$

जहाँ R प्रोटॉन की त्रिज्या, $R \ll a_0$ है। H' के कारण निम्नतम ऊर्जा अवस्था में विस्थापन है first-order correction,

$$\begin{aligned}
 1. \quad & \left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{4R^2}{3a_0^2} \\
 2. \quad & \left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{R}{a_0} \\
 3. \quad & - \left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{2R^2}{a_0^2} \\
 4. \quad & \checkmark \left(\frac{e^2}{4\pi\epsilon_0 a_0} \right) \frac{2R^2}{3a_0^2}
 \end{aligned}$$

$\Delta E = \langle \Psi_0 | H' | \Psi_0 \rangle$
 $= \int |\Psi_0(r)|^2 H'(r) d^3r$
 since this is a spherically symm. perturbation
 $d^3r = r^2 \sin\theta dr d\theta d\phi$
 here, $a_0 \gg R$, therefore in the region $0 < r < R$
 $\Psi_0(r) \approx \Psi_0(0) = \frac{1}{\sqrt{\pi a_0^3}}$
 $\Delta E \sim |\Psi_0(0)|^2 \int_0^R \left(\frac{1}{r} - \frac{1}{R} \right) \frac{c^2}{4\pi\epsilon_0} 4\pi r^2 dr$
 $= \frac{c^2}{\pi a_0^3 \epsilon_0} \left[\frac{r^2}{2} \Big|_0^R - \frac{1}{R} \frac{r^3}{3} \Big|_0^R \right] = \frac{c^2}{\pi a_0^3 \epsilon_0} \left[\frac{R^2}{2} - \frac{R^2}{3} \right]$
 $= \boxed{\left(\frac{c^2}{4\pi\epsilon_0 a_0^3} \right) \frac{2R^2}{3a_0^2}}$

Question Number : 56 Question Id : 56295456 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

The probability density of a free particle of mass m at time $t = 0$, is given

by $A \exp\left(-\frac{x^2}{2\sigma^2(0)}\right)$. At $t > 0$, its probability density is proportional to $\exp\left(-\frac{x^2}{2\sigma^2(t)}\right)$, where $\sigma^2(t)$ is

$$1. \quad \sigma^2(0) + \frac{\hbar^2 t^2}{\sigma^2(0)m^2}$$

$$2. \quad \sigma^2(0) + \frac{\hbar^2 t^2}{4\sigma^2(0)m^2}$$

$$3. \quad \sigma^2(0) + \frac{4\hbar^2 t^2}{\sigma^2(0)m^2}$$

$$4. \quad \sigma^2(0) + \frac{2\hbar^2 t^2}{\sigma^2(0)m^2}$$

$$\mathcal{S} = A \underbrace{\exp\left(-\frac{x^2}{2\sigma^2(0)}\right)}$$

gaussian wavepacket

\rightarrow A Gaussian wavepacket

has some initial position spread $\sigma_n(0)$

\rightarrow Because it's localized it must

also have a momentum spread $\sigma_p = \frac{\hbar}{2\sigma_n(0)}$, for a free

particle each momentum component moves at a different velocity $v = \frac{p}{m}$

\rightarrow These components separate over time so the packet spreads

\rightarrow mathematically, the spreading comes from simply letting the momentum uncertainty produce position uncertainty, as it evolves

$$\sigma_n(t)^2 = \sigma_n(0)^2 + \left(\frac{\sigma_p}{m} t\right)^2, \quad \therefore \sigma_p = \frac{\hbar}{2\sigma_n}$$

$$\boxed{\sigma_n(t)^2 = \sigma_n(0)^2 + \frac{\hbar^2 t^2}{4m^2 \sigma_n(0)^2}}$$

\rightarrow this is why $\sigma^2(t)$ increases with time, even without any force

Question Number : 56 Question Id : 56295456 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

द्रव्यमान m के मुक्त कण का समय $t = 0$, पर प्रायिकता घनत्व $\exp\left(-\frac{x^2}{2\sigma^2(0)}\right)$ से दिया जाता है। $t > 0$ पर, इसका प्रायिकता घनत्व $\exp\left(-\frac{x^2}{2\sigma^2(t)}\right)$ के आनुपातिक है, जहाँ $\sigma^2(t)$ है

1. $\sigma^2(0) + \frac{\hbar^2 t^2}{\sigma^2(0)m^2}$
2. $\sigma^2(0) + \frac{\hbar^2 t^2}{4\sigma^2(0)m^2}$
3. $\sigma^2(0) + \frac{4\hbar^2 t^2}{\sigma^2(0)m^2}$
4. $\sigma^2(0) + \frac{2\hbar^2 t^2}{\sigma^2(0)m^2}$

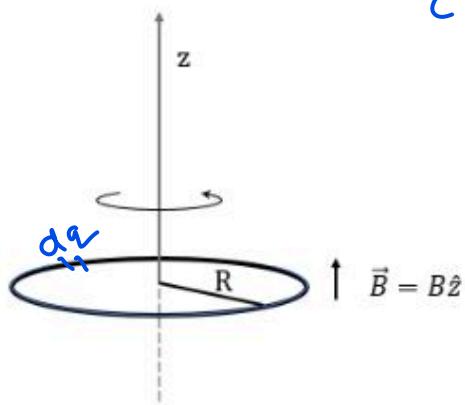
Question Number : 57 Question Id : 56295457 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

A thin circular wire loop of mass M , having radius R , carries a static charge Q .

The plane of the loop is held perpendicular to a uniform magnetic field \vec{B} along the z -axis passing through its centre, as shown in the figure. The loop, initially at rest, can freely rotate about the z -axis. When the magnetic field is switched off the loop starts rotating with an angular frequency

$$\mathcal{E} = \oint \vec{E} \cdot d\vec{\ell}$$

$$\mathcal{E} = -\frac{d\Phi}{dt}$$



$$\mathcal{E} = -\pi R^2 (0 - B)$$

$$\mathcal{E} = \pi R^2 B$$

$$dF = E_\phi dq$$

$$\int \vec{E} \cdot d\vec{\ell} = \pi R^2 B$$

$$F = E_\phi (Q)$$

$$E_\phi (2\pi R) = \pi R^2 B$$

$$(E_\phi = \frac{RB}{2})$$

$$1. \quad \frac{QB}{M}$$

$$2. \quad \frac{QB}{2M}$$

$$3. \quad \frac{\pi QB}{M}$$

$$4. \quad \frac{\pi QB}{2M}$$

$$F = \frac{QB R}{2}$$

torque will be,

$$\tau = r \perp F = \frac{QB R^2}{2}$$

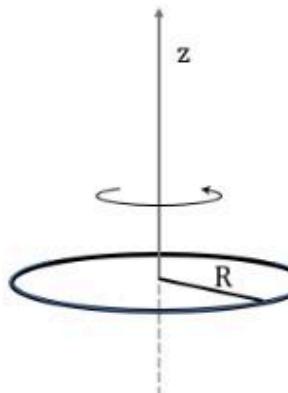
We know, $\tau = \frac{dL}{dt} \Rightarrow \int dL = \int t dt$

$$L = \frac{QB R^2}{2} xt$$

Question Number : 57 Question Id : 56295457 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

द्रव्यमान M के, त्रिज्या R वाले पतले वृत्ताकार तार पाश में स्थैतिज आवेश Q है। पाश के तल को इसके z -अक्ष के अनुदिश उसके केंद्र से होकर जाने वाले एक समान चुंबकीय क्षेत्र \vec{B} के लम्बवत रखा जाता है, जैसा चित्र में दर्शाया गया है। आरंभ में विरामवस्था वाला पाश z -अक्ष के इर्द-गिर्द मुक्त घूर्णन कर सकता है। जब चुंबकीय क्षेत्र को शून्य कर दिया जाता है, पाश निम्न कोणीय आवृत्ति से घूर्णन आरंभ कर देता है

we know,



$$L = Iw$$

and for
ring

$$I = MR^2$$

1. $\frac{QB}{M}$
2. $\frac{QB}{2M}$
3. $\frac{\pi QB}{M}$
4. $\frac{\pi QB}{2M}$

$$m \cancel{R^2}(\omega) = \frac{Q \cancel{B} \cancel{R^2}}{2} \times t$$

$$\boxed{\omega = \frac{QB}{2m}}$$

just after
so take I's

Question Number : 58 Question Id : 56295458 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

The charge density of the electron cloud of a hydrogen atom is given by $\rho(\vec{r}) = -\frac{e}{8\pi a^3} \exp(-r/a)$, where a is some characteristic length. The potential energy due to the interaction between the proton (sitting at the origin) and the electron cloud is given by

$$\begin{aligned}
 1. \quad & -\frac{e^2}{2\pi\epsilon_0 a} \quad g(r) = -\frac{e}{8\pi a^3} e^{-r/a} \quad U = \int \frac{Kcdq}{r} \\
 2. \quad & -\frac{e^2}{4\pi\epsilon_0 a} \quad = \frac{q}{4\pi\epsilon_0} \int \frac{g 4\pi r^2 dr}{r} \\
 3. \quad & -\frac{e^2}{\pi\epsilon_0 a} \\
 4. \quad & \checkmark -\frac{e^2}{8\pi\epsilon_0 a} \quad = \frac{1}{6} \int_0^\infty \frac{-e^2}{8\pi a^3} r e^{-r/a} dr \\
 & \quad = \frac{-e^2}{8\pi\epsilon_0 a^3} \times a^2 \quad = \boxed{\frac{-e^2}{8\pi\epsilon_0 a}}
 \end{aligned}$$

general formula:-

$$\int_0^\infty x^n e^{-ax} dx = \frac{n!}{a^{n+1}}$$

$$\int_0^\infty x^n e^{-ax^2} dx = \frac{1}{2} a^{-(n+1)/2} \Gamma\left(\frac{n+1}{2}\right)$$

$$(n=0) \int_0^\infty c e^{-ax^2} dx = \frac{1}{2} \sqrt{\pi/a}$$

$$(n=1) \int_0^\infty x e^{-ax^2} dx = \frac{1}{2a}$$

$$(n=2) \int_0^\infty x^2 e^{-ax^2} dx = \frac{\sqrt{\pi}}{4a^{3/2}}$$

Question Number : 58 Question Id : 56295458 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

किसी हाइड्रोजन परमाणु के इलेक्ट्रॉन अभ का आवेश घनत्व $\rho(\vec{r}) = -\frac{e}{8\pi a^3} \exp(-r/a)$ से दिया जाता है, जहाँ a कोई अभिलक्षणिक दैर्घ्य है। प्रोटॉन (मूल बिन्दु पर स्थित) तथा इलेक्ट्रॉन अभ के मध्य की अन्योन्यक्रिया के कारण स्थितिज ऊर्जा निम्नवत दी जाती है।

1. $-\frac{e^2}{2\pi\epsilon_0 a}$

2. $-\frac{e^2}{4\pi\epsilon_0 a}$

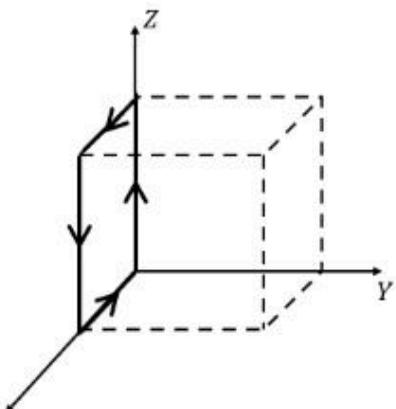
3. $-\frac{e^2}{\pi\epsilon_0 a}$

4. $-\frac{e^2}{8\pi\epsilon_0 a}$

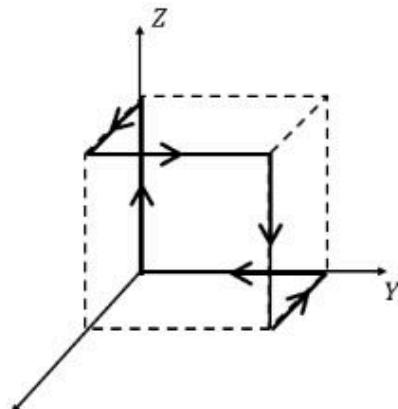
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Question Number : 59 Question Id : 56295459 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

Two identical cubes are shown in figures (a) and (b). The magnitude of the magnetic field at the centre of the cube in (a), produced by the currents as shown, is B_o . The magnitude of the magnetic field at the centre of the cube in (b) will be



(a)



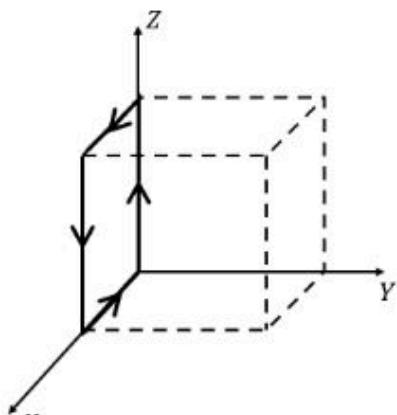
(b)

1. $\sqrt{3}B_o$
2. $2B_o$
3. $\frac{3}{2}B_o$
4. $\sqrt{2}B_o$

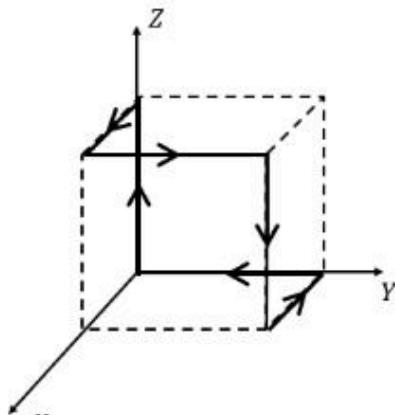
Question Number : 59 Question Id : 56295459 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

चित्र (a) तथा (b) में दो सर्वथासम घन दिखाए गए हैं। (a) में धाराओं द्वारा घन के केंद्र में उत्पन्न चुंबकीय क्षेत्र का परिमाण चित्रानुरूप B_o है। (b) में घन के केंद्र पर चुंबकीय क्षेत्र का परिमाण होगा



(a)

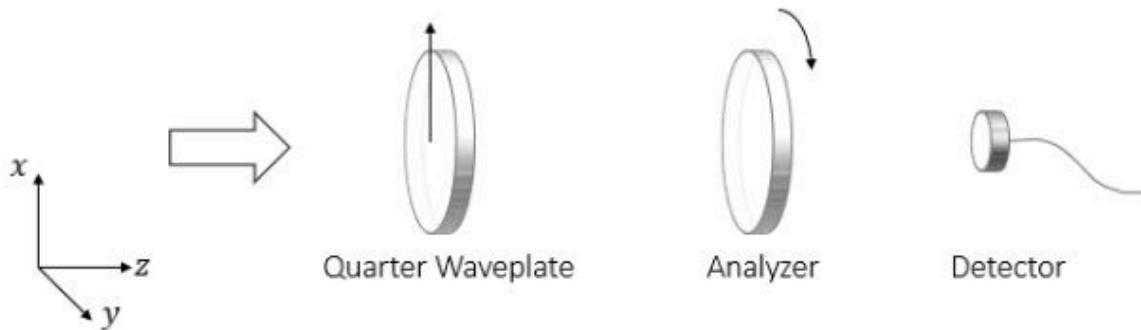


(b)

1. $\sqrt{3}B_o$
2. $2B_o$
3. $\frac{3}{2}B_o$
4. $\sqrt{2}B_o$

Question Number : 60 Question Id : 56295460 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

A beam of light along the z -axis passes through a quarter wave plate and an analyzer as shown in the figure. The fast axis of the quarter wave plate is aligned with the x -axis. The light intensity is measured by a detector placed after the analyzer.

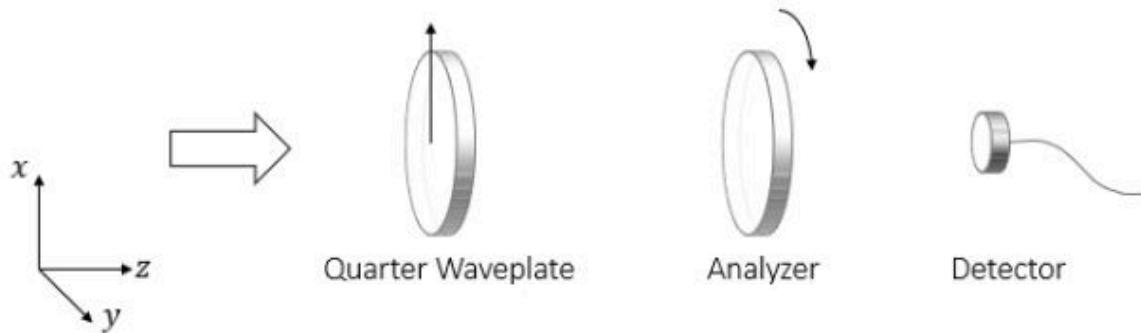


Consider two scenarios where the incident light beam is (a) circularly polarized and (b) linearly polarized along the x -axis. If the polarization axis of the analyzer is rotated by one full cycle about the z -axis, the number of times the detector measures the maximum intensity in each case would be

1. (a) 4 and (b) 0
2. (a) 2 and (b) 0
3. (a) 4 and (b) 4
4. (a) 2 and (b) 2

Question Number : 60 Question Id : 56295460 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

z -अक्ष की दिशा में कोई प्रकाश पुंज चतुर्थांश तरंग पट्टिका तथा विश्लेषक में से होकर जाता है। चतुर्थांश पट्टिका का क्षिप्र अक्ष x -अक्ष के साथ संरेखित है। प्रकाश तीव्रता को विश्लेषक के बाद रखे संसूचक से मापा जाता है।



दो परिवर्तनों पर विचार कीजिए जहाँ आपाती प्रकाश पुंज (a) वृत्त ध्रुवित है तथा (b) x -अक्ष के अनुदिश रैखिकतः ध्रुवित है। यदि विश्लेषक का ध्रुवण अक्ष z -अक्ष के इर्द-गिर्द एक पूरा चक्र घूर्णित कर दिया जाए, तो प्रत्येक परिवर्तन में जितनी संख्या में संसूचक अधिकतम तीव्रता मापन करेगा, वह है

1. (a) 4 तथा (b) 0
2. (a) 2 तथा (b) 0
3. (a) 4 तथा (b) 4
4. (a) 2 तथा (b) 2

Question Number : 61 Question Id : 56295461 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

Consider $2N$ Ising spins, s_i ($s_i = \pm 1$) in a one-dimensional lattice with periodic boundary conditions. The Hamiltonian is given by

$$H = -J \sum_{i=1}^{2N} s_i s_{i+1},$$

where J denotes the strength of the nearest-neighbour interactions with $J > 0$. Let F be the fully ferromagnetic state and let A be the lowest energy state with zero magnetization. The energy difference between these two states is

1. $\frac{3J}{2}$
2. $4J$
3. $\frac{J}{2}$
4. $2J$

Question Number : 61 Question Id : 56295461 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

किसी एक विमीय जालक में $2N$ आवर्ती परिसीमा प्रतिबंधित आइसिंग प्रचक्रणों s_i ($s_i = \pm 1$) पर विचार करें। हैमिल्टनी निम्नवत् दिया जाता है

$$H = -J \sum_{i=1}^{2N} s_i s_{i+1},$$

जहां J निकटतम-प्रतिवेश के साथ अन्योन्यक्रिया की प्रबलता दर्शाता है, जबकि $J > 0$ । मानें कि F पूर्णतः लोहचुंबकीय अवस्था है तथा A शून्य चुंबकन वाली निम्नतम् ऊर्जा अवस्था है। इन दो ऊर्जा-अवस्थाओं के बीच का ऊर्जा-अंतर है

1. $\frac{3J}{2}$
2. $4J$
3. $\frac{J}{2}$
4. $2J$

Question Number : 62 Question Id : 56295462 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

Two discrete time random walkers start from the point $x = 0$ at time $t = 0$ taking discrete steps of unit length along the x axis. The first walker is unbiased and the second walker is biased to move towards the right with probability p . The probability that they are at a distance of 2 units from each other at both time steps $t = 1$ and $t = 2$ is

1. $\frac{1}{4}$
2. $\frac{1}{2} - \frac{p}{2}$
3. $1 - \frac{3p}{4}$
4. $\frac{p}{2}$

Question Number : 62 Question Id : 56295462 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

दो विविक्त यादृच्छक पथिक $t = 0$ पर $x = 0$ से एकांक लंबाई वाले कदम लेते हुए x अक्ष के अनुदिश चलना प्रारंभ करते हैं। पहला पथिक अनभिनत है तथा दूसरा पथिक p प्रायिकता के साथ दाँयी ओर मुड़ने के लिए अभिनत है। वह प्रायिकता कि वे दोनों काल चरणों $t = 1$ तथा $t = 2$ पर एक दूसरे से 2 एकांक दूर हों, है

1. $\frac{1}{4}$
2. $\frac{1}{2} - \frac{p}{2}$
3. $1 - \frac{3p}{4}$
4. $\frac{p}{2}$

Question Number : 63 Question Id : 56295463 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

A rigid molecule can have two possible rotational states: $j = 0$ or $j = 1$. Its rotational energies are given by $\epsilon_j = \frac{\hbar^2}{2I} j(j + 1)$, where I is its moment of inertia. For an ensemble of such molecules in thermal equilibrium at temperature T , the ratio of the number of molecules in the $j = 1$ state (N_1), to those in $j = 0$ state (N_0), is $\frac{N_1}{N_0} = 0.003$. The temperature T (in units of $\frac{\hbar^2}{2Ik_B}$, where k_B is the Boltzmann constant) is closest to

1. 0.29
2. 0.21
3. 0.15
4. 0.34

Question Number : 63 Question Id : 56295463 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

किसी द्रव्य की दो घूर्णन अवस्थाएं संभव हैं: $j = 0$ या $j = 1$. इसकी घूर्णन ऊर्जायें $\epsilon_j = \frac{\hbar^2}{2I} j(j + 1)$ द्वारा दी जाती हैं जहां I इसका जड़त्व आघूर्ण है। तापमान T पर तापीय सम्भ्य में ऐसे अणुओं के समुदाय के लिए, $j = 1$ अवस्था (N_1), तथा $j = 0$ अवस्था (N_0), में अणुओं की संख्याओं का अनुपात $\frac{N_1}{N_0} = 0.003$ है। तापमान T निम्न के निकटतम है ($\frac{\hbar^2}{2Ik_B}$ की इकाइयों में, जहां k_B बोल्ट्समान स्थिरांक है)

1. 0.29
2. 0.21
3. 0.15
4. 0.34

Question Number : 64 Question Id : 56295464 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

A thermodynamic system (at temperature T and volume V), is described by its internal energy $U = AT^4V$ and pressure $p = \frac{1}{3}AT^4$, where A is a constant of appropriate dimension. The Helmholtz free energy of the system is

1. $\frac{4}{3}AT^4V$
2. $\frac{1}{3}AT^4V$
3. $-\frac{1}{3}AT^4V$
4. $-\frac{4}{3}AT^4V$

Question Number : 64 Question Id : 56295464 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

कोई ऊष्मागतिक निकाय (तापमान T तथा आयतन V पर) अपनी आंतरिक ऊर्जा $U = AT^4V$ द्वारा वर्णित है तथा दब $p = \frac{1}{3}AT^4$ है, जहां A समुचित विमा का स्थिरांक है।

निकाय की हेल्महोल्ट्स मुक्त ऊर्जा है

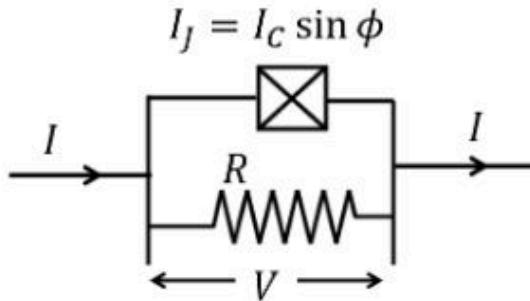
1. $\frac{4}{3}AT^4V$
2. $\frac{1}{3}AT^4V$
3. $-\frac{1}{3}AT^4V$
4. $-\frac{4}{3}AT^4V$

Question Number : 65 Question Id : 56295465 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

The current $I_J(t)$ through a Josephson junction (shown by the crossed box in the figure) and the voltage $V(t)$ across it, are given by

$$\begin{aligned} I_J(t) &= I_C \sin \phi(t) \\ \frac{d\phi(t)}{dt} &= \frac{2eV(t)}{\hbar} \end{aligned}$$

where I_C is the critical current of the junction and $\phi(t)$ is the phase difference across the junction. A resistor R is connected in parallel to the junction and a constant current $I > I_C$ flows through the combination as shown.



The energy dissipated in R in the time ϕ changes by 2π is

1. $\frac{\hbar}{2e} I$
2. $\frac{\hbar}{2e} I_C$
3. $\frac{\hbar}{2e} (I - I_C)$
4. $\frac{\hbar}{2e} (I + I_C)$

Question Number : 65 Question Id : 56295465 Question Type : MCQ Option Shuffling : No Display
 Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
 Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
 Correct Marks : 5 Wrong Marks : 1.25

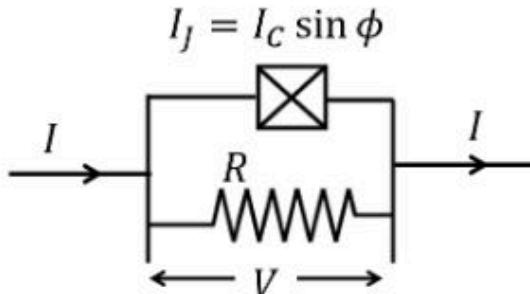
किसी जोसेफसन संधि में (जिसे चित्र में क्रॉसित बक्से द्वारा दिखाया गया है) धारा

$I_J(t)$ तथा इस पर लगाए गई वोल्टता $V(t)$ निम्न से दी जाती हैं

$$I_J(t) = I_C \sin \phi(t)$$

$$\frac{d\phi(t)}{dt} = \frac{2eV(t)}{\hbar}$$

जहां I_C जंक्शन की क्रांतिक धारा है तथा $\phi(t)$ जंक्शन पर आर-पार कलांतर है। प्रतिरोधक R संधि के समांतर में जुड़ा है तथा, जैसा प्रदर्शित है, स्थिर धारा $I > I_C$ इस संयोजन में से बहती है



जितनी देर में ϕ में 2π का परिवर्तन होता है, R में हुआ ऊर्जा-क्षय है

1. $\frac{\hbar}{2e} I$
2. $\frac{\hbar}{2e} I_C$
3. $\frac{\hbar}{2e} (I - I_C)$
4. $\frac{\hbar}{2e} (I + I_C)$

**Question Number : 66 Question Id : 56295466 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

A semiconductor has the dispersion relation $E = E_0 - A \cos(\alpha k_x)$, where A and α are positive constants. The effective electron mass close to the minimum energy is

1. $\frac{\hbar^2}{A^2\alpha}$

2. $\frac{1}{4} \frac{\hbar^2}{A^2\alpha}$

3. $\frac{\hbar^2}{A\alpha^2}$

4. $\frac{1}{2} \frac{\hbar^2}{A\alpha^2}$

**Question Number : 66 Question Id : 56295466 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

किसी अर्द्धचालक के लिए निम्न विक्षेपण संबंध है $E = E_0 - A \cos(\alpha k_x)$, जहाँ A तथा α धनात्मक स्थिरांक हैं। न्यूनतम ऊर्जा के निकट प्रभावी इलेक्ट्रॉन द्रव्यमान है

1. $\frac{\hbar^2}{A^2\alpha}$

2. $\frac{1}{4} \frac{\hbar^2}{A^2\alpha}$

3. $\frac{\hbar^2}{A\alpha^2}$

4. $\frac{1}{2} \frac{\hbar^2}{A\alpha^2}$

Question Number : 67 Question Id : 56295467 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

A gas of electrons (with no source of scattering) is placed in an electric field $\vec{E} = Ee^{i\omega t}(\hat{i} + \hat{k})$ and a magnetic field $\vec{B} = B\hat{k}$, where E and B are constants. The frequency at which the conductivity in the z -direction, given by the ratio of the current and the electric field, both in the z -direction, diverges is

1. 0
2. $\frac{eB}{m}$
3. $-\frac{eB}{m}$
4. $\frac{eB}{2m}$

Question Number : 67 Question Id : 56295467 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

कोई इलेक्ट्रॉन गैस (विना किसी प्रकीर्णन स्रोत के) किसी वैद्युत क्षेत्र $\vec{E} = Ee^{i\omega t}(\hat{i} + \hat{k})$ तथा चुंबकीय क्षेत्र $\vec{B} = B\hat{k}$ में रखा जाता है, जहाँ E तथा B अचर हैं। वह आवृति जिस पर z -दिशा में चालकता, जिसे z -दिशा में वैद्युत धारा और वैद्युत क्षेत्र का अनुपात माने, अपसरित होती है, निम्न है

1. 0
2. $\frac{eB}{m}$
3. $-\frac{eB}{m}$
4. $\frac{eB}{2m}$

Question Number : 68 Question Id : 56295468 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

The minimum number of two input NOR gates required to obtain the following output for three digital inputs A , B and C

$$Y = (\bar{A} + \bar{B} + \bar{C})(\bar{A} + B + \bar{C})(\bar{A} + \bar{B} + C)$$

would be

1. 4
2. 3
3. 5
4. 6

Question Number : 68 Question Id : 56295468 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No

Correct Marks : 5 Wrong Marks : 1.25

तीन अंकरूप निवेशों A , B तथा C के लिए निम्न निर्गत

$$Y = (\bar{A} + \bar{B} + \bar{C})(\bar{A} + B + \bar{C})(\bar{A} + \bar{B} + C)$$

पाने के लिए आवश्यक द्वि-निवेश NOR गेट की न्यूनतम संख्या है

1. 4
2. 3
3. 5
4. 6

**Question Number : 69 Question Id : 56295469 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

A highly collimated laser beam with a diameter of 1 cm and wavelength 500 nm is directed from the earth's surface towards the moon (~384,000 km away from the earth). Assuming ideal diffraction limited propagation in vacuum, which of the following best estimates the diameter of the beam upon returning to the earth after reflection from an ideal reflector installed on the moon.

1. 200 m
2. 20 m
3. 20 km
4. 200 km

**Question Number : 69 Question Id : 56295469 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

व्यास 1 cm तथा तरंगदैर्घ्य 500 nm वाला एक प्रबलतः समांतरित लेज़र किरण पुंज पृथ्वी की सतह से चन्द्रमा (पृथ्वी में ~384,000 km दूर) की ओर भेजा जाता है। निर्वात में अपवर्तन-सीमित आदर्श संचरण मानते हुए, चन्द्रमा पर रखे आदर्श परावर्तक से टकरा कर पृथ्वी पर लौटे किरण पुंज के व्यास के लिए सर्वश्रेष्ठ आकलन कौन सा है

1. 200 m
2. 20 m
3. 20 km
4. 200 km

Question Number : 70 Question Id : 56295470 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

Consider a laser cooling experiment where atoms are slowed down by an inelastic process of absorption and subsequent emission of photons. If light of wavelength 776.5 nm is used to slow down potassium atoms (mass number 39) with initial speed 130 ms^{-1} , the number of such absorption and emission cycles needed to bring the atoms to rest is closest to

1. 10^3
2. 10^2
3. 10^5
4. 10^4

Question Number : 70 Question Id : 56295470 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

लेसर प्रशीतन प्रयोग पर विचार करें जहां अप्रत्यास्थ प्रक्रिया द्वारा अवशोषण तथा उसके बाद फोटॉन उत्सर्जन से परमाणु धीमे हो जाते हैं। यदि 776.5 nm तरंगदैर्घ्य का प्रकाश आरंभिक वेग 130 ms^{-1} वाले पोटेशियम परमाणु (द्रव्यमान संख्या 39) को धीमा करने के लिए उपयोग में लाते हैं, परमाणुओं को विरामावस्था में लाने के लिए जितने अवशोषण तथा उत्सर्जन चक्रों की आवश्यकता होगी, वे हैं

1. 10^3
2. 10^2
3. 10^5
4. 10^4

Question Number : 71 Question Id : 56295471 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

An atom is subjected to a weak magnetic field $B = 0.1 \text{ T}$. A spectral line of wavelength 184.9 nm corresponding to a $J = 1$ to $J = 0$ transition splits into three components. The highest and the lowest components are separated by $3.2 \times 10^{-4} \text{ nm}$. The magnetic moment of the atom in $J = 1$ state (in units of Bohr magneton) is

1. 2.82
2. 0.71
3. 1.41
4. 4.23

Question Number : 71 Question Id : 56295471 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

किसी परमाणु पर दुर्बल चुंबकीय क्षेत्र $B = 0.1 \text{ T}$ लगाया जाता है। $J = 1$ से $J = 0$ संक्रमण के संगत 184.9 nm की वर्णक्रम रेखा तीन घटकों में टूट जाती है। उच्चतम् तथा न्यूनतम् घटकों में $3.2 \times 10^{-4} \text{ nm}$ का अंतर है। $J = 1$ अवस्था में परमाणु का चुंबकीय आधूर्ण (बोर मैग्नेटोन में व्यक्त)

1. 2.82
2. 0.71
3. 1.41
4. 4.23

**Question Number : 72 Question Id : 56295472 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

In a rotational-vibrational spectrum of HCl (H^{35}Cl), the first *R*-branch line and the first *P*-branch line are observed at $\lambda^{-1} = 2906 \text{ cm}^{-1}$ and $\lambda^{-1} = 2865 \text{ cm}^{-1}$, respectively. The equilibrium bond length of this molecule would be closest to

1. 0.2 Å
2. 1.3 Å
3. 13 Å
4. 2.1 Å

**Question Number : 72 Question Id : 56295472 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

HCl (H^{35}Cl) के घूर्णन-कंपन वर्णक्रम में प्रथम *R*-शाखा रेखा तथा प्रथम *P*-शाखा रेखा क्रमशः $\lambda^{-1} = 2906 \text{ cm}^{-1}$ तथा $\lambda^{-1} = 2865 \text{ cm}^{-1}$ पर प्रेक्षित की जाती हैं। अणु की साम्यावस्था आबंध लंबाई निम्न के निकटतम होगी

1. 0.2 Å
2. 1.3 Å
3. 13 Å
4. 2.1 Å

Question Number : 73 Question Id : 56295473 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

If the binding energies per nucleon of the nuclei $X(A = 240)$ and $Y(A = 120)$ are 7.6 MeV and 8.5 MeV respectively, the energy released in the symmetric fission, $X \rightarrow Y + Y$ is

1. 94 MeV
2. 9.4 MeV
3. 108 MeV
4. 216 MeV

Question Number : 73 Question Id : 56295473 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

यदि नाभिकों $X(A = 240)$ तथा $Y(A = 120)$ की बंधन ऊर्जा/न्यूक्लिओन क्रमशः 7.6 MeV तथा 8.5 MeV हैं, सममित विखंडन $X \rightarrow Y + Y$ में उत्सर्जित ऊर्जा है

1. 94 MeV
2. 9.4 MeV
3. 108 MeV
4. 216 MeV

**Question Number : 74 Question Id : 56295474 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

When a neutron of 1 keV kinetic energy impinges on a ^{12}C target, the total scattering cross section is 1000 barns. The approximate value of the phase shift δ_0 is

1. 18°
2. 108°
3. 90°
4. 36°

**Question Number : 74 Question Id : 56295474 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time :
N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval
to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25**

जब 1 keV गतिज ऊर्जा का न्यूट्रोन ^{12}C लक्ष्य पर बरसता है, कुल प्रकीर्णन अनुप्रस्थ
परिच्छेद 1000 बार्न है। कला विस्थापन δ_0 का लगभग मान है

1. 18°
2. 108°
3. 90°
4. 36°

Question Number : 75 Question Id : 56295475 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

The ρ -mesons are $J^P = 1^-$ particles that decay strongly into pions. The ratio of the particle decay widths $\frac{\Gamma(\rho^0 \rightarrow \pi^0 \pi^0)}{\Gamma(\rho^+ \rightarrow \pi^+ \pi^0)}$ is closest to

1. 1
2. $\frac{1}{2}$
3. 0
4. 2

Question Number : 75 Question Id : 56295475 Question Type : MCQ Option Shuffling : No Display
Question Number : Yes Is Question Mandatory : No Calculator : Yes Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Single Line Question Option : No Option Orientation : Vertical
Allowed Progression : Yes Number of Replay : 999 Play On Load : No Control Enable : Yes Time interval to replay(In Seconds) : 0 Allow Volume Control : No
Correct Marks : 5 Wrong Marks : 1.25

ρ -मेसॉन $J^P = 1^-$ कण हैं जो प्रबलतः पायँन में क्षयित हो जाते हैं। कण-क्षय विस्तार (particle decay widths) का अनुपात $\frac{\Gamma(\rho^0 \rightarrow \pi^0 \pi^0)}{\Gamma(\rho^+ \rightarrow \pi^+ \pi^0)}$ निम्न के निकटतम है

1. 1
2. $\frac{1}{2}$
3. 0
4. 2