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Printed at: **Star Print,** Mumbai

P.O. No. 20573

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PREFACE

Target's **'MHT-CET Physics Test Series'** is a complete practice book, extremely handy and a go to tool for the preparation of MHT-CET examination.

The core objective of the book is to help students gauge their preparedness to appear for MHT-CET examination, as it includes a beautiful assortment of MCQs in the form of Topic Tests and Revision Tests along with Model Test Papers as per the latest paper pattern.

- **Topic Tests** are provided for powerful concept building.
- **Revision Tests** develop confidence in the students as it includes MCQs from different topics**.**
- **Model Tests** help students to improve their performance in physics by analysing their strengths and shortcomings.

MCQs are meticulously developed after a thorough analysis of the MHT-CET 2025 Examination (all shift question papers). The compilation of diverse question types serves as an invaluable resource for exam preparation. This also aligns with the learning objectives, subject matter and cognitive skills expected of MHT-CET aspirants.

We have provided answers to all the questions along with detailed solutions for difficult questions.

We are sure that, these question papers would provide ample practice to students in a systematic manner and would boost their confidence to face the challenges posed in examinations.

We wish the students all the best for their examinations!

Publisher
Edition: Fourth

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

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A book affects eternity; one can never tell where its influence stops.

NEW PAPER PATTERN

- There will be three papers of Multiple Choice Questions (MCQs) in 'Mathematics', 'Physics and Chemistry' and 'Biology' of 100 marks each.
- Duration of each paper will be 90 minutes.
- Questions will be based on Syllabus of State Council of Educational Research and Training, Maharashtra with approximately 20% weightage given to Std. XI and 80% weightage will be given to Std. XII curriculum.
- Difficulty level of questions will be at par with JEE (Main) for Mathematics, Physics, Chemistry and at par with NEET for Biology.
- There will be no negative marking.
- Questions will be mainly application based.
- Details of the papers are as given below:

Paper	Subject(s)	No. of MCQs based on		Mark(s) Per Question	Total Marks	Duration in Minutes
		Std XI	Std XII			
Paper I	Mathematics	10	40	2	100	90
Paper II	Physics	10	40	1	100	90
	Chemistry	10	40			
Paper III	Biology	20	80	1	100	90

- Questions will be set on

i. the entire syllabus of Std. XII of Physics, Chemistry, Mathematics and Biology subjects prescribed by State Council of Educational Research and Training, Maharashtra and

ii. chapters / units from Std. XI curriculum prescribed by State Council of Educational Research and Training, Maharashtra as mentioned below:

Sr.no	Subject	Chapters/Units of Std. XI
1	Physics	Vectors, Error Analysis, Motion in a Plane, Laws of Motion, Gravitation, Thermal Properties of Matter, Sound, Optics, Electrostatics, Semiconductors
2	Chemistry	Some Basic Concepts of Chemistry, Structure of Atom, Chemical Bonding, Redox Reactions, Elements of Group 1 and 2, States of Matter (Gaseous and Liquids), Adsorption and Colloids (Surface Chemistry), Hydrocarbons, Basic Principles of Organic Chemistry, Chemistry in Everyday Life
3	Mathematics	Trigonometry - II, Straight Line, Circle, Probability, Complex Numbers, Permutations and Combinations, Functions, Limits, Continuity, Conic Section
4	Biology	Biomolecules, Respiration and Energy Transfer, Human Nutrition, Excretion and osmoregulation

- **Language of Question Paper:**
  The medium for examination shall be English / Marathi / Urdu for Physics, Chemistry and Biology. Mathematics paper shall be in English only.
- **Duration of Online Computer Based Test (CBT):**
  The duration of the examination for PCB is 180 minutes and PCM is 180 minutes.
  a. **For PCM** - This paper is having 2 Groups of Physics-Chemistry and Mathematics with total 180 Minutes Duration, first 90 minutes Physics and Chemistry will be enabled and only after completion of first 90 minutes' time Physics-Chemistry group will be auto submitted and Mathematics group will be enabled with 90 minutes' duration.
  b. **For PCB** - This paper is having 2 Groups of Physics-Chemistry and Biology with total 180 Minutes Duration, first 90 minutes Physics and Chemistry will be enabled and only after completion of time response for Physics-Chemistry group will be auto submitted and Biology group will be enabled with 90 minutes' duration.

[Note: Candidate should note that if he/she is appearing for both the groups i.e. PCM and PCB, the Percentile / Percentage score of Physics or Chemistry will not be interchanged among the groups.**]**

INDEX

Time: 40 min Total Marks: 40

1. Bird moves with velocity 20 m/s in a direction making an angle of 60° with the eastern line and 60° with the vertical upward. Represent the velocity vector in rectangular form.

(A) $10\,\hat{i}+10\sqrt{2}\,\hat{j}+10\,\hat{k}$

(B) $20\,\hat{i}+20\sqrt{2}\,\hat{j}-20\,\hat{k}$

(C) $-10\,\hat{i}-10\sqrt{2}\,\hat{j}+10\,\hat{k}$

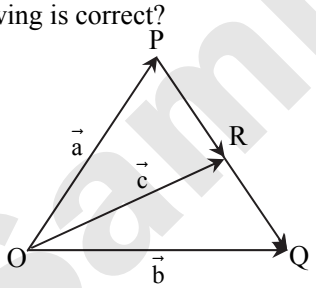
(D) $10\sqrt{2}\,\hat{i}-10\,\hat{j}+10\,\hat{k}$

2. Correct example of vector quantities could be
(A) Distance and Speed
(B) Displacement and Velocity
(C) Distance and Displacement
(D) Speed and Velocity

3. Two forces of magnitudes F and $\sqrt{3}$ F act at right angles to each other. Their resultant makes an angle β with F. The value of β is –
(A) 30º (B) 45º
(C) 60º (D) 135º

4. Two vectors have magnitudes 3 unit and 4 unit respectively. What should be the angle between them if the magnitude of the resultant is -
(i) 1 unit (ii) 5 unit (iii) 7 unit
(A) 180º, 90º, 0º (B) 80º, 70º, 0º
(C) 90º, 170º, 50º (D) None of these

5. Figure shows the vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ where $\vec{R}$ is the mid-point of PQ. Then which of the following is correct?



(A) $\vec{a}+\vec{b}=2\vec{c}$ (B) $\vec{a}+\vec{b}=\vec{c}$
(C) $\vec{a}-\vec{b}=2\vec{c}$ (D) $\vec{a}-\vec{b}=\vec{c}$

6. If the resultant vector forms an angle of 45°, then the two components are
(A) parallel to each other
(B) perpendicular to each other
(C) anti parallel to each other
(D) anti perpendicular to each other

7. How many minimum number of coplanar vectors having different magnitudes can be added to give zero resultant?
(A) 2 (B) 3 (C) 4 (D) 5

8. The resultant of $\vec{A}$ and $\vec{B}$ is $\vec{R}_1$. On reversing the vector $\vec{B}$, the resultant becomes $\vec{R}_2$. What is the value of $R_1^2+R_2^2$?

(A) A^2+B^2 (B) A^2-B^2
(C) $2(A^2+B^2)$ (D) $2(A^2-B^2)$

9. A unit radial vector $\hat{r}$ makes angles of $\alpha=30^\circ$ relative to the x-axis, $\beta=60^\circ$ relative to the y-axis, and $\gamma=90^\circ$ relative to the z-axis. The vector $\hat{r}$ can be written as

(A) $\frac{1}{2}\hat{i}+\frac{\sqrt{3}}{2}\hat{j}$ (B) $\frac{\sqrt{3}}{2}\hat{i}+\frac{1}{2}\hat{j}$

(C) $\frac{\sqrt{2}}{3}\hat{i}+\frac{1}{\sqrt{3}}\hat{j}$ (B) None of these

10. If $\vec{P}\cdot\vec{Q}=\frac{PQ}{2}$, then the angle between $\vec{P}$ and $\vec{Q}$ is:

(A) 0° (B) 30°
(C) 45° (D) 60°

11. Which of the following vector identities is false?

(A) $\vec{P}+\vec{Q}=\vec{Q}+\vec{P}$

(B) $\vec{P}+\vec{Q}=\vec{Q}\times\vec{P}$

(C) $\vec{P}.\vec{Q}=\vec{Q}.\vec{P}$

(D) $\vec{P}\times\vec{Q}\neq\vec{Q}\times\vec{P}$

12. If the vector $\left(\hat{i}+\hat{j}+\hat{k}\right)$ and $3\hat{i}$ form two sides of a triangle, then area of the triangle is :

(A) $\sqrt{3}$ unit (B) $2\sqrt{3}$ unit

(C) $\frac{3}{\sqrt{2}}$ unit (D) $3\sqrt{2}$ unit

13. A particle moves in x - y plane under the action of a force $\vec{F}$ such that the x and y components of linear momentum $\vec{p}$ at any time t are $2\cos t$ and $2\sin t$. Find the angle between $\vec{F}$ and $\vec{p}$ at a given time.

(A) 60° (B) 30°
(C) 0° (D) 90°

14. A particle of mass m is moving with a constant velocity v parallel to x -axis in an x - y plane. Calculate angular momentum with respect to origin at any moment.

(A) $-mvb\,\hat{k}$ (B) Zero

(C) $\frac{mvb}{2}\hat{k}$ (D) $mvb\cos\theta\,\hat{k}$

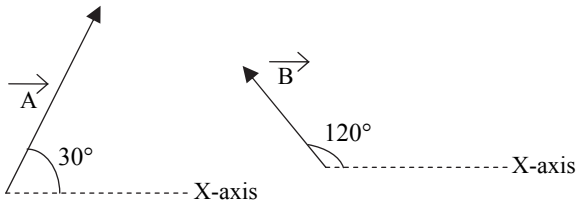
Based on:
Topics – 01, 02

Revision Test
01

Time: 40 min | Total Marks: 40

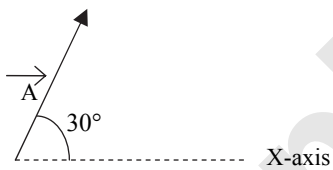
1. If the pointer of the voltmeter is not exactly at the zero of the scale then the error is called _____.
   (A) instrumental error
   (B) systematic error
   (C) personal error
   (D) random error

2. Vector $\vec{A}$ and $\vec{B}$ are shown in the figure. The angle between vector $\vec{A}$ and $\vec{B}$ is –



   (A) 60° (B) 90°
   (C) 30° (D) none of these

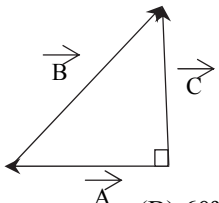
3. If $\vec{P} = \hat{i}+2\hat{j}-4\hat{k}$ and $\vec{Q} = \hat{i}+2\hat{j}-\hat{k}$ the $\left(\vec{P}+\vec{Q}\right).\left(\vec{P}-\vec{Q}\right)$ is



   (A) 5 (B) 15
   (C) 25 (D) 115

4. **Statement-I:** Systematic errors can be removed completely.
   Statement-II: the cause of systematic errors can be known.
   (A) Statement-1 is true and statement-2 is true
   (B) Statement-1 is true and statement-2 is false
   (C) Statement-1 is false and statement-2 is true
   (D) Statement-1 is false and statement-2 is false

5. In the adjoining vector diagram, what is the angle between $\vec{A}$ and $\vec{B}$? (Given: C = B/2).



   (A) 30º (B) 60º
   (C) 120º (D) 150º

6. A body is acted upon by two forces of magnitudes $F_1 = \sqrt{2}$ N and $F_2 = 3$ N which are inclined at 45° to each other. The magnitude of resultant force acting on the body is
   (A) 17 N (B) 11 N
   (C) $\sqrt{17}$ N (D) $\sqrt{11}$ N

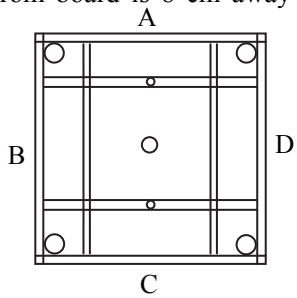
7. **Statement-I:** Random errors can be positive or negative.
   Statement-II: Cause of random errors are uncertain.
   (A) Statement-1 is true and statement-2 is true
   (B) Statement-1 is true and statement-2 is false
   (C) Statement-1 is false and statement-2 is true
   (D) Statement-1 is false and statement-2 is false

8. The three coterminous edges of a parallelepiped are $\vec{a} = 2\hat{i}-6\hat{j}+3\hat{k}$, $\vec{b} = 5\hat{j}$, $\vec{c} = -2\hat{i}+\hat{k}$. The volume of parallelepiped is
   (A) 36 cubic unit. (B) 40 cubic unit.
   (C) 45 cubic unit. (D) 54 cubic unit.

9. A body of mass 10 kg is placed on a smooth inclined plane making an angle of 30° with the horizontal, the component of the force of gravity trying to move the body down the inclined plane is [g = 9.8 m/s^2]
   (A) 98 N (B) 49 N
   (C) 10 N (D) 5 N

10. Thickness of the paper measured by micrometer screw gauge of least count 0.01 mm is 1.03 mm, the percentage error in the measurement of thickness of paper is
   (A) 1.1% (B) 1%
   (C) 0.97% (D) 0.8%

11. A carrom board of 50 cm × 50 cm is shown below. Assuming side B as +ve Y-axis and C as +ve X-axis, If striker shot from middle of the border from side C, obeying laws of reflection, stops exactly opposite to its original position at side A, then the position vector of a point at which the striker hits along side B is
   (Given: Border of carrom board is 8 cm away from its edge.)
   (A) $\left(25\hat{i}+25\hat{j}\right)$cm
   (B) $\left(50\hat{i}+8\hat{j}\right)$cm
   (C) $\left(25\hat{j}\right)$cm
   (D) $\left(25\hat{i}+42\hat{j}\right)$cm



Time: 40 min Total Marks: 40

1. When a body is projected vertically up from the ground, its velocity is reduced to $(1/4)^{th}$ of its initial value at height y above the ground. The maximum height reached by the body is

(A) $\frac{3}{4y}$ (B) $\frac{8y}{15}$ (C) $\frac{9y}{16}$ (D) 9y

2. A particle starts from rest, accelerates at 3 m s^{-2} for 20 s and then goes for constant speed for 30 s and then decelerates at 4 m s^{-2} till it stops. The distance travelled is

(A) 2850 m (B) 2200 m
(C) 2750 m (D) 2500 m

3. A ball is dropped from a highly raised platform at t = 0 starting from rest. After 9 second another ball is thrown downwards from the same platform with a speed v. The two balls meet at t = 20 s. What is the value of v?
(Take g = 10 m/s^2)

(A) 126.8 m/s (B) 132.5 m/s
(C) 129.6 m/s (D) 140 m/s

4. A particle is moving on a circular path with constant speed, then its acceleration will be

(A) zero.
(B) external radial acceleration.
(C) internal radial acceleration.
(D) constant acceleration.

5. The maximum horizontal range of a projectile is 739.6 m. Its initial speed and maximum height is [g = 10 m/s^2]

(A) 98 m s^{-1}, 154.16 m
(B) 245 m s^{-1}, 98 m
(C) 196 m s^{-1}, 86 m
(D) 86 m s^{-1}, 184.9 m

6. Match the motions given in column I with nature of their respective displacement - time graph given in column II:

	Column - I		Column - II
i.	Projectile motion	a.	Straight line parallel to x-axis
ii.	Simple harmonic motion	b.	Parabolic path
iii.	Non-uniform acceleration along X-axis	c.	Sinusoidal curve
iv.	Uniform circular motion	d.	Curved line with varying slope

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

7. The angle between velocity and acceleration of a particle describing uniform circular motion is

(A) 180° (B) 90°
(C) 45° (D) 60°

8. Which of the following is NOT an example of a projectile?

(A) Aeroplane in flight.
(B) A bullet fired from the gun.
(C) A hammer thrown by an athlete.
(D) A stone thrown from the top of the building.

9. A bomber plane moves horizontally with a speed of 600 m/s and a bomb released from it, strikes the ground in 12 s. Angle at which it strikes the ground will be (g = 10 m/s^2)

(A) $\tan^{-1}\left(\frac{1}{5}\right)$ (B) $\tan^{-1}\left(\frac{6}{5}\right)$
(C) $\tan^{-1}(1)$ (D) $\tan^{-1}(5)$

10. A car of mass 1000 kg moves on a circular path with constant speed of 10 m/s. It turned through 90° after travelling 785 m on the road. The centripetal force acting on the car is
(Take $\pi = 3.14$)

(A) 320 N (B) 200 N
(C) 640 N (D) 1280 N

11. A large number of bullets are fired in all directions with a speed of 150 m/s. What is the maximum area on the ground on which these bullets will spread (Take g = 10 m/s^2)

(A) 3×10^7 m^2 (B) 1.6×10^7 m^2
(C) 1.2×10^7 m^2 (D) 8×10^7 m^2

12. The angular velocity of a wheel is 60 rad/s. If the radius of the wheel is 0.3 m, then linear velocity of the wheel is

(A) 18 m/s (B) 15 m/s
(C) 35 m/s (D) 28 m/s

13. A bullet strikes a plank of thickness 5 cm with a velocity of 1500 m/s and emerges out with a velocity of 300 m/s, the average retardation of the bullet is

(A) -8.4×10^6 m/s^2 (B) 21.6×10^6 m/s^2
(C) -60×10^5 m/s^2 (D) 60×10^5 m/s^2

Model Test Paper - 01

Time: 45 min | Total Marks: 50

1. Given that $\vec{A}+\vec{B}+\vec{C}=0$ out of there vector two are equal in magnitude and the magnitude of the third vector is $\sqrt{2}$ times that of either of the two having equal magnitude. Find the angles between the vectors.

(A) 60°,120°,120° (B) 90°,120°,120°
(C) 90°,135°,135° (D) 60°,135°,135°

2. The second overtone of a closed pipe if its fundamental frequency is 80 Hz is

(A) 250 Hz (B) 400 Hz
(C) 300 Hz (D) 350 Hz

3. The ratio of the accelerations for a ring (mass m and radius R) rolling down an incline of angle 'θ' without slipping and slipping down the incline without rolling is

(A) 1 : 2 (B) 2 : 1
(C) 3 : 1 (D) 1 : $\sqrt{3}$

4. A body of mass 15 kg is placed on a smooth inclined plane making an angle of 45° with the horizontal. What is the component of the force of gravity trying to move the body down the inclined plane? [g = 9.8 m/s²]

(A) 147 N (B) 103.9 N
(C) 75 N (D) 15 N

5. The least energetic wave number in the Paschen series is

(A) $\frac{5R}{16}$ (B) $\frac{R}{4}$ (C) $\frac{R}{9}$ (D) $\frac{7R}{144}$

6. Which of the following is the wrong pairing?

(A) Maximum height reached by a projectile - θ = 90°
(B) Maximum range of projectile - θ = 45°
(C) Same range of projectile - Complementary angles
(D) Same height reached - Complementary angles

7. A capillary tube is held vertically in water. The internal radius of the tube is (1/28) cm. If the surface tension is 70 dyne/cm and angle of contact is zero, then rise in the capillary tube is

(A) 7 cm (B) 4 cm
(C) 12 cm (D) 28 cm

8. When wavefronts pass from denser medium to rarer medium, the width of the wavefront

(A) increases.
(B) may increase or decrease.
(C) decreases.
(D) remains unchanged.

9. If the magnetic field linked with the coil is doubled, the e.m.f induced in coil will be _____.

(A) double (B) same
(C) half (D) four times

10. If Y = a + b, the maximum percentage error in the measurement of Y will be

(A) $\left(\frac{\Delta a}{a}+\frac{\Delta b}{b}\right)\times 100$ (B) $\left(\frac{\Delta a}{a+b}+\frac{\Delta b}{a+b}\right)\times 100$
(C) $\left(\frac{\Delta a}{a}-\frac{\Delta b}{b}\right)\times 100$ (D) $\left(\frac{\Delta a}{a-b}-\frac{\Delta b}{a-b}\right)\times 100$

11. Two tuning forks A and B produce 8 beats per second when sounded together. When B is slightly loaded with wax, the beats are reduced to 6 per second. If the frequency of A is 300 Hz, the frequency of B is

(A) 300 Hz (B) 306 Hz
(C) 294 Hz (D) 350 Hz

12. A body is kept on a horizontal disc of radius 4 m at a distance of 2 m from the centre. The coefficient of friction between the body and the surface of disc is 0.8. The speed of rotation of the disc at which the body starts slipping is ($g = 10\ m/s^2$)

(A) 2 rad/s (B) 6 rad/s
(C) 0.8 rad/s (D) 0.2 rad/s

13. A galvanometer has a resistance of 3774 ohm. A shunt S is connected across it such that (1/35) of the total current passes through the galvanometer. Then the value of the shunt is

(A) 3663 ohm (B) 111 ohm
(C) 107.7 ohm (D) 3555.3 ohm

14. The study of _____ is useful in understanding quantization of energy.

(A) binding energy curve
(B) diffraction of light
(C) photoelectric effect
(D) electric flux

15. Two balls of masses 9 g and 5 g are moving with kinetic energies in the ratio of 4 : 5. What is the ratio of their linear momenta?

(A) 6 : 5 (B) 5 : 6
(C) 3 : 4 (D) 4 : 3

16. Emissive power of a blackbody at a temperature 200 K is 81 J/m^2s. Another one is an ordinary body having emissivity 0.8 at 600 K. What is the emissive power of ordinary body?

(A) 6218.2 J/m^2s (B) 8000 J/m^2s
(C) 5248.8 J/m^2s (D) 1784.6 J/m^2s

17. The current flowing through a straight wire produces a magnetic field
(A) antiparallel to the direction of current.
(B) parallel to the wire.
(C) in the form of concentric circle.
(D) in a parabolic path.

18. The self inductance of a coil is 5 mH. If a current of 4 A is flowing in it, then the magnetic flux produced in the coil will be
(A) 0.02 weber (B) 20 weber
(C) zero (D) 2 weber

19. What should be the angular speed of an earth like planet in radian/second so that a body of 5 kg weighs zero at the equator of the planet? (Take g_{planet} = 12 m/s^2 and radius of planet = 7200 km)
(A) 0.89×10^{-3} (B) 1.29×10^{-3}
(C) 2.74×10^{-3} (D) 4.16×10^{-3}

20. What will be the distance between two adjacent node if two travelling waves, $y_1 = A \sin [k (x + ct)]$ and $y_2 = A \sin [k (x – ct)]$ are superposed on a string?
(A) $\frac{ct}{\pi}$ (B) $\frac{ct}{2\pi}$
(C) $\frac{\pi}{2k}$ (D) $\frac{\pi}{k}$

21. Three particles, each having a charge of 10 μC are placed at the corners of an equilateral triangle of side 10 cm. The electrostatic potential energy of the system is
(A) Zero (B) 13.5 J
(C) 27 J (D) 100 J

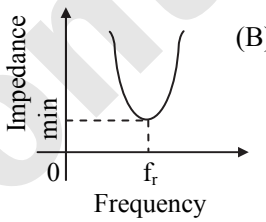
22. In a potentiometer experiment, the balancing point with a cell is at a length 240 cm. On shunting the cell with a resistance of 4 Ω, the balancing length becomes 120 cm. The internal resistance of the cell is
(A) 1 Ω (B) 2 Ω
(C) 0.5 Ω (D) 4 Ω

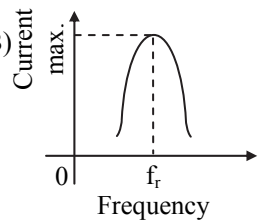
23. Out of the factors given below, upon which factor/s does photoelectric effect depend?
i. Temperature of metal plate
ii. Velocity of emitted photoelectron
iii. Frequency of incident light
(A) Only (iii) (B) (i) and (iii)
(C) (ii) and (iii) (D) (i), (ii) and (iii)

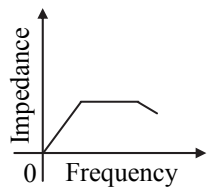
24. A/an _____ medium is required for propagation of sound.
(A) denser
(B) elastic
(C) plastic
(D) chemically ionized

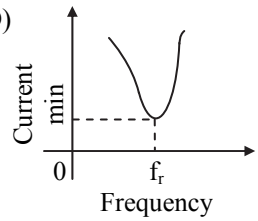
25. Emissive power of cube is 1000 J/m^2 s and it radiates heat at the rate 360 watt at that temperature. The length of each side of cube will be
(A) 24.5 cm (B) 0.245 cm
(C) 2.45 cm (D) 0.025 cm

26. The force acting on a charge 'q' in both electric and magnetic field, simultaneously is
(A) $\vec{F} = \left(q\vec{E}\right) + q\left(\vec{B} \times \vec{v}\right)$
(B) $\vec{F} = \left(q\vec{E}\right) + q\left(\vec{v} \times \vec{B}\right)$
(C) $\vec{F} = \left(q \times \vec{E}\right) + q\left(\vec{v} \cdot \vec{B}\right)$
(D) $\vec{F} = \left(q\vec{E}\right) + q\left(\vec{v} \cdot \vec{B}\right)$

27. Out of the following graphs, which graph shows the correct relation (graphical representation) for LC parallel resonant circuit?
(A)


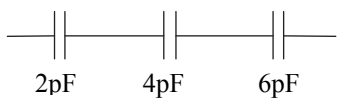
(B)


(C)


(D)


28. If the error in the measurement of radius of a sphere is 2%, then error in the determination of volume of the sphere will be
(A) 8% (B) 2% (C) 4% (D) 6%.

29. The length of the seconds pendulum is increased by 0.2 %. The clock
(A) gains 51.84 seconds per day.
(B) loses 86.4 seconds per day.
(C) neither loses nor gains time.
(D) loses 6 seconds per day.

30. The minimum value of effective capacitance that can be obtained by combining 3 capacitors of capacitances 2 pF, 4 pF and 6 pF is


(A) $\frac{12}{11}$ pF (B) 1 pF
(C) 2 pF (D) $\frac{11}{12}$ pF

Topic Test - 01

1. (A)

Let eastern line be taken as X-axis, northern as Y axis and vertical upward as Z - axis.

Let the velocity v makes angle α, β and γ with X, Y and Z axes respectively, then $\alpha = \gamma = 60°$.

Since, direction cosines are given as

$\cos2\alpha + \cos2\beta + \cos2\gamma = 1$

$\cos2(60°) + \cos2\beta + \cos2(60°) = 1$

Now, $\cos 60° = \frac{1}{2}$

$\therefore \quad \frac{1}{2} + \cos2\beta = 1 \Rightarrow \cos\beta = \frac{1}{\sqrt{2}} \Rightarrow \beta = 45°$

$\therefore \quad \vec{v} = v\cos\alpha\,\hat{i} + v\cos\beta\,\hat{j} + v\cos\gamma\,\hat{k}$

$= 20\left(\frac{1}{2}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \frac{1}{2}\hat{k}\right) = 10\,\hat{i} + 10\sqrt{2}\,\hat{j} + 10\,\hat{k}$

2. (B)

3. (C)

$\tan\beta = \frac{B\sin\theta}{A + B\cos\theta}$

$= \frac{F\sqrt{3}\sin\theta}{F + F\sqrt{3}\cos\theta}$

$= \frac{\sqrt{3}\sin\theta}{1 + \sqrt{3}\cos\theta}$

$\tan\beta = \frac{\sqrt{3}}{1} \qquad (\because \theta = 90°)$

$\beta = 60°$

4. (A)

i. Resultant of 3 unit and 4 unit = 1 unit

$\Rightarrow$ minimum possible value

$\therefore$ Angle b/w the vectors = 180°

ii. $5 = \sqrt{3^2 + 4^2 + 2\times3\times4\times\cos\theta}$

$\Rightarrow \cos\theta = 0$

$\Rightarrow \theta = 90°$

iii. Resultant of 3 unit and 4 unit = 7 unit

$\Rightarrow$ maximum possible value

$\therefore$ Angle b/w the vectors = 0°

5. (A)

From triangle law in $\triangle OPR$:

$\vec{a} + \overrightarrow{PR} = \vec{c} \Rightarrow \overrightarrow{PR} = \vec{c} - \vec{a}$

From triangle law in $\triangle ORQ$:

$\vec{c} + \overrightarrow{RQ} = \vec{b} \Rightarrow \overrightarrow{RQ} = \vec{b} - \vec{c}$

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

$2\vec{c} = \vec{a} + \vec{b}$

[Since $\overrightarrow{PR} = \overrightarrow{RQ}$, as R is midpoint of PQ]

6. (B) **7. (B)**

8. (C)

$R_1^2 = A^2 + B^2 + 2AB\cos\theta$

$|\vec{R}_2| = |\vec{A} - \vec{B}| \Rightarrow R_2^2 = A^2 + B^2 - 2AB\cos\theta$

Thus, $R_1^2 + R_2^2 = 2(A^2 + B^2)$

9. (B)

$\vec{r} = 1\cos\alpha\,\hat{i} + 1\cos\beta\hat{j} + 1\cos\gamma\hat{k} = \frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j} + 0\hat{k}$

10. (D)

$\vec{P}\cdot\vec{Q} = \frac{PQ}{2}$

$\Rightarrow PQ\cos\theta = \frac{PQ}{2}$

$\Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = 60°$

11. (B)

12. (C)

$A \times B = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 1 \\ 3 & 0 & 0 \end{vmatrix} = 3\hat{j} - 3\hat{k}$

$|A\times B| = \sqrt{0+9+9} = \sqrt{18} = 3\sqrt{2}$

$\frac{1}{2}|A\times B| = \frac{3}{\sqrt{2}}$

13. (D)

$\vec{p} = 2\cos t\,\hat{i} + 2\sin t\,\hat{j}$

$\therefore \quad |\vec{p}| = 2\sqrt{2}$ units

Now, $\vec{F} = \frac{d\vec{p}}{dt} = -2\sin t\,\hat{i} + 2\cos t\,\hat{j}$

Taking dot product,

$\vec{F}\cdot\vec{p} = \left(2\cos t\,\hat{i} + 2\sin t\,\hat{j}\right)\cdot\left(-2\sin t\,\hat{i} + 2\cos t\,\hat{j}\right)$

$= (2)(-2) + (2)(2)$

$= 0$

As $\vec{F}\cdot\vec{p} = 0$, $\theta = 90°$

14. (A)

$\vec{L} = \vec{r}\times\vec{p} = \begin{vmatrix} i & j & k \\ x & y & 0 \\ p_x & p_y & 0 \end{vmatrix}$

Since the particle is moving in xy plane, therefore, $z = 0$ and $p_z = 0$.

$\vec{L} = k(xp_y - yp_x) = x(vt)$ (at any time t)

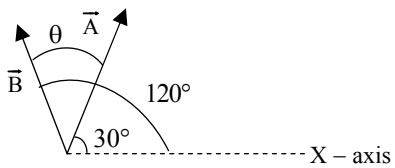
$= \hat{k}(vt\cdot0 - bmv) = -mvb\hat{k}$

Here: $y = b$ and $p_x = mv$, $p_y = 0$

Revision Test - 01

1. (A)

2. (B)



$\theta = 120° - 30° = 90°$

3. (B)

$\vec{P} + \vec{Q} = \left(\hat{i} + 2\hat{j} - 4\hat{k}\right) + \left(\hat{i} + 2\hat{j} - \hat{k}\right)$

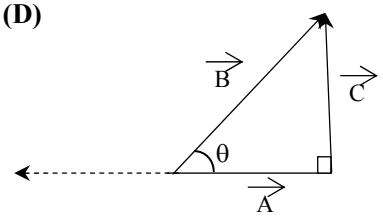
$= 2\hat{i} + 4\hat{j} - 5\hat{k}$

$\vec{P} - \vec{Q} = \left(\hat{i} + 2\hat{j} - 4\hat{k}\right) - \left(\hat{i} + 2\hat{j} - \hat{k}\right) = -3\hat{k}$

$\left(\vec{P} + \vec{Q}\right).\left(\vec{P} - \vec{Q}\right) = \left(2\hat{i} + 4\hat{j} - 5\hat{k}\right)\left(-3\hat{k}\right) = 15$

4. (A)

5. (D)



$\sin\theta = \frac{c}{b} = \frac{\frac{B}{2}}{B} = \frac{1}{2}$

$\theta = 30°$

Angle b/w $\vec{A}$ and $\vec{B}$ $= 180° - 30° = 150°$

6. (C)

$F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$

$= \sqrt{\left(\sqrt{2}\right)^2 + (3)^2 + 2\left(\sqrt{2}\right)(3)\cos 45°}$

$F = \sqrt{2 + 9 + 6} = \sqrt{17}$ N

7. (A)

8. (B)

Using ***Smart tip – 6(iii)***,

Volume of parallelepiped $= \vec{A} \cdot \left(\vec{B} \times \vec{C}\right)$

$$\left[\vec{A}\,\vec{B}\,\vec{C}\right] = \begin{vmatrix} 2 & -6 & 3 \\ 0 & 5 & 0 \\ -2 & 0 & 1 \end{vmatrix}$$

$= 2(5 - 0) + 6(0 - 0) + 3(0 + 10)$

$= 10 + 30 = 40$

9. (B)

Component of force of gravity $= F_y = F\sin\theta$

$F_y = mg\sin 30° = 10 \times 9.8 \times \frac{1}{2} = 49$ N

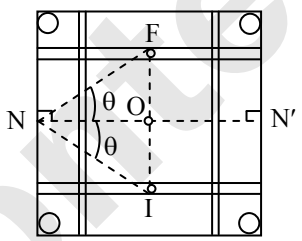
10. (C)

Percentage error $= \left(\frac{\Delta d}{d} \times 100\right)\%$

$= \left(\frac{0.01}{1.03} \times 100\right)\%$

$= 0.97\%$

11. (C)



Co-ordinates of initial point I are (25, 8).

Similarly, for final point F co-ordinates are, (25, 42).

As laws of reflection are obeyed with respect to X-axis, striker must hit at point N or N′ to reach point F.

Hence, along side B,

co-ordinates of point N are (0, 25).

i.e., position vector of striker at N $= \left(25\hat{j}\right)$cm

12. (D)

$\hat{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{\vec{A}}{A}$

13. (C)

If A is a constant or a physical quantity with power zero then, P is independent of A. As a result, error in measuring value of A will not affect quantity P.

14. (B)

Rotating a vector by angle (θ) does not change is magnitude.

15. (D)

Magnitude of vector $\vec{A}$ $= |\vec{A}|$

$= \sqrt{(2)^2 + (6)^2}$

$= \sqrt{4 + 36} = \sqrt{40}$

Model Test Paper - 01

1. (C)

Given A = B , C = $\sqrt{2}$ A = $\sqrt{2}$ B = B .

From fig 2.29

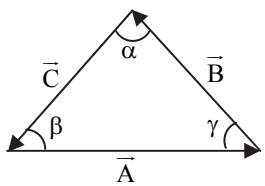
$\alpha = \beta$ and $\alpha + \beta = 180° \Rightarrow \gamma = 180° - 2\alpha$

Apply Lami's Theorem: $\frac{A}{\sin\alpha} = \frac{C}{\sin y}$

$\Rightarrow \frac{A}{\sin\alpha} = \frac{\sqrt{2}A}{\sin(180-2\alpha)}$

$\Rightarrow \frac{1}{\sin\alpha} = \frac{\sqrt{2}}{2\sin\alpha\cos\alpha} \Rightarrow \cos\alpha = \frac{1}{\sqrt{2}} \Rightarrow \alpha = 45°$

$\Rightarrow \beta = 45°$ and $\gamma = 180° - 2\alpha = 90°$



Angle between $\vec{A}$ and $\vec{B}$ = 180° − γ = 90°, angle between $\vec{B}$ and $\vec{C}$ = 180 − α = 135°, angle between $\vec{C}$ and $\vec{A}$ = 180° − β = 135°

2. (B)

Fundamental frequency n_1 = 80 Hz

For closed organ pipe, second overtone means fifth harmonic so its frequency is

$n_5 = 5n_1 = 5 \times 80 = 400$ Hz

3. (A)

The acceleration of the slipping ring is,

$a_{slipping} = g \sin\theta$

The acceleration of the rolling ring is,

$a_{rolling} = \frac{g\sin\theta}{\left(1+\frac{K^2}{R^2}\right)} = \frac{g\sin\theta}{\left(1+\frac{1}{1}\right)} = \frac{g\sin\theta}{2}$

$\therefore \quad \frac{a_{rolling}}{a_{slipping}} = \frac{1}{2}$

4. (B)

Component of force of gravity = $F_y = F \sin\theta$

$F_y = mg \sin 45° = 15 \times 9.8 \times \frac{1}{\sqrt{2}} = 103.9$ N

5. (D)

Least energetic wavelength in Paschen coressponds to n = 3 and m = 4.

$\therefore \quad \frac{1}{\lambda_p} = R\left(\frac{1}{n^2} - \frac{1}{m^2}\right) = R\left(\frac{1}{3^2} - \frac{1}{4^2}\right) = \frac{7R}{144}$

$\therefore$ Least energetic wave number,

$\bar{\nu} = \frac{7R}{144}$

6. (D)

7. (B)

Rise in capillary = $h = \frac{2T\cos\theta}{r\rho g}$

As angle of contact $\theta = 0° \Rightarrow \cos\theta = 1$ and ρ = 1 g/cc

$\therefore \quad h = \frac{2T}{r\rho g} = \frac{2\times 70}{(1/28)\times 1\times 980} = \frac{140\times 28}{980} = 4$ cm

8. (C)

9. (A)

Since e ∝ B, so when magnetic field is doubled, induced e.m.f. will also becomes double.

10. (B)

11. (B)

n_A = 300 Hz,

Given that, $|n_A - n_B| = 8$ b.p.s

When B is loaded with wax, the number of beats reduces to 6 per second.

$|n_A - n_B| = 6$ b.p.s

$\therefore \quad n_B$ = 306 Hz or 294 Hz

The frequency 306 meets both the conditions

$\therefore \quad n_B > n_A$

$\therefore \quad n_B - n_A = 6$ is the correct equation.

$n_B = n_A + 6 = 300 + 6 = 306$ Hz

12. (A)

Using formula,

$\mu mg = m\omega^2 r$

$\therefore \quad \omega = \sqrt{\frac{\mu g}{r}}$

$\omega = \sqrt{\frac{0.8\times 10}{2}} = \sqrt{4} = 2$ rad/s

13. (B)

$\frac{I_g}{I} = \frac{1}{34} = \frac{S}{S+3774}$

$\therefore \quad S = \frac{3774}{34} = 111\ \Omega$

14. (C)

15. (A)

$K = \frac{1}{2}mv^2 = \frac{1}{2}\times\frac{m(mv^2)}{m} = \frac{(mv)^2}{2m} \Rightarrow K = \frac{p^2}{2m}$

$\therefore \quad \frac{K_1}{K_2} = \frac{p_1^2}{2m_1}\times\frac{2m_2}{p_2^2} \Rightarrow \frac{4}{5} = \left(\frac{p_1}{p_2}\right)^2 \times \frac{5}{9}$

$\therefore \quad p_1 : p_2 = 6 : 5$

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