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National Eligibility cum Entrance Test**

NEET - 2024

LATEST

5 Years

CHAPTERWISE SOLVED PAPERS

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Topic wise Trend Analysis of NEET/AIPMT Previous Question Papers

PHYSICS

| Topic | NEET 2019 | NEET 2019 Odisha | NEET 2020 | NEET 2020 Phase-II | NEET 2021 | NEET 2022 | Re NEET 2022 | NEET 2023 |
|---|-----------|------------------|-----------|--------------------|-----------|-----------|--------------|-----------|
| Oscillations (SHM, Damped and Forced Oscillations & Resonance) | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 1 |
| Circular Motion | 3 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| Capacitors | 0 | 1 | 1 | 1 | 2 | 1 | 2 | 1 |
| Basic Mathematics & Vectors. | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Alternating Current | 0 | 2 | 2 | 1 | 2 | 2 | 3 | 1 |
| Electromagnetic Induction | 2 | 1 | 0 | 2 | 2 | 2 | 1 | 1 |
| Collisions and Centre of Mass | 1 | 2 | 1 | 1 | 0 | 2 | 1 | 1 |
| Unit, Dimension & Measurements | 1 | 1 | 3 | 1 | 3 | 4 | 2 | 1 |
| Work, Energy & Power | 1 | 1 | 0 | 0 | 2 | 1 | 1 | 2 |
| EM Waves | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 |
| Ray Optics and Optical Instruments | 4 | 2 | 1 | 4 | 3 | 3 | 2 | 3 |
| Rotational Motion | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |
| Electrostatics | 3 | 2 | 3 | 3 | 4 | 3 | 2 | 2 |
| Gravitation | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 2 |
| Kinematics | 2 | 3 | 1 | 1 | 3 | 3 | 2 | 4 |
| Properties of matter and Fluid Mechanics | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 3 |
| Wave Optics (Nature of Light, Interference, Diffraction & Polarization) | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 2 |
| Laws of Motion and Friction | 1 | 2 | 1 | 1 | 1 | 0 | 3 | 3 |
| Current Electricity and Effect of Current | 3 | 2 | 5 | 4 | 4 | 4 | 4 | 3 |
| Semiconductor and Digital Electronics | 2 | 2 | 3 | 4 | 3 | 3 | 3 | 3 |
| Magnetic Effect of Current and Magnetism | 3 | 3 | 2 | 1 | 4 | 3 | 4 | 3 |
| Wave Motion and Doppler's Effect | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 |
| Modern Physics | 3 | 4 | 7 | 5 | 5 | 5 | 5 | 4 |
| Thermal Physics (Thermal Expansion, Calorimetry, Heat Transfer, KTG & Thermodynamics) | 4 | 4 | 5 | 5 | 2 | 3 | 3 | 5 |
| Total | 45 | 45 | 45 | 45 | 50 | 50 | 50 | 50 |

CHEMISTRY

| Topic | NEET 2019 | NEET 2019 Odisha | NEET 2020 | NEET 2020 Phase-II | NEET 2021 | NEET 2022 | Re NEET 2022 | NEET 2023 |
|--|-----------|------------------|-----------|--------------------|-----------|-----------|--------------|-----------|
| s/p/d/f Blocks | 7 | 10 | 8 | 9 | 6 | 8 | 8 | 6 |
| Chemical Bonding | 4 | 3 | 2 | 3 | 4 | 2 | 2 | 4 |
| Oxygen Containing Group (Alcohol, Ether, Phenol, Aldehyde/ Ketone, Benzaldehyde, Acid & It's Acid Derivatives, Benzoic Acid) | 2 | 3 | 4 | 2 | 5 | 5 | 7 | 5 |
| Hydrocarbon (Alkane, Alkene, Alkyne) & Halogen Derivatives | 3 | 3 | 3 | 4 | 3 | 2 | 4 | 2 |
| Complex Compound | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| Electrochemistry | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 |
| Thermodynamics | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 |
| Solution | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 |
| Reaction Mechanism | 2 | 1 | 1 | 1 | 0 | 2 | 1 | 2 |
| Chemical Kinetics | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Ionic Equilibrium, Acid-Base, pH/ Buffer/ Titration | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 |

| | | | | | | | | |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Atomic Structure/Nuclear Chemistry | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 |
| Biomolecules | 1 | 1 | 2 | 2 | 1 | 0 | 1 | 2 |
| Solid State | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 |
| Mole Concept | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 2 |
| Metallurgy | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 |
| Polymers | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Periodic Table | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 |
| Nitrogen Containing Groups (Amines, Anilene, Nitro, Cyanides) | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 2 |
| States of Matter (Gases & Liquids) | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| Surface Chemistry | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| Purification-Separation, Chemistry in everyday life | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 3 |
| Isomerism | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 |
| Chemical Evolution | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| Nomenclature (IUPAC) | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| Redox Reaction | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| Environmental Chemistry | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 1 |
| Hydrogen & It's Compounds | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| Total | 45 | 45 | 45 | 45 | 50 | 50 | 50 | 50 |

BIOLOGY

| Topic | NEET 2019 | NEET 2019 Odisha | NEET 2020 | NEET 2020 Phase-II | NEET 2021 | NEET 2022 | Re NEET 2022 | NEET 2023 |
|---|-----------|------------------|-----------|--------------------|------------|------------|--------------|------------|
| Principle of inheritance, Biotechnology, Molecular basis of inheritance, Biomolecules, Mutation Microbes (Genetics) | 21 | 22 | 20 | 20 | 28 | 25 | 22 | 21 |
| Ecology, Demography | 8 | 8 | 8 | 10 | 9 | 12 | 12 | 11 |
| Plant Physiology | 8 | 10 | 9 | 9 | 8 | 13 | 14 | 8 |
| Plant Diversity | 6 | 6 | 4 | 5 | 6 | 5 | 5 | 7 |
| Cell, Cell division | 7 | 5 | 6 | 7 | 9 | 7 | 6 | 8 |
| Animal Embryology and Reproductive System | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| Life History of Angiosperm (Reproduction in Plants) | 4 | 3 | 3 | 3 | 4 | 4 | 5 | 5 |
| Plant Morphology, Modification, Families | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 4 |
| Immunity, Disease, Biomedical Technique, Drug Addiction, Mental Health | 5 | 3 | 3 | 2 | 4 | 2 | 3 | 3 |
| Animal Diversity | 2 | 2 | 4 | 4 | 4 | 2 | 2 | 2 |
| Origin & Evolution | 4 | 3 | 4 | 4 | 2 | 2 | 2 | 2 |
| Plant Anatomy / Tissues | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 4 |
| Endocrine System | 2 | 3 | 3 | 2 | 1 | 2 | 4 | 1 |
| Strategies for enhancement in food production (Plant breeding + Animal breeding) | 1 | 2 | 1 | 1 | 3 | 1 | 3 | 4 |
| Digestive System, Vitamins, Nutritional Imbalance | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |
| Skeletal System & Muscles | 2 | 2 | 1 | 1 | 3 | 2 | 2 | 1 |
| Animal Respiratory System | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Animal Tissues | 1 | 1 | 4 | 1 | 1 | 3 | 3 | 2 |
| Circulatory System | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 |
| Excretory System | 2 | 2 | 2 | 2 | 0 | 1 | 1 | 2 |
| Earthworm and Cockroach\Frog | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| Nervous System | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| Receptors (Eye, Ear, Nose) | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 2 |
| Total | 90 | 90 | 90 | 90 | 100 | 100 | 100 | 100 |

PHYSICS

1. Units and Measurements

Units

1. The unit of thermal conductivity is :

ऊष्मा चालकता का मात्रक है :

- (a) $J m^{-1} K^{-1}$ (b) $W m K^{-1}$
 (c) $W m^{-1} K^{-1}$ (d) $J m K^{-1}$

NEET (UG)-05.05.2019

Ans. (c) : Thermal conductivity is the amount of heat that flows per unit time through a unit area with a temperature gradient of one Kelvin per unit length.

$$\frac{Q}{t} = kA \left(\frac{\Delta T}{\ell} \right)$$

Where k = thermal conductivity

$$k = \frac{Q \cdot \ell}{\Delta T \cdot A t} = \frac{\text{Joule.m}}{\text{K.m}^2 \cdot \text{s}}$$

$$k = W m^{-1} K^{-1}$$

Measurements

2. A screw gauge gives the following readings when used to measure the diameter of a wire- एक स्क्रूगेज जब एक तार के व्यास को मापने के लिए प्रयुक्त किया जाता है, तो निम्नलिखित पाठयांक देता है :

Main scale reading : 0 mm

मुख्य पैमाने का पाठयांक = 0 मिलीमीटर

Circular scale reading : 52 divisions

वृत्तीय पैमाने का पाठयांक = 52 खाने

Given that 1 mm on main scale corresponds to 100 divisions on the circular scale. The diameter of the wire from the above data is दिया गया है कि मुख्य पैमाना पर 1 मिलीमीटर, वृत्तीय पैमाना के 100 खानों के संगत होता है। उपर्युक्त दिए गये प्रेक्षणों से तार का व्यास है :

- (a) 0.052 cm (b) 0.52 cm
 (c) 0.026 cm (d) 0.26 cm

NEET (UG)-12.09.2021

Ans. (a) : Here, Pitch of screw gauge = P = 1mm

No. of circular divisions, n = 100

$$\text{Thus, least count (LC)} = P/n = \frac{1}{100} = 0.01 \text{ mm} \\ = 0.001 \text{ cm}$$

Diameter of wire = MSR + (CSR × LC)

Where, MSR = Main scale reading, CSR = Circular scale reading.

$$= 0 + (52 \times 0.001 \text{ cm}) = 0.052 \text{ cm}$$

3. The angle of 1' (minute of arc) in radian is nearly equal to 1 (चाप के कोण) के कोण का रेडियन्स में मान होता है लगभग

- (a) $1.75 \times 10^{-2} \text{ rad}$ (b) $2.91 \times 10^{-4} \text{ rad}$
 (c) $4.85 \times 10^{-4} \text{ rad}$ (d) $4.80 \times 10^{-6} \text{ rad}$

NEET (UG)-14.10.2020, Phase-II

Ans. (b) : 1 minute = $\left(\frac{1}{60} \right)^\circ = \frac{1}{60} \times \frac{\pi}{180} \text{ radian}$

$$1 \text{ min} = 2.91 \times 10^{-4} \text{ radian}$$

4. A screw gauge has least count of 0.01 mm and there are 50 divisions in its circular scale.

The pitch of the screw gauge is :

किसी स्क्रू गेज का अल्पतमांक 0.01 mm है तथा इसके वृत्तीय पैमाने पर 50 भाग हैं।

इस स्क्रू गेज का चूड़ी अन्तराल (पिच) है:

- (a) 0.25 mm (b) 0.5 mm
 (c) 1.0 mm (d) 0.01 mm

NEET (UG)-13.09.2020

Ans. (b) : Screw gauge: A gauge is an instrument that is used to find the diameter of the wire or thin sheet.

Given that : L.C of screw gauge = 0.01 mm
 no. of divisions of circular Scale = 50

$$\text{L.C.} = \frac{\text{Pitch}}{\text{No. of division on circular scale}}$$

$$0.01 \text{ mm} = \frac{\text{Pitch}}{50}$$

$$\text{Pitch} = 0.5 \text{ mm}$$

5. The main scale of a vernier callipers has n divisions/cm. n divisions of the vernier scale coincide with (n - 1) divisions of main scale. The least count of the vernier callipers is, किसी वर्नीयर कैलीपर्स के मुख्य पैमाने पर n भाग प्रति सेन्टीमीटर हैं। वर्नीयर पैमाने के n भाग मुख्य पैमाने के (n - 1) भागों के संपाती हैं। वर्नीयर कैलीपर्स का अल्पतमांक है—

- (a) $\frac{1}{n(n+1)} \text{ cm}$ (b) $\frac{1}{(n+1)(n-1)} \text{ cm}$
 (c) $\frac{1}{n} \text{ cm}$ (d) $\frac{1}{n^2} \text{ cm}$

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Ans. (d) : n main scale divisions (MSD) = 1 cm

$$1 \text{ MSD} = \frac{1}{n} \text{ cm}$$

n vernier scale division VSD = (n - 1) MSD

$$1 \text{ VSD} = \left(\frac{n-1}{n} \right) \text{ MSD}$$

$$1 \text{ VSD} = \left(\frac{n-1}{n} \right) \times \frac{1}{n} \text{ cm}$$

$$1 \text{ VSD} = \frac{n-1}{n^2} \text{ cm}$$

Least Count (L.C.) = 1MSD - 1VSD

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

$$\text{L.C.} = \frac{1}{n^2} \text{ cm}$$

Accuracy, Precision of Instruments and Errors in Measurement

6. A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be:
 एक धात्विक तार का द्रव्यमान (0.4 ± 0.002) g, त्रिज्या (0.3 ± 0.001) mm तथा लंबाई (5 ± 0.02) cm है। घनत्व के मापन में अधिकतम संभव त्रुटि लगभग होगी :
 (a) 1.4% (b) 1.2% (c) 1.3% (d) 1.6%

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Ans. (d) : Given that : $m = (0.4 \pm 0.002)$ g
 $r = (0.3 \pm 0.001)$ mm
 $l = (5 \pm 0.02)$ cm

The volume of the wire is given by –

$$V = \pi r^2 L$$

The density of the wire is –

$$\rho = \frac{m}{\pi r^2 L}$$

$$\begin{aligned} \frac{\Delta \rho}{\rho} \times 100 &= \frac{\Delta m}{m} \times 100 + 2 \frac{\Delta r}{r} \times 100 + \frac{\Delta L}{L} \times 100 \\ &= \frac{0.002}{0.4} \times 100 + 2 \times \frac{0.001}{0.3} \times 100 + \frac{0.02}{5} \times 100 \\ &= \frac{2}{4} + \frac{2}{3} + \frac{2}{5} = \frac{30 + 40 + 24}{60} = \frac{94}{60} \end{aligned}$$

$$\frac{\Delta \rho}{\rho} \times 100 = 1.56\% = 1.6\%$$

7. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are :/ताप तथा वोल्टेज स्रोत में अप्रत्याशी उतार चढ़ाव के कारण मापन में त्रुटियाँ हैं :
 (a) Random errors/यादृच्छिक त्रुटियाँ
 (b) Instrumental errors/यंत्रगत त्रुटियाँ
 (c) Personal errors/व्यक्तिगत त्रुटियाँ
 (d) Least count errors/अल्पतमांक त्रुटियाँ

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Ans. (a) : The error in the measurement which arise due to unpredictable fluctuations in the temperature and voltage supply are random error.

8. The percentage error in the measurement of g is: (Given that $g = \frac{4\pi^2 L}{T^2}$, $L = (10 \pm 0.1)$ cm, $T = (100 \pm 1)$ s)
 g के मापन में हुई प्रतिशत त्रुटि है:
 (दिया है $g = \frac{4\pi^2 L}{T^2}$, $L = (10 \pm 0.1)$ cm, $T = (100 \pm 1)$ s)
 (a) 2% (b) 5%
 (c) 3% (d) 7%

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Ans. (c) : The percentage error in the measurement of g is–

$$g = \frac{4\pi^2 L}{T^2}$$

Since errors are always added then,

$$\begin{aligned} \frac{\Delta g}{g} \times 100 &= \frac{\Delta L}{L} \times 100 + 2 \frac{\Delta T}{T} \times 100 \\ &= \left(\frac{0.1}{10} \times 100 \right) + 2 \left[\frac{1}{100} \times 100 \right] \\ \frac{\Delta g}{g} \times 100 &= 1 + 2 = 3\% \end{aligned}$$

9. Time intervals measured by a clock give the following readings :/किसी घड़ी द्वारा मापे गए समय अंतरालों के पाठयांक नीचे दिये गए हैं।
 1.25 s, 1.24 s, 1.27 s, 1.21 s and 1.28 s
 What is the percentage relative error of the observations?
 इन प्रेक्षणों की आपेक्षिक प्रतिशत त्रुटि क्या है?
 (a) 1.6% (b) 2% (c) 4% (d) 16%

NEET (UG)-14.10.2020, Phase-II

Ans. (a): Arithmetic mean of given value is taken as true value.

$$t_{\text{mean}} = \frac{t_1 + t_2 + t_3 + t_4 + t_5}{5}$$

$$t_{\text{mean}} = \frac{1.25 + 1.24 + 1.27 + 1.21 + 1.28}{5}$$

$$t_{\text{mean}} = 1.25 \text{ sec}$$

$$\Delta t_{\text{mean}} = \frac{|\Delta t_1| + |\Delta t_2| + |\Delta t_3| + |\Delta t_4| + |\Delta t_5|}{5}$$

$$= \frac{|1.25 - 1.25| + |1.24 - 1.25| + |1.27 - 1.25| + |1.21 - 1.25| + |1.28 - 1.25|}{5}$$

$$= \frac{0 + 0.01 + 0.02 + 0.04 + 0.03}{5} = \frac{0.1}{5}$$

$$\% \text{ error} = \frac{\Delta t_{\text{mean}}}{t_{\text{mean}}} = \frac{0.1 \times 100}{5 \times 1.25}$$

$$\% \text{ error} = 1.6\%$$

10. In an experiment, the percentage of error occurred in the measurement of physical quantities A, B, C and D are 1%, 2%, 3% and 4% respectively. Then the maximum percentage of error in the measurement X,

$$\text{where } X = \frac{A^2 B^{1/2}}{C^{1/3} D^3}, \text{ will be}$$

किसी प्रयोग में भौतिक राशियों A, B, C और D की माप में होने वाली त्रुटि की प्रतिशतता क्रमशः 1%, 2%, 3% और 4% है। तब X की माप, जबकि $X =$

$$\frac{A^2 B^{1/2}}{C^{1/3} D^3}, \text{ है, में अधिकतम प्रतिशत त्रुटि होगी-}$$

- (a) 16% (b) -10%
 (c) 10% (d) $\left(\frac{3}{13}\right)\%$

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Ans. (a) Given $X = \frac{A^2 B^{1/2}}{C^{1/3} D^3}$

The percentage error in X is given by

$$\frac{\Delta X}{X} \times 100 = 2 \left(\frac{\Delta A}{A} \right) \times 100 + \frac{1}{2} \left(\frac{\Delta B}{B} \right) \times 100 + \frac{1}{3} \left(\frac{\Delta C}{C} \right) \times 100 + 3 \left(\frac{\Delta D}{D} \right) \times 100 \quad \dots(i)$$

Here, $\frac{\Delta A}{A} \times 100 = 1\%$ $\frac{\Delta B}{B} \times 100 = 2\%$
 $\frac{\Delta C}{C} \times 100 = 3\%$ $\frac{\Delta D}{D} \times 100 = 4\%$

Substituting these values in equation (i) we get

$$\frac{\Delta X}{X} \times 100 = 2(1\%) + \frac{1}{2}(2\%) + \frac{1}{3}(3\%) + 3(4\%)$$

$$= 2\% + 1\% + 1\% + 12\% = 16\%$$

Significant Figures

11. The diameter of a spherical bob, when measured with vernier calipers yielded the following values : 3.33 cm, 3.32 cm, 3.34cm, 3.33cm, and 3.32 cm.

The mean diameter to appropriate significant figures is:

एक गोलाकार बॉब का व्यास, जब वर्नियर कैलीपर्स से मापा जाता है, तो निम्नलिखित मान प्राप्त होते हैं: 3.33 सेमी, 3.32 सेमी, 3.34 सेमी, 3.33 सेमी और 3.32 सेमी।

उपयुक्त सार्थक अंकों में औसत व्यास है:

- (a) 3.33cm/3.33 सेमी (b) 3.32cm/3.32 सेमी
 (c) 3.328/3.328 सेमी (d) 3.3cm/3.3 सेमी

RE NEET Manipur (UG)- 06.06.2023

Ans. (a) :

$$\text{Mean diameter} = \frac{3.33 + 3.32 + 3.34 + 3.33 + 3.32}{5}$$

$$= 3.328 \text{ cm}$$

Mean diameter = 3.33 cm

(by taking appropriate significant figure)

12. The area of a rectangular field (in m²) of length 55.3 m and breadth 25 m after rounding off the value for correct significant digits is

55.3 m लम्बाई एवं 25 m चौड़ाई वाले आयताकार क्षेत्र के क्षेत्रफल (m² में) का मान, निकटतम पूर्णांक बनाने के बाद सही सार्थक अंक के लिए है:

- (a) 14 × 10² (b) 138 × 10¹ (c) 1382 (d) 1382.5

NEET (UG)-17.07.2022

Ans. (a) : Given, Length = 55.3 m, Breadth = 25 m
 We know that
 Area = Length × Breadth
 = 55.3 × 25 = 1382.5 = 14 × 10²
 Resultant should have 2 significant figure.

13. Taking into account of the significant figures, what is the value of 9.99 m – 0.0099 m?

सार्थक अंकों को महत्त्व देते हुए 9.99 m – 0.0099 m का मान क्या है?

- (a) 9.98 m (b) 9.980 m
 (c) 9.9 m (d) 9.9801 m

NEET (UG)-13.09.2020

Ans. (a) : Let X = 9.99 m - 0.0099m = 9.9801 m
 But our answer, should have same no. of significant figure as least accurate number.
 So, X = 9.98m

Dimensional Analysis and its Applications

14. The mechanical quantity, which has dimensions of reciprocal of mass (M⁻¹) is/वह यांत्रिक राशि, जिसकी विमाएं द्रव्यमान के व्युत्क्रम (M⁻¹) होती है-

- (a) Torque/ बल आघूर्ण
 (b) Gravitational constant/गुरुत्वाकर्षण स्थिरांक
 (c) Angular momentum/कोणीय गति
 (d) Coefficient of thermal conductivity
 ऊष्मीय चालकता का गुणांक

RE NEET Manipur (UG)- 06.06.2023

Ans. (b) : Dimension of torque = [M¹L²T⁻²]
 dimension of Gravitational constant = [M⁻¹L³T⁻²]
 dimension of angular momentum = [ML²T⁻¹]
 dimension of coefficient of thermal conductivity = [MLT⁻³θ⁻¹]
 From above it is clear that the gravitational constant is mechanical quantity which has dimensions of reciprocal of mass (M⁻¹).

15. Match List-I with List-II

सूची-I का सूची-II के साथ मिलान करें:

| | List-I/सूची-I | | List-II/सूची-II |
|-----|--|-------|---|
| (A) | Gravitational constant (G) गुरुत्वीय स्थिरांक (G) | (i) | [L ² T ⁻²] |
| (B) | Gravitational potential energy/गुरुत्वीय स्थितिज ऊर्जा | (ii) | [M ⁻¹ L ³ T ⁻²] |
| (C) | Gravitational potential गुरुत्वीय विभव | (iii) | [LT ⁻²] |
| (D) | Gravitational intensity गुरुत्वीय तीव्रता | (iv) | [ML ² T ⁻²] |

Choose the correct answer from the options given below/नीचे दिए गए विकल्पों में से सही उत्तर चुनें:

- (a) (A) - (iv), (B) - (ii), (C) - (i), (D) - (iii)
 (b) (A) - (ii), (B) - (i), (C) - (iv), (D) - (iii)
 (c) (A) - (ii), (B) - (iv), (C) - (i), (D) - (iii)
 (d) (A) - (ii), (B) - (iv), (C) - (iii), (D) - (i)

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Ans. (c) : Option (a) Gravitational constant (G),

$$F = \frac{Gm_1m_2}{r^2}$$

$$G = \frac{Fr^2}{m_1m_2} = \frac{[MLT^{-2}][L^2]}{[M^2]}$$

$$G = [M^{-1}L^3T^{-2}]$$

Option (b) Gravitational potential energy,

$$U = \frac{1}{2}mgh = [M^1L^2T^{-2}]$$

Option (c) Gravitational potential,

$$= \frac{\text{Work}}{\text{Mass}} = \frac{[ML^2T^{-2}]}{[M]} = [L^2T^{-2}]$$

Option (d) Gravitational intensity, $I = \frac{\text{Force}}{\text{mass}} = [LT^{-2}]$

16. The physical quantity that has the same dimensional formula as pressure is: भौतिक राशि जिसका, दाब के समान ही विमीय सूत्र है, वह है;

- (a) Force/बल (b) Momentum/संवेग
(c) Young's modulus of elasticity
प्रत्यास्थता का यंग गुणांक
(d) Coefficient of viscosity/श्यानता गुणांक

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Ans. (c): Pressure = $\frac{\text{Force}}{\text{Area}} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$

Young' modulus (Y) = $\frac{\text{Stress}}{\text{Strain}}$

$$Y = \frac{\frac{F}{A}}{\frac{\Delta L}{L}} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$$

Hence, the young's modulus of elasticity has the same dimensional formula as pressure.

17. Plane angle and solid angle have समतलीय कोण एवं घन कोण में होता है:

- (a) Both units and dimensions/मात्रक एवं विमा दोनों
(b) Units but no dimensions/मात्रक पर कोई विमा नहीं
(c) Dimensions but no units
विमा लेकिन कोई मात्रक नहीं
(d) No units and no dimensions
ना कोई मात्रक ना कोई विमा

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Ans. (b) : Plane angle = $\frac{\text{arc}}{\text{radius}}$, has radian as unit but

No - dimensions. Solid angle = $\frac{\text{area}}{r^2}$, has steradian as unit but No - dimensions.

18. The dimensions $[MLT^{-2}A^{-2}]$ belong to the विमाएं $[MLT^{-2}A^{-2}]$ सम्बन्धित हैं:

- (a) Electric permittivity/वैद्युत विद्युतशीलता
(b) Magnetic flux/चुम्बकीय फ्लक्स
(c) Self inductance/स्व-प्रेरकत्व
(d) Magnetic permeability/चुम्बकीय पारगम्यता

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Ans. (d) : Solve by option

(a) dimension of electric permittivity is $M^{-1}L^{-3}T^4I^2$
option (b) Magnetic flux

$$\phi = B.A = \frac{F}{il} A = \frac{[MLT^{-2}][L^2]}{[IL]} = [ML^2T^{-2}I^{-1}]$$

option (c) self inductance

$$L = \frac{Q}{I} = [ML^2T^{-2}I^{-2}]$$

option (d) Magnetic permeability

$$L = \frac{\mu_0 N^2 A}{\ell}$$

$$\mu_0 = \frac{L\ell}{N^2 A} \Rightarrow \mu_0 = \frac{[ML^2T^{-2}I^{-2}][L]}{L^2}$$

$$\mu_0 = [MLT^{-2}I^{-2}] \text{ or } [MLT^{-2}A^{-2}]$$

So option (d) is the correct answer.

19. If E and G respectively denote Energy and Gravitational constant, then $\frac{E}{G}$ has the

dimension of-यदि E तथा G क्रमशः ऊर्जा तथा गुरुत्वाकर्षण नियतांक को प्रदर्शित करते हैं, तो $\frac{E}{G}$ की विमा होती है :

- (a) $[M^2][L^{-2}][T^{-1}]$ (b) $[M^2][L^{-1}][T^0]$
(c) $[M][L^{-1}][T^{-1}]$ (d) $[M][L^0][T^0]$

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Ans. (b) : $[E] = ML^2T^{-2}$

$$[G] = \frac{F \times r^2}{m_1 m_2} = \frac{[MLT^{-2}L^2]}{M^2} = M^{-1}L^3T^{-2}$$

$$\therefore \left[\frac{E}{G} \right] = \frac{ML^2T^{-2}}{M^{-1}L^3T^{-2}} = [M^2L^{-1}T^0]$$

20. If Force [F], Acceleration [A] and Time [T] are chosen as the fundamental physical quantities. Find the dimensions of energy. यदि बल [F], त्वरण [A] तथा समय [T] को मुख्य भौतिक राशियाँ मान लिया जाए, तो ऊर्जा की विमा ज्ञात कीजिए।

- (a) $[F][A^{-1}][T]$ (b) $[F][A][T]$
(c) $[F][A][T^2]$ (d) $[F][A][T^{-1}]$

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Ans. (c) : Energy = $F^\alpha A^\beta T^\gamma$

$$M^1L^2T^{-2} = (MLT^{-2})^\alpha (LT^{-2})^\beta (T)^\gamma$$

$$M^1L^2T^{-2} = M^\alpha L^{\alpha+\beta} T^{-2\alpha-2\beta+\gamma}$$

Equating the power constants of M, L and T on LHS & RHS

$$\alpha = 1$$

$$\alpha + \beta = 2 \Rightarrow \beta = 1$$

$$-2\alpha - 2\beta + \gamma = -2 \Rightarrow \gamma = 2$$

$$\therefore \text{Energy} = F^1 A^1 T^2$$

21. Dimensions of stress are : प्रतिबल की विमाएँ हैं:

- (a) $[ML^2T^{-2}]$ (b) $[ML^0T^{-2}]$
(c) $[ML^{-1}T^{-2}]$ (d) $[MLT^{-2}]$

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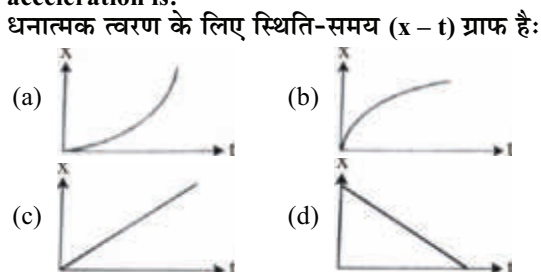
Ans. (c) : Stress = $\frac{\text{Force}}{\text{Area}} = \frac{[MLT^{-2}]}{[L^2]}$

$$\text{Stress} = [ML^{-1}T^{-2}]$$

2. Motion in Straight Line

Position, Path Length and Displacement

22. The position-time ($x - t$) graph for positive acceleration is:



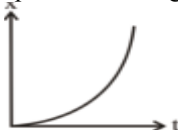
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Ans. (a) : For +ve acceleration,

$$\frac{dv}{dt} > 0. \text{ So, velocity is increasing}$$

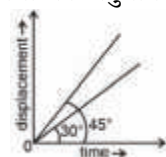
Acceleration is given by second derivative of displacement hence the variation of acceleration on $x-t$ graph will be parabolic.

Also, slope of $x-t$ graph is increasing.



23. The displacement-time graphs of two moving particles make angles of 30° and 45° with the x -axis as shown in the figure. The ratio of their respective velocity is

दो गतिमान कणों का विस्थापन-समय अभिरेख चित्र में प्रदर्शित x -अक्ष से 30° एवं 45° का कोण बनाता है। उनके क्रमशः वेगों का अनुपात होगा:

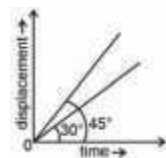


(a) $1:\sqrt{3}$
(c) $1:1$

(b) $\sqrt{3}:1$
(d) $1:2$

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Ans. (a) :



Let displacement be s and time be t and y -intercept is zero

$$\therefore s = ut + 0$$

$s = ut$, where u is velocity as per law of motion

Also u is slope of the graph s vs t

$$\therefore u = \tan\theta$$

$$u_1 = \tan 30^\circ \Rightarrow u_1 = \frac{1}{\sqrt{3}}$$

$$u_2 = \tan 45^\circ \Rightarrow u_2 = 1$$

$$\therefore u_1 : u_2 = \frac{1}{\sqrt{3}} : 1$$

$$u_1 : u_2 = 1 : \sqrt{3}$$

Average Velocity and Average Speed

24. A vehicle travels half the distance with speed θ and the remaining distance with speed 2θ . Its average speed is :

एक वाहन आधी दूरी चाल θ से तथा शेष दूरी चाल 2θ से गति करता है। इसकी औसत चाल है :

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

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Ans. (d) : Average speed = $\frac{\text{total distance travelled}}{\text{total time taken}}$

$$= \frac{L}{\frac{L}{\theta} + \frac{L}{2\theta}} = \frac{1}{\frac{1}{2\theta} + \frac{1}{4\theta}} = \frac{4}{3}\theta$$

$$\text{Average speed} = \frac{4}{3}\theta$$

25. A person travelling in a straight line moves with a constant velocity v_1 for certain distance 'x' and with a constant velocity v_2 for next equal distance. The average velocity v is given by the relation/कोई व्यक्ति किसी सरल रेखा में गमन करते समय कोई निश्चित दूरी x नियत वेग v_1 से तय करता है तथा नियत वेग v_2 से इतनी ही दूरी तय करता है। औसत वेग v के लिए संबंध है-

(a) $v = \sqrt{v_1 v_2}$ (b) $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

(c) $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$ (d) $\frac{v}{2} = \frac{v_1 + v_2}{2}$

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Ans. (c) : Total distance travelled = $2x$
Distance travelled during each phase = x

$$\text{Time taken during first phase} = \frac{x}{v_1}$$

$$\text{Time taken during second phase} = \frac{x}{v_2}$$

Total time taken

$$t = \frac{x}{v_1} + \frac{x}{v_2} = x \left(\frac{1}{v_1} + \frac{1}{v_2} \right)$$

Average velocity = $\frac{\text{Total distance}}{\text{Total time taken}}$

$$v = \frac{2x}{x \left(\frac{1}{v_1} + \frac{1}{v_2} \right)} \Rightarrow v = \frac{2}{\left(\frac{1}{v_1} + \frac{1}{v_2} \right)}$$

$$\frac{1}{v_1} + \frac{1}{v_2} = \frac{2}{v}$$

Instantaneous Velocity and Instantaneous Speed

26. The position of a particle is given by कण की स्थिति दी जाती है

$$\vec{r}(t) = 4t\hat{i} + 2t^2\hat{j} + 5\hat{k}$$

Where t is in seconds and r in meter. Find the magnitude and direction of velocity $v(t)$, at $t = 1s$, with respect to x -axis.

जहाँ t सेकंड में और r मीटर में है। x -अक्ष के संबंध में $t = 1s$ पर वेग $v(t)$ का परिणाम और दिशा ज्ञात कीजिए।

- (a) $3\sqrt{2}ms^{-1}, 30^\circ$ (b) $3\sqrt{2}ms^{-1}, 45^\circ$
 (c) $4\sqrt{2}ms^{-1}, 45^\circ$ (d) $4\sqrt{2}ms^{-1}, 60^\circ$

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Ans. (c) : Given: $\vec{r}(t) = (4t\hat{i} + 2t^2\hat{j} + 5\hat{k})$

$$\frac{d\vec{r}}{dt} = 4\hat{i} + 4t\hat{j}$$

$$\vec{V} = \left. \frac{d\vec{r}}{dt} \right|_{t=1} = 4\hat{i} + 4\hat{j}$$

$$|\vec{V}| = \sqrt{4^2 + 4^2} = \sqrt{32}$$

$$|\vec{V}| = 4\sqrt{2} \text{ m/sec}$$

$$\tan\phi = \frac{V_y}{V_x} = \frac{4}{4} = 1$$

$$\phi = 45^\circ$$

Kinematic Equation for Motion

27. A bullet from a gun is fired on a rectangular wooden block with velocity u . When bullet travels 24 cm through the block along its length

horizontally, velocity of bullet becomes $\frac{u}{3}$.

Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is :

बन्दूक की एक गोली लकड़ी के एक आयताकार गुटके पर u वेग से दागी जाती है। जब गोली गुटके में क्षैतिज

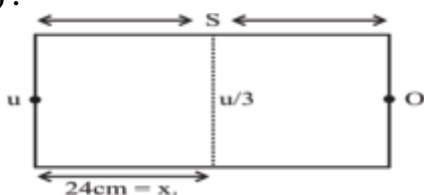
दिशा में 24 cm घुस जाती है, गोली का वेग $\frac{u}{3}$ हो

जाता है। तब यह पुनः रुकने से पूर्व तक उसी दिशा में लक्ष्य को ठीक दूसरी सतह तक भेदती है। गुटके की कुल लम्बाई है :

- (a) 30 cm (b) 27 cm
 (c) 24 cm (d) 28 cm

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Ans. (b) :



By using eqⁿ of motion –

$$v^2 = u^2 + 2as$$

$$\left(\frac{u}{3}\right)^2 = u^2 - 2a \times 24$$

$$24 \times 2a = \frac{8u^2}{9} \quad \dots(i)$$

Now, again using eqⁿ of motion –

$$v^2 = u^2 + 2as \Rightarrow 0 = u^2 - 2as$$

$$u^2 = 2as \quad \dots(ii)$$

On dividing eqⁿ (i) by eqⁿ (ii) we get

$$\frac{24 \times 2a}{2as} = \frac{8u^2}{9} \times \frac{1}{u^2} \Rightarrow \frac{24}{s} = \frac{8}{9}$$

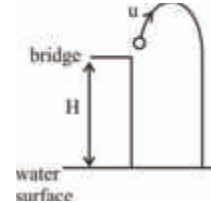
$$s = 27 \text{ cm}$$

28. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity 4 m s^{-1} . The ball strikes the water surface after 4s. The height of bridge above water surface is (Take $g = 10 \text{ m s}^{-2}$) : एक नदी पर एक क्षैतिज पुल बनाया गया है। पुल पर खड़ा एक छात्र 4 m s^{-1} के वेग से एक छोटी गेंद ऊर्ध्वाधर ऊपर की ओर फेंकता है। 4 s बाद गेंद पानी की सतह से टकराती है। पानी की सतह से ऊपर पुल की ऊँचाई है। ($g = 10 \text{ m s}^{-2}$ लीजिए) :

- (a) 68 m (b) 56 m
 (c) 60 m (d) 64 m

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Ans. (d) :



By equation of motion –

$$S = ut - \frac{1}{2}gt^2$$

$$-H = 4 \times 4 - \frac{1}{2} \times 10 \times (4)^2$$

$$-H = 16 - 80 \Rightarrow -H = -64$$

$$H = 64 \text{ m}$$

29. The ratio of the distances travelled by a freely falling body in the 1st, 2nd, 3rd and 4th second स्वच्छंद रूप से गिरते हुए किसी पिण्ड द्वारा पहले, दूसरे, तीसरे एवं चौथे सेकेण्ड में तय की गई दूरियों का अनुपात होगा:

- (a) 1 : 1 : 1 : 1 (b) 1 : 2 : 3 : 4
 (c) 1 : 4 : 9 : 16 (d) 1 : 3 : 5 : 7

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Ans. (d) : We know that the equation of motion for the n^{th} second.

$$S_n^{\text{th}} = u + \frac{a}{2}(2n - 1)$$

∴ Body is freely falling so, $u = 0$ and $a = g = \text{constant}$

$$= 0 + \frac{a}{2}(2n-1)$$

$$S_n^{\text{th}} \propto (2n-1)$$

$$= S_{1\text{sd}} : S_{2\text{sd}} : S_{3\text{sd}} : S_{4\text{sd}}$$

$$= [2(1)-1] : [2(2)-1] : [2(3)-1] : [2(4)-1]$$

$$= 1 : 3 : 5 : 7$$

30. A car starts from rest and accelerates at 5 m/s^2 . At $t = 4 \text{ s}$, a ball is dropped out of a window by a person sitting in the car. What is the velocity and acceleration of the ball at $t = 6 \text{ s}$?
 एक कार विरामावस्था से प्रारम्भ करती है तथा 5 मी./से.^2 से त्वरित होती है। $t = 4$ सेकण्ड पर कार में बैठे व्यक्ति द्वारा एक गेंद खिड़की के बाहर गिरायी जाती है। $t = 6$ सेकण्ड पर गेंद का वेग तथा त्वरण क्या होता है? (दिया है : $g = 10 \text{ मी./से.}^2$)

- (a) $20\sqrt{2} \text{ m/s}$, 10 m/s^2 (b) 20 m/s , 5 m/s^2
 (c) 20 m/s , 0 (d) $20\sqrt{2} \text{ m/s}$, 0

NEET (UG)-12.09.2021

Ans. (a) : Motion of car in horizontal direction Velocity of car at $t = 4 \text{ sec}$ -

$$v_x = u_x + at \quad (\because a = 0)$$

$$v_x = at = 4 \times 5 = 20 \text{ m/s}$$

So, horizontal velocity of car = 20 m/s

According to question-

At $t = 4 \text{ sec}$, a ball is dropped out of window of car.

\therefore After 2sec, Horizontal velocity of ball = 20 m/sec

Vertical velocity of ball at $t = 6 \text{ sec}$ i.e after 2 sec of free fall

$$v_y = u_y + gt$$

$$v_y = 20 \text{ m/s} \quad (\because u_y = 0, g = 10)$$

So, Net velocity of ball = $\sqrt{20^2 + 20^2} = 20\sqrt{2} \text{ m/s}$

& once it starts falling, acceleration is only 'g' i.e. 10 m/s^2 .

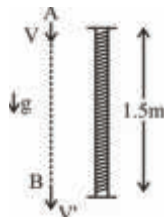
31. A person sitting in the ground floor of a building notices through the window of height 1.5 m , a ball dropped from the roof of the building crosses the window in 0.1 s . What is the velocity of the ball when it is at the topmost point of the window? ($g = 10 \text{ m/s}^2$)

किसी भवन के भूतल पर बैठा कोई व्यक्ति 1.5 m ऊँचाई की किसी खिड़की से ये नोट करता है कि भवन की छत से गिरायी गयी कोई गेंद उस खिड़की को 0.1 s में पार करती है। जब यह गेंद इस खिड़की के शीर्ष बिन्दु पर थी, तब इसका वेग क्या था? ($g = 10 \text{ m/s}^2$)

- (a) 20 m/s (b) 15.5 m/s
 (c) 14.5 m/s (d) 4.5 m/s

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Ans. (c) :



Given, For journey from A to B. {upward direction is taken as +ve }

Distance ball has to travel, $s = h = -1.5 \text{ m}$

$$\text{Acceleration (a)} = -g = -10 \frac{\text{m}}{\text{s}^2}$$

Initial velocity of Ball = $-V$

- sign represents downward direction

Time taken by ball to cross window = $t = 0.1 \text{ sec}$.

From equation of motion, $s = ut + \frac{1}{2}at^2$

$$-1.5 = (-V)(0.1) + \frac{1}{2}(-10)(0.1)^2$$

$$\boxed{V = 14.5 \text{ m/s.}}$$

32. A ball is thrown vertically downward with a velocity of 20 m/s from the top of a tower. It hits the ground after some time with a velocity of 80 m/s . The height of the tower is : ($g = 10 \text{ m/s}^2$)/किसी मीनार के शिखर से किसी गेंद को 20 m/s के वेग से उर्ध्वाधर अधोमुखी फेंका गया है। कुछ समय पश्चात यह गेंद धरती से 80 m/s के वेग से टकराती है। इस मीनार की ऊँचाई है: ($g = 10 \text{ m/s}^2$)

- (a) 340 m (b) 320 m (c) 300 m (d) 360 m

NEET (UG)-13.09.2020

Ans. (c) : Given that, Initial velocity of ball, $u = 20 \frac{\text{m}}{\text{s}}$

$$\text{Final velocity of Ball, } v = 80 \frac{\text{m}}{\text{s}}$$

(acceleration due to gravity) $g = 10 \text{ m/s}^2$

According to equation of motion for constant accelerating motion -

$$\therefore v^2 = u^2 + 2gh$$

$$80^2 = 20^2 + 2 \times 10 \times h \Rightarrow h = 300 \text{ m}$$

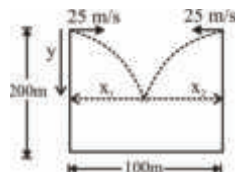
33. Two bullets are fired horizontally and simultaneously towards each other from roof tops of two buildings 100 m apart and of same height of 200 m , with the same velocity of 25 m/s . When and where will the two bullets collide? ($g = 10 \text{ m/s}^2$)

एक दूसरे से 100 m दूरी पर स्थित 200 m ऊँचाई के दो भवनों की छतों से एक-दूसरे की ओर क्षैतिज दिशा में समान वेग 25 m/s से दो गोलियाँ एक ही क्षण दागी गयी है। ये दोनों गोलियाँ कब और कहाँ एक-दूसरे से संघट्ट करेंगी? ($g = 10 \text{ m/s}^2$)

- (a) They will not collide/ये गोलियाँ संघट्ट नहीं करेंगी
 (b) After 2s at a height of 180 m
 2s के पश्चात 180 m की ऊँचाई पर
 (c) After 2s at a height of 20 m
 2s के पश्चात 20 m की ऊँचाई पर
 (d) After 4 s at a height of 120 m
 4s के पश्चात 120 m की ऊँचाई पर

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Ans. (b):



Given data

$$V_A = 25 \text{ m/s}, \quad V_B = -25 \text{ m/s}$$

$$\text{Distance (d)} = 100 \text{ m}$$

$$V_{AB} = V_A - V_B = 25 - (-25) = 50 \text{ m/s}$$

$$\text{Time } t = \frac{d}{V_{AB}} = \frac{100}{50} = 2 \text{ sec.}$$

Calculating vertical distance traveled by bullets given initial velocity $U_y = 0 \text{ m/s}$

$$\text{Acceleration } a = 10 \text{ m/s}^2$$

$$y = U_y t + \frac{1}{2} a t^2 = 0 + \frac{1}{2} (10) \times (2)^2 \Rightarrow y = 20$$

Calculating height from ground-

$$h = 200 \text{ m} - 20 \text{ m}$$

$$\boxed{h = 180 \text{ m}}$$

3. Motion in a Plane

Scalars and Vectors

34. Which of the following statement is not true? निम्नलिखित में से कौन सा कथन सत्य नहीं है?

- Pressure is a vector quantity
दबाव एक सदिश राशि है
- Relative density is a scalar quantity
आपेक्षिक घनत्व एक अदिश राशि है
- Coefficient of viscosity is a scalar quantity
श्यानता गुणांक अदिश राशि है
- Surface tension is a scalar quantity
पृष्ठ तनाव एक अदिश राशि है

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Ans. (a) : • **Scalar quantity** - Those physical quantity which require only magnitude but no direction for their complete representation are called scalars.

Example- distance, speed, work, mass, density, Relative density, **Pressure**, coefficient of viscosity, surface tension.

• **Vector quantity** : Those physical quantities which require magnitude as well as direction for their complete representation.

Example- displacement, velocity, acceleration.

35. If $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$ and $\vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$, then the scalar and vector products of \vec{F} and \vec{r} have the magnitudes respectively as :

यदि $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$ तथा $\vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$, तो \vec{F} एवं \vec{r} के अदिश एवं सदिश गुणन के परिमाण क्रमशः हैं:

- $5, \sqrt{3}$
- $4, \sqrt{5}$
- $10, \sqrt{2}$
- $10, 2$

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Ans. (c) : Given that-
 $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$
 $\vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$

Scalar product of vector is given by -

$$\vec{F} \cdot \vec{r} = (2\hat{i} + \hat{j} - \hat{k}) \cdot (3\hat{i} + 2\hat{j} - 2\hat{k})$$

$$= 6 + 2 + 2$$

$$|\vec{F} \cdot \vec{r}| = |10| = 10$$

vector product of vector is given by-

$$\vec{F} \times \vec{r} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -1 \\ 3 & 2 & -2 \end{vmatrix} = \hat{i}(-2+2) - \hat{j}(-4+3) + \hat{k}(4-3)$$

$$\vec{F} \times \vec{r} = \hat{j} + \hat{k}$$

$$|\vec{F} \times \vec{r}| = \sqrt{1+1} = \sqrt{2}$$

Relative Velocity

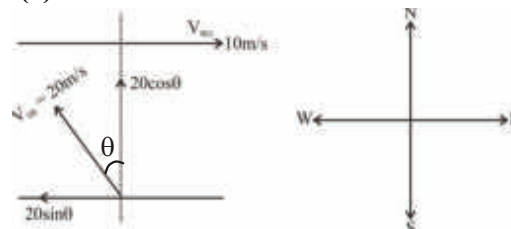
36. The speed of a swimmer in still water is 20 m/s. The speed of river water is 10 m/s and is flowing due east. If he is standing on the south bank and wishes to cross the river along the shortest path the angle at which he should make his strokes w.r.t. north is given by :

स्थिर जल में किसी तैराक की चाल 20 m/s है। नदी के जल की चाल 10 m/s है और वह ठीक पूर्व की ओर बह रहा है। यदि वह दक्षिणी किनारे पर खड़ा है और नदी को लघुतम पथ के अनुदिश पार करना चाहता है तो उत्तर के सापेक्ष उसे जिस कोण पर स्ट्रोक लगाने चाहिए वह है-

- 0°
- 60° west/पश्चिम
- 45° west/पश्चिम
- 30° west/पश्चिम

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Ans. (d) :



Speed of swimmer w.r.t. river, $V_{SR} = 20 \text{ m/s}$

Speed of river flow, $V_{RG} = 10 \text{ m/s}$

$$20 \sin \theta = 10 \text{ m/s}$$

$$\sin \theta = \frac{10}{20} = \frac{1}{2}$$

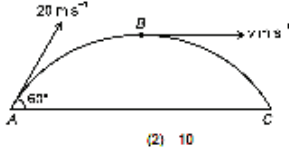
$$\sin \theta = \sin 30^\circ$$

$$\boxed{\theta = 30^\circ} \text{ west}$$

Projectile Motion

37. A ball is projected from point A with velocity 20 m s^{-1} at an angle 60° to the horizontal direction. At the highest point B of the path (as shown in figure), the velocity $v \text{ m s}^{-1}$ of the ball will be

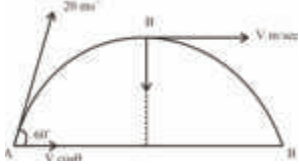
एक गेंद को बिन्दु A से 20 m s^{-1} के वेग से क्षैतिज दिशा से 60° के कोण पर प्रक्षेपित किया जाता है। पथ के उच्चतम बिंदु B पर (जैसा कि चित्र में दिखाया गया है), गेंद का वेग $v \text{ m s}^{-1}$ होगा



- (a) Zero/शून्य (b) 10
(c) 20 (d) $10\sqrt{3}$

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Ans. (b) :



At highest point vertical component of velocity is zero and horizontal component of velocity $(v) = u \cos \theta$

$$= 20 \cos 60^\circ = \frac{20}{2}$$

$$v = 10 \text{ m/sec}$$

Therefore, at point B velocity is 10 m/sec.

38. A bullet is fired from a gun at the speed of 280 m s^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is $(g = 9.8 \text{ m s}^{-2}, \sin 30^\circ = 0.5)$:

किसी बन्दूक से एक गोली क्षैतिज से 30° की दिशा में ऊपर की ओर 280 m s^{-1} की चाल से दागी जाती है। गोली द्वारा तय की गई अधिकतम ऊँचाई है

$$(g = 9.8 \text{ ms}^{-2}, \sin 30^\circ = 0.5)$$

- (a) 3000 m (b) 2800 m (c) 2000 m (d) 1000 m

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Ans. (d) : Height attained by the body in projectile motion is –

$$H = \frac{u^2 \sin^2 \theta}{2g} = \frac{(280)^2 \times \sin^2 30^\circ}{2 \times 9.8}$$

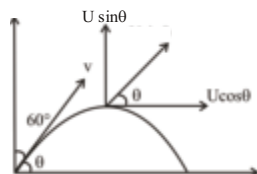
$$H = 1000 \text{ m}$$

39. A ball is projected with a velocity 10 ms^{-1} at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be किसी गेंद को ऊर्ध्व दिशा में 60° के कोण पर 10 ms^{-1} के वेग से प्रक्षेपित किया जाता है। प्रक्षेप्य पथ की अधिकतम ऊँचाई पर इसकी चाल होगी:

- (a) 10 ms^{-1} (b) Zero
(c) $5\sqrt{3} \text{ ms}^{-1}$ (d) 5 ms^{-1}

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Ans. (c) :



Initially angle between the motion of a particle with a horizontal surface $\theta = 90 - 60 = 30^\circ$

Velocity of ball $(u) = 10 \text{ m/s}$

At highest point only horizontal component is there which is given by $(v) = u \cos \theta$

$$\therefore v = 10 \cdot \cos 30^\circ$$

$$v = 10 \times \frac{\sqrt{3}}{2} \Rightarrow v = 5\sqrt{3} \text{ m/sec}$$

40. A cricket ball is thrown by a player at a speed of 20 m/s in a direction 30° above the horizontal. The maximum height attained by the ball during its motion is : $(g = 10 \text{ m/s}^2)$

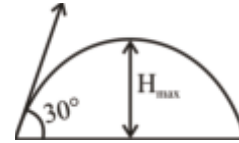
एक क्रिकेट गेंद किसी खिलाड़ी द्वारा 20 m/s की चाल से क्षैतिज से ऊपर 30° के कोण की दिशा में फेंकी जाती है। गेंद द्वारा इसकी गति के दौरान प्राप्त की गई अधिकतम ऊँचाई है :

- (a) 5 m (b) 10 m (c) 20 m (d) 25 m

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Ans. (a) : Given that – $v = 20 \text{ m/sec}$

$$\theta = 30^\circ$$



Height attained by the body in projectile motion –

$$H = \frac{v^2 \sin^2 \theta}{2g}$$

$$\Rightarrow H = \frac{(20)^2 \sin^2 30^\circ}{2 \times 10} = \frac{400 \times \left(\frac{1}{2}\right)^2}{2 \times 10} \Rightarrow H = 5 \text{ m}$$

Uniform Circular Motion

41. A particle moving in a circle of radius R with a uniform speed takes a time T to complete one revolution. If this particle were projected with the same speed at an angle ' θ ' to the horizontal, the maximum height attained by it equals $4R$. The angle of projection θ is then given by :

एक कण R त्रिज्या के वृत्त में समान चाल से गति करते हुए एक चक्कर पूरा करने में T समय लेता है।

यदि यही कण क्षैतिज से उसी चाल से कोण ' θ ' पर प्रक्षेपित किया जाए, तो $4R$ के बराबर अधिकतम ऊँचाई प्राप्त करता है। प्रक्षेपण कोण ' θ ' दिया जाता है :

$$(a) \theta = \sin^{-1} \left(\frac{2gT^2}{\pi^2 R} \right)^{1/2} \quad (b) \theta = \cos^{-1} \left(\frac{gT^2}{\pi^2 R} \right)^{1/2}$$

$$(c) \theta = \cos^{-1} \left(\frac{\pi^2 R}{gT^2} \right)^{1/2} \quad (d) \theta = \sin^{-1} \left(\frac{\pi^2 R}{gT^2} \right)^{1/2}$$

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Ans. (a) : To Complete a Circular Path of radius R , time period is T .

$$\text{So, velocity of particle } (u) = \frac{2\pi R}{T} \text{ -----(i)}$$

Now the particle is projected with same speed at angle θ with horizontal

$$\text{So maximum height (H)} = \left(\frac{u^2 \sin^2 \theta}{2g} \right)$$

Given $H = 4R$

$$4R = \frac{u^2 \sin^2 \theta}{2g}$$

$$\sin^2 \theta = \frac{8gR}{u^2} \text{-----(ii)}$$

$$\sin^2 \theta = \frac{8gRT^2}{4\pi^2 R^2} \text{ [using equation (i)]}$$

$$\sin^2 \theta = \frac{2gT^2}{\pi^2 R} \Rightarrow \theta = \sin^{-1} \left(\frac{2gT^2}{\pi^2 R} \right)^{1/2}$$

4. Laws of Motion

Newton's Law of Motion

42. A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is : एक फुटबॉल का खिलाड़ी दक्षिण दिशा की ओर दौड़ रहा है और विरोधी से बचने के लिए अचानक समान चाल से पूरब की ओर मुड़ता है। खिलाड़ी पर आरोपित बल जब वह मुड़ता है, होगा :

- (a) along south-West/ दक्षिण-पश्चिम की ओर
- (b) along eastward/ पूरब की ओर
- (c) along northward / उत्तर की ओर
- (d) along north-east/ उत्तर-पूरब की ओर

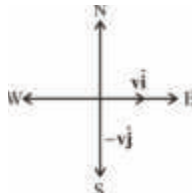
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Ans. (d) : Method-1

Player moves towards south and then turn towards east with the same speed. The force that acts on the player while turning is along north-east due to centripetal force.

Centripetal force : It is the force acting on the object in curvilinear motion directed towards the axis of rotation or centre of curvature.

Method-2



Force act on the player is –

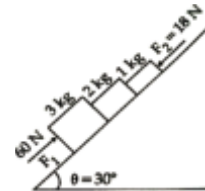
$$F = m \frac{\Delta v}{\Delta t}$$

$$\Delta \vec{v} = v_f - v_i$$

$$= v_i - (-v_j) = v(\hat{i} + \hat{j})$$

The direction of force is in same direction of change of velocity. Hence, the direction of force acts on the player while turning is along north-east.

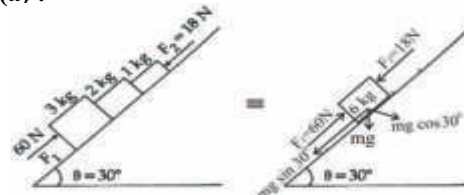
43. In the diagram shown, the normal reaction force between 2 kg and 1 kg is (Consider the surface, to be smooth) : Given $g = 10 \text{ ms}^{-2}$
दर्शाये हुए चित्र में, 2 kg एवं 1 kg के बीच अभिलम्ब प्रतिक्रिया बल है: (माना तल चिकना है) दिया है $g = 10 \text{ ms}^{-2}$



- (a) 25 N
- (b) 39 N
- (c) 6 N
- (d) 10 N

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Ans. (a) :



Considering all the masses together the net mass is $m = 3 + 2 + 1 = 6 \text{ kg}$

Balancing the net force along the inclined plane and applying Pseudo force. We get,

$$F_1 - F_2 - mg \sin 30^\circ = ma$$

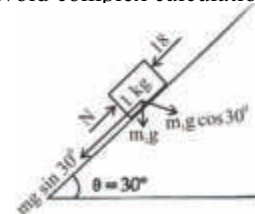
where a is acceleration of equivalent 6 kg mass.

$$\Rightarrow 60 - 18 - mg \sin 30^\circ = ma$$

$$\Rightarrow 60 - 18 - 6 \times 10 \times \frac{1}{2} = 6 \times a$$

$$\Rightarrow a = \frac{12}{6} = 2 \text{ m/s}^2$$

Now, F.B.D. of 1 kg mass (end mass has been considered to avoid complex calculation),



Similarly balancing the 1 kg mass along inclined plane we get $N - 18 - m_1 g \sin 30^\circ = m_1 a$

$$\Rightarrow N - 18 - 10 \times \frac{1}{2} = 1 \times 2$$

$$\Rightarrow N = 25 \text{ N}$$

44. A small block slides down on a smooth inclined plane, starting from rest at time $t = 0$. Let S_n be the distance travelled by the block in the interval $t = n - 1$ to $t = n$. Then the ratio $\frac{S_n}{S_{n+1}}$ is

विरामावस्था ($t = 0$) से एक छोटा ब्लॉक चिकने नतसमतल से नीचे की ओर खिसकता है। यदि अन्तराल $t = n - 1$ से $t = n$ के बीच ब्लॉक द्वारा चली गयी दूरी S_n हो, तो $\frac{S_n}{S_{n+1}}$ का अनुपात होता है :