

Exercise – I (JEE-Main Pattern)

SECTION-A

- This section contains **TWENTY** questions.
- Each question has **FOUR** options (1), (2), (3) and (4). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +4, if only the bubble corresponding to the correct option is darkened.

Zero Marks : 0, if none of the bubbles is darkened.

Negative Marks : -1 in all other cases.

1. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, then the dimensions of surface tension will be. (Surface tension = force / length)

(1) $E V^{-2} T^{-1}$ (2) $E V^{-1} T^{-2}$ (3) $E^{-2} V^{-1} T^{-3}$ (4) $E V^{-2} T^{-2}$

PUV001

2. Which of the following is incorrect statements?

(1) A dimensionally correct equation may be correct
 (2) A dimensionally correct equation may be incorrect
 (3) A dimensionally incorrect equation may be incorrect
 (4) A dimensionally incorrect equation is incorrect

PUV002

3. Use the small angle approximation to find approximate value for $\left(\frac{\sin 1^\circ}{\cos 2^\circ}\right)$:-

(1) 1 (2) $\frac{\pi}{30}$ (3) $\frac{\pi}{60}$ (4) $\frac{\pi}{180}$

PUV003

4. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to :

(1) $\sqrt{\frac{Gh}{c^3}}$ (2) $\sqrt{\frac{hc^5}{G}}$ (3) $\sqrt{\frac{c^3}{Gh}}$ (4) $\sqrt{\frac{Gh}{c^5}}$

PUV004

5. The density of a material in SI units is 128 kg m^{-3} . In certain units in which the unit of length is 25 cm and the unit of mass is 50 g, the numerical value of density of the material is :

(1) 410 (2) 640 (3) 16 (4) 40

PUV005

6. If speed (V), acceleration (a) and force (F) are considered as fundamental units, the dimension of Young's modulus will be :-

(1) $V^{-2} a^2 F^2$ (2) $V^{-4} a^2 F$ (3) $V^{-4} a^{-2} F$ (4) $V^{-2} a^2 F^{-2}$

PUV006

7. The force of interaction between two atoms is given by $F = \alpha\beta \exp\left(-\frac{x^2}{\alpha kt}\right)$; where x is the distance, k is the Boltzmann constant and T is temperature and α and β are two constants. The dimension of β is:
 (1) $M^2L^2T^{-2}$ (2) M^2LT^{-4} (3) $M^0L^2T^{-4}$ (4) MLT^{-2} PUV007
8. If force, acceleration, and time are taken as fundamental quantities, then the dimensions of length will be:
 (1) FT^2 (2) $F^{-1}A^2T^{-1}$ (3) FA^2T (4) AT^2 PUV008
9. In a particular system, the units of length, mass and time are chosen to be 10 cm, 10 g and 0.1 s respectively. The unit of force in this system will be equal to :-
 (1) 0.1 N (2) 1 N (3) 10 N (4) 100 N PUV009
10. The units of three physical quantities x, y and z are $\text{gcm}^2\text{s}^{-5}$, gs^{-1} and cms^{-2} respectively. The relation among the units of x, y and z is :-
 (1) $z = x^2y$ (2) $y^2 = xz$ (3) $x = yz^2$ (4) $x = y^2z$ PUV010
11. **Statement 1** : Method of dimensions cannot tell whether an equation is correct.
and
Statement 2 : A dimensionally incorrect equation may be correct.
 (1) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement 1.
 (2) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
 (3) Statement-1 is true, statement-2 is false.
 (4) Statement-1 is false, statement-2 is true. PUV011
12. A man rows a boat with a speed of 18 km/hr in north-west direction. The shoreline makes an angle of 15° south of west. Obtain the component of the velocity of the boat along the shoreline.
 (1) 9 km/hr (2) $18\frac{\sqrt{3}}{2}$ km/hr
 (3) $18 \cos(15^\circ)$ km/hr (4) $18 \cos(75^\circ)$ km/hr PUV012
13. **Statement 1** : Unit vector has a unit though its magnitude is one
and
Statement 2 : Unit vector is obtained by dividing a vector by its own magnitude.
 (1) Statement-1 is true, statement-2 is true, and statement-2 is correct explanation for statement 1.
 (2) Statement-1 is true, statement-2 is true, and statement-2 is NOT the correct explanation for statement-1.
 (3) Statement-1 is true, statement-2 is false.
 (4) Statement-1 is false, statement-2 is true. PUV013

14. A vector of magnitude 10 m in the direction 37° south of west has its initial point at $(5\text{ m}, 2\text{ m})$. If positive x -axis represents the east and positive y -axis the north, the coordinates of its terminal point are

(1) $(-3\text{ m}, -4\text{ m})$ (2) $(3\text{ m}, 4\text{ m})$ (3) $(-4\text{ m}, 6\text{ m})$ (4) $(-4\text{ m}, -6\text{ m})$

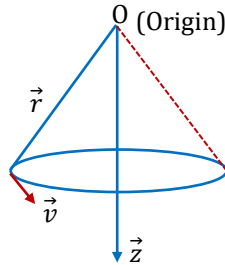
PUV014

15. After firing, a bullet is found to move at an angle of 37° to horizontal. Its acceleration is 10 m/s^2 downwards. Find the component of acceleration in the direction of the velocity.

(1) -6 m/s^2 (2) -4 m/s^2 (3) -8 m/s^2 (4) -5 m/s^2

PUV015

16. A string connected with bob is suspended by the point (O) such that it sweeps out conical surface in horizontal plane. Here $\vec{r}$ is the position vector of bob, $\vec{v}$ is its velocity and $\vec{z}$ is the axis of swept cone as shown. Select **INCORRECT** statement :-



- (1) $\vec{r} \cdot \vec{z}$ is always zero (2) $\vec{r} \cdot \vec{v}$ is always zero
(3) $\vec{z} \cdot \vec{v}$ is always constant (4) $\vec{r} \cdot \vec{z}$ is always non zero constant

PUV016

17. Two forces P and Q of magnitude $2f$ and $3f$, respectively, are at an angle θ with each other. If the force Q is doubled, then their resultant also gets doubled. Then, the angle is:

(1) 30° (2) 60° (3) 90° (4) 120°

PUV017

18. Consider three vectors $\vec{A} = \hat{i} + \hat{j} - 2\hat{k}$, $\vec{B} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{C} = 2\hat{i} - 3\hat{j} + 4\hat{k}$. A vector $\vec{X}$ of the form $\alpha\vec{A} + \beta\vec{B}$ (α and β are numbers) is perpendicular to $\vec{C}$. The ratio of α and β is

(1) $1 : 1$ (2) $2 : 1$ (3) $-1 : 1$ (4) $3 : 1$

PUV018

19. Given the vectors $\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{B} = 3\hat{i} - 2\hat{j} - 2\hat{k}$ and $\vec{C} = p\hat{i} + p\hat{j} + 2p\hat{k}$. Find the angle between $(\vec{A} - \vec{B})$ and $\vec{C}$

(1) $\theta = \cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (2) $\theta = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (3) $\theta = \cos^{-1}\left(\frac{\sqrt{2}}{3}\right)$ (4) none of these

PUV019

20. Two forces $(\hat{i} + \hat{j} + \hat{k})N$ and $(\hat{i} + 2\hat{j} + 3\hat{k})N$ act on a particle and displace it from $(2, 3, 4)$ to point $(5, 4, 3)$. Displacement is in m . Work done is :

(1) $2J$ (2) $3J$ (3) $4J$ (4) $5J$

PUV020

SECTION-B

- This section contains **TEN** Questions. Attempt any five Questions. First five Questions Attempt will be considered for marking.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places; e.g. 6.25, 7.00, -0.33, -0.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct).
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4, if ONLY the correct numerical value is entered as answer.
Zero Marks : 0 in all other cases.

1. If mass is expressed as $v^x d^y a^z$ where v is velocity; d is density and a is acceleration then the value of $x + y + z$ is

PUV021

2. The angle subtended by the moon's diameter at a point on the earth is about 0.50° . Use this and the fact that the moon is about 384000 km away to find the approximate diameter of the moon (in km).



PUV022

3. Three particles P , Q and R are moving along the vectors $\vec{A} = \hat{i} + \hat{j}$, $\vec{B} = \hat{j} + \hat{k}$ and $\vec{C} = -\hat{i} + \hat{j}$ respectively. They strike on a point and start to move in different directions. Now particle P is moving normal to the plane which contains vector $\vec{A}$ and $\vec{B}$. Similarly, particle Q is moving normal to the plane which contains vector $\vec{A}$ and $\vec{C}$. The angle between the direction of motion of P and Q is $\cos^{-1} \left(\frac{1}{\sqrt{x}} \right)$. Then the value of x is _____.

PUV023

4. During a war between $Ra1$ and $G1$, the power shot shot by $G1$ reaches to $Ra1$. It was found that the power of the power shot fired depends on mass (m_0) of $G1$, velocity (v_0) of his hand and time lag (t_0) between his thought of firing & actual time when shot was fired. If power of power shot depends on k^{th} power of velocity of his hand, fill k in OMR sheet.

PUV024

5. If the resultant of two forces of magnitudes P and Q acting at a point at an angle of 60° is $\sqrt{7} Q$, then P/Q is

PUV025

6. Two forces $\vec{F}_1$ and $\vec{F}_2$ of magnitude $10\sqrt{10}N$ each are inclined at an angle of 1.8° to each other. What is the magnitude (in N) of vector $\vec{F}_1 - \vec{F}_2$? (Take $\pi^2 = 10$.)

PUV026

7. If $\hat{i} + 2\hat{j} - n\hat{k}$ is perpendicular to $4\hat{i} + 2\hat{j} + 2\hat{k}$, then the value of n is

PUV027

8. A force $\vec{F} = 5\hat{i} + 2\hat{j} + \hat{k}$ displaces a body from a point of coordinate $(1, 1, 1)$ to another point of coordinates $(2, 0, 3)$. Calculate the work done (in J) by the force.

PUV028

9. Three vectors $\vec{P}$, $\vec{Q}$ and $\vec{R}$ are such that $|\vec{P}| = |\vec{Q}|$, $|\vec{R}| = \sqrt{2}|\vec{P}|$ and $\vec{P} + \vec{Q} + \vec{R} = \vec{0}$. If the angle between $\vec{P}$ and $\vec{R}$ is $\frac{\alpha\pi}{4}$ (in radians) then find the value of (α) .

PUV029

10. The sum of two force acting at a point is $16N$. If their resultant is normal to the smaller force and has a magnitude of $8N$, then find the value of smaller force.

PUV030

Exercise - II (JEE-Main PYQs)

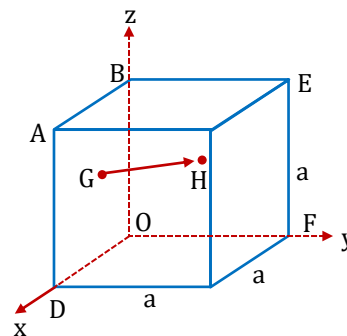
1. Two vectors $\vec{A}$ and $\vec{B}$ have equal magnitudes. The magnitude of $(\vec{A} + \vec{B})$ is 'n' times the magnitude of $(\vec{A} - \vec{B})$. The angle between $\vec{A}$ and $\vec{B}$ is : [JEE Main-2019]

(1) $\sin^{-1} \left[\frac{n^2-1}{n^2+1} \right]$ (2) $\cos^{-1} \left[\frac{n-1}{n+1} \right]$ (3) $\cos^{-1} \left[\frac{n^2-1}{n^2+1} \right]$ (4) $\sin^{-1} \left[\frac{n-1}{n+1} \right]$

PUV031

2. In the cube of side 'a' shown in the figure, the vector from the central point of the face $ABOD$ to the central point of the face $BEFO$ will be: [JEE Main-2019]

(1) $\frac{1}{2} a(\hat{i} - \hat{k})$
 (2) $\frac{1}{2} a(\hat{j} - \hat{i})$
 (3) $\frac{1}{2} a(\hat{k} - \hat{i})$
 (4) $\frac{1}{2} a(\hat{j} - \hat{k})$



PUV032

3. Let $|\vec{A}_1| = 3$, $|\vec{A}_2| = 5$ and $|\vec{A}_1 + \vec{A}_2| = 5$. The value of $(2\vec{A}_1 + 3\vec{A}_2) \cdot (3\vec{A}_1 - 2\vec{A}_2)$ is :- [JEE Main-2019]

(1) -112.5 (2) -106.5 (3) -118.5 (4) -99.5

PUV033

4. A quantity f is given by $f = \sqrt{\frac{hc^5}{G}}$ where c is the speed of light, G is the universal gravitational constant and h is the Planck's constant. Dimension of f is that of : [JEE Main-2020]

(1) Momentum (2) Area (3) Energy (4) Volume

PUV034

5. If momentum (P), area (A) and time (T) are taken to be the fundamental quantities then the dimensional formula for energy is : [JEE Main-2020]

(1) $[PA^{-1} T^{-2}]$ (2) $[PA^{1/2} T^{-1}]$ (3) $[P^2 A T^{-2}]$ (4) $[P^{1/2} A T^{-1}]$

PUV035

6. Amount of solar energy received on the Earth's surface per unit area per unit time is defined as solar constant. The dimension of solar constant is: [JEE Main-2020]

(1) $ML^2 T^{-2}$ (2) MLT^{-2} (3) $M^2 L^0 T^{-1}$ (4) $ML^0 T^{-3}$

PUV036

7. If time (t), velocity (v), and angular momentum (ℓ) are taken as the fundamental units. Then the dimension of mass (m) in terms of t , v and ℓ is : [JEE Main-2021]

(1) $[t^{-1} v^1 \ell^{-2}]$ (2) $[t^1 v^2 \ell^{-1}]$ (3) $[t^{-2} v^{-1} \ell^1]$ (4) $[t^{-1} v^{-2} \ell^1]$

PUV037

8. The force is given in terms of time t and displacement x by the equation

$$F = A \cos Bx + C \sin Dt$$

The dimensional formula of $\frac{AD}{B}$ is :

(1) $[M^0 L T^{-1}]$ (2) $[M L^2 T^{-3}]$ (3) $[M^1 L^1 T^{-2}]$ (4) $[M^2 L^2 T^{-3}]$

[JEE Main-2021]

PUV038

9. If E , L , M and G denote the quantities as energy, angular momentum, mass and the universal constant of gravitation respectively, then the dimensions of P in the formula $P = EL^2M^{-5}G^{-2}$ are:

[JEE Main-2021]

- (1) $[M^0 L^1 T^0]$ (2) $[M^{-1} L^{-1} T^2]$ (3) $[M^1 L^1 T^{-2}]$ (4) $[M^0 L^0 T^0]$

PUV039

10. If force (F), length (L) and time (T) are taken as the fundamental quantities, then what will be the dimension of density :

[JEE Main-2021]

- (1) $[FL^{-4} T^2]$ (2) $[FL^{-3} T^2]$ (3) $[FL^{-5} T^2]$ (4) $[FL^{-3} T^3]$

PUV040

11. Match List-I with List-II.

List-I

- (a) Torque
(b) Impulse
(c) Tension
(d) Surface Tension

List-II

- (i) MLT^{-1}
(ii) MT^{-2}
(iii) ML^2T^{-2}
(iv) MLT^{-2}

Choose the most appropriate answer from the option given below:

[JEE Main-2021]

- (1) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii) (2) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(3) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii) (4) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

PUV041

12. If velocity [V], time [T] and force [F] are chosen as the base quantities, the dimensions of the mass will be :

[JEE Main-2021]

- (1) $[FT^{-1} V^{-1}]$ (2) $[FTV^{-1}]$ (3) $[FT^2 V]$ (4) $[FVT^{-1}]$

PUV042

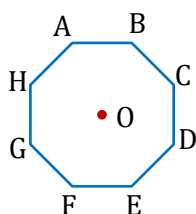
13. If $\vec{P} \times \vec{Q} = \vec{Q} \times \vec{P}$, the angle between $\vec{P}$ and $\vec{Q}$ is θ ($0^\circ < \theta < 360^\circ$). The value of ' θ ' will be _____°.

[JEE Main-2021]

PUV043

14. In an octagon $ABCDEFGH$ of equal side, what is the sum of $\vec{AB} + \vec{AC} + \vec{AD} + \vec{AE} + \vec{AF} + \vec{AG} + \vec{AH}$ if, $\vec{AO} = 2\hat{i} + 3\hat{j} - 4\hat{k}$

[JEE Main-2021]



- (1) $-16\hat{i} - 24\hat{j} + 32\hat{k}$ (2) $16\hat{i} + 24\hat{j} - 32\hat{k}$ (3) $16\hat{i} + 24\hat{j} + 32\hat{k}$ (4) $16\hat{i} - 24\hat{j} + 32\hat{k}$

PUV044

15. If $\vec{A}$ and $\vec{B}$ are two vectors satisfying the relation $\vec{A} \cdot \vec{B} = |\vec{A} \times \vec{B}|$. Then the value of $|\vec{A} - \vec{B}|$ will be :

[JEE Main-2021]

- (1) $\sqrt{A^2 + B^2}$ (2) $\sqrt{A^2 + B^2 + \sqrt{2}AB}$ (3) $\sqrt{A^2 + B^2 + 2AB}$ (4) $\sqrt{A^2 + B^2 - \sqrt{2}AB}$

PUV045

16. What will be the projection of vector $\vec{A} = \hat{i} + \hat{j} + \hat{k}$ on vector $\vec{B} = \hat{i} + \hat{j}$?

[JEE Main-2021]

- (1) $\sqrt{2}(\hat{i} + \hat{j} + \hat{k})$ (2) $2(\hat{i} + \hat{j} + \hat{k})$ (3) $\sqrt{2}(\hat{i} + \hat{j})$ (4) $(\hat{i} + \hat{j})$

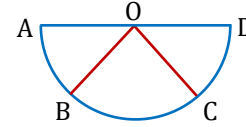
PUV046

17. **Assertion A :** If A, B, C, D are four points on a semi-circular arc with centre at ' O ' such that $|\overrightarrow{AB}| = |\overrightarrow{BC}| = |\overrightarrow{CD}|$, then

$$\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} = 4\overrightarrow{AO} + \overrightarrow{OB} + \overrightarrow{OC}$$

Reason R : Polygon law of vector addition yields

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CD} + \overrightarrow{AD} = 2\overrightarrow{AO}$$



In the light of the above statements, choose the most appropriate answer from the options given below: [JEE Main-2021]

- (1) **A** is correct but **R** is not correct.
- (2) **A** is not correct but **R** is correct.
- (3) Both **A** and **R** are correct and **R** is the correct explanation of **A**.
- (4) Both **A** and **R** are correct but **R** is not the correct explanation of **A**.

PUV047

18. The magnitude of vectors $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$ in the given figure are equal. The direction of $\overrightarrow{OA} + \overrightarrow{OB} - \overrightarrow{OC}$ with x-axis will be :

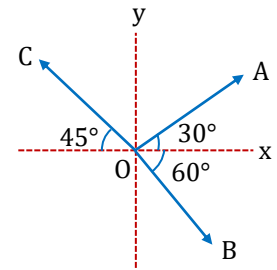
[JEE Main-2021]

(1) $\tan^{-1} \frac{(1-\sqrt{3}-\sqrt{2})}{(1+\sqrt{3}+\sqrt{2})}$

(2) $\tan^{-1} \frac{(\sqrt{3}-1+\sqrt{2})}{(1+\sqrt{3}-\sqrt{2})}$

(3) $\tan^{-1} \frac{(\sqrt{3}-1+\sqrt{2})}{(1-\sqrt{3}+\sqrt{2})}$

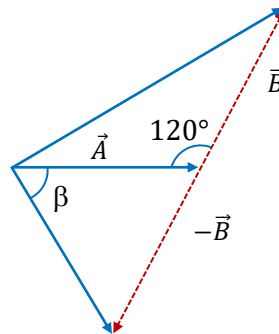
(4) $\tan^{-1} \frac{(1+\sqrt{3}-\sqrt{2})}{(1-\sqrt{3}-\sqrt{2})}$



PUV048

19. The angle between vector $(\vec{A})$ and $(\vec{A} - \vec{B})$ is :

[JEE Main-2021]



(1) $\tan^{-1} \left(\frac{-\frac{B}{2}}{A - B\frac{\sqrt{3}}{2}} \right)$

(2) $\tan^{-1} \left(\frac{A}{0.7B} \right)$

(3) $\tan^{-1} \left(\frac{\sqrt{3}B}{2A - B} \right)$

(4) $\tan^{-1} \left(\frac{B \cos \theta}{A - B \sin \theta} \right)$

PUV049

20. Identify the pair of physical quantities which have different dimensions:

[JEE Main-2022]

- | | |
|--|--|
| (1) Wave number and Rydberg's constant | (2) Stress and Coefficient of elasticity |
| (3) Coercivity and Magnetisation | (4) Specific heat capacity and Latent heat |

PUV050

21. If force (F), velocity (V) and time (T) are considered as fundamental physical quantity, then dimensional formula of density will be: [JEE Main-2023]

(1) $FV^{-2}T^2$ (2) $FV^{-4}T^2$ (3) FV^4T^{-6} (4) $F^2V^{-2}T^6$

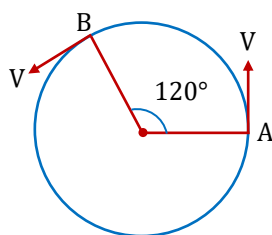
PUV163

22. The speed of a wave produced in water is given by $v = \lambda^a g^b \rho^c$. Where λ , g and ρ are wavelength of wave, acceleration due to gravity and density of water respectively. The values of a , b and c respectively, are : [JEE Main-2023]

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

PUV164

23. As shown in the figure, a particle is moving with constant speed π m/s. Considering its motion from A to B, the magnitude of the average velocity is: [JEE Main-2023]



(1) π m/s (2) $\sqrt{3}$ m/s (3) $2\sqrt{3}$ m/s (4) $1.5\sqrt{3}$ m/s

PUV165

24. A particle is moving with constant speed in a circular path. When the particle turns by an angle 90° , the ratio of instantaneous velocity to its average velocity is $\pi : x\sqrt{2}$. The value of x will be [JEE Main-2023]

(1) 2 (2) 5 (3) 1 (4) 7

PUV166

Exercise – III (JEE-Advanced Pattern)

SECTION-I

- This section contains **THREE** question.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:
Full Marks : +3 if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 if none of the bubbles is darkened.
Negative Marks : -1 in all other cases.

- A boy A is standing $20\sqrt{3}m$ away in a direction 30° north of east from his friend B . Another boy C standing somewhere east of B can reach A , if he walks in a direction 60° north of east. In a Cartesian coordinate system with its x -axis towards the east, the position of C with respect to A is
 (A) $(-20\hat{i} + -10\hat{j}) m$ (B) $(-10\hat{i} - 10\sqrt{3}\hat{j}) m$
 (C) $(10\hat{i} + 10\sqrt{3}\hat{j}) m$ (D) It depends on where we chose the origin.
PUV051
- A body moves in anticlockwise direction on a circular path in the x - y plane. The radius of the circular path is $5 m$ and its centre is at the origin. In a certain interval of time, displacement of the body is observed to be $6 m$ in the positive y -direction. Which of the following is true?
 (A) Its initial position vector is $5\hat{i} m$. (B) Its initial position vector is $(-3\hat{i} + 4\hat{j}) m$.
 (C) Its final position vector is $(4\hat{i} + 3\hat{j}) m$. (D) Its final position vector is $6\hat{j} m$.
PUV052
- A particle moves from a position $3\hat{i} + 2\hat{j} - 6\hat{k}$ to a position $14\hat{i} + 13\hat{j} + 9\hat{k}$ in m and a uniform force of $4\hat{i} + \hat{j} + 3\hat{k} N$ acts on it. The work done by the force is :-
 (A) $200 J$ (B) $100 J$ (C) $300 J$ (D) $500 J$
PUV053

SECTION-II

- This section contains **THREE** questions.
 - Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
 - For each question, choose the correct option(s) to answer the question.
 - Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 if only (all) the correct option(s) is (are) chosen.
Partial Marks : +3 if all the four options are correct but **ONLY** three options are chosen.
Partial Marks : +2 if three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
Partial Marks : +1 if two or more options are correct but **ONLY** one option is chosen and it is a correct option.
Zero Marks : 0 if none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -2 in all other cases.
- For Example :** If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

4. The vector $\hat{i} + x\hat{j} + 3\hat{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\hat{i} + (4x - 2)\hat{j} + 2\hat{k}$. The values of x are

(A) 1 (B) $-\frac{2}{3}$ (C) 2 (D) $\frac{4}{3}$

PUV054

5. The value of $|\vec{A} + \vec{B} - \vec{C} + \vec{D}|$ can be zero if :-

(A) $|\vec{A}| = 5, |\vec{B}| = 3, |\vec{C}| = 4, |\vec{D}| = 13$ (B) $|\vec{A}| = 2\sqrt{2}, |\vec{B}| = 2, |\vec{C}| = 2, |\vec{D}| = 5$
(C) $|\vec{A}| = 2\sqrt{2}, |\vec{B}| = 2, |\vec{C}| = 2, |\vec{D}| = 10$ (D) $|\vec{A}| = 5, |\vec{B}| = 4, |\vec{C}| = 3, |\vec{D}| = 8$

PUV055

6. Priya says that the sum of two vectors by the parallelogram method is $\vec{R} = 5\hat{i}$. Subhangi says it is $\vec{R} = \hat{i} + 4\hat{j}$. Both used the parallelogram method, but one used the wrong diagonal. Which one of the vector pairs below contains the original two vectors?

(A) $\vec{A} = +3\hat{i} - 2\hat{j}; \vec{B} = -2\hat{i} + 2\hat{j}$ (B) $\vec{A} = -3\hat{i} - 2\hat{j}; \vec{B} = +2\hat{i} + 2\hat{j}$
(C) $\vec{A} = +3\hat{i} + 2\hat{j}; \vec{B} = +2\hat{i} - 2\hat{j}$ (D) $\vec{A} = +3\hat{i} + 2\hat{j}; \vec{B} = -2\hat{i} + 2\hat{j}$

PUV056

SECTION-III

- This section contains **TWO** paragraphs.
- Based on each paragraph, there are **THREE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 if only the bubble corresponding to the correct answer is darkened.

Zero Marks : 0 in all other cases.

PARAGRAPH FOR QUESTION NO. 7 TO 9

In a certain system of absolute units, the acceleration produced by gravity in a body falling freely is denoted by 5, the kinetic energy of a 500 kg shot moving with velocity 400 metres per second is denoted by 2000 and its momentum by 100.

7. The unit of length is :-

(A) 15 m (B) 50 m (C) 25 m (D) 100 m

PUV057

8. The unit of time is :-

(A) 10 s (B) 20 s (C) 5 s (D) 15 s

PUV058

9. The unit of mass is :-

(A) 200 kg (B) 400 kg (C) 800 kg (D) 1200 kg

PUV059

PARAGRAPH FOR QUESTION NO. 10 TO 12

A physical quantity is a physical property of a phenomenon, body, or substance, that can be quantified by measurement.

The magnitude of the components of a vector are to be considered dimensionally distinct. For example, rather than an undifferentiated length unit L , we may represent length in the x direction as L_x , and so forth. This requirement stems ultimately from the requirement that each component of a physically meaningful equation (scalar or vector) must be dimensionally consistent. As an example, suppose we wish to calculate the drift S of a swimmer crossing a river flowing with velocity V_x and of width D and he is swimming in direction perpendicular to the river flow with velocity V_y relative to river, assuming no use of directed lengths, the quantities of interest are then

V_x, V_y both dimensioned as $\frac{L}{T}$, S the drift and D width of river both having dimension L . With these four quantities, we may conclude that the equation for the drift S may be written: $S = V_x^a V_y^b D^c$

Or dimensionally $L = \left(\frac{L}{T}\right)^{a+b} \times (L)^c$ from which we may deduce that $a + b + c = 1$ and $a + b = 0$, which leaves one of these exponents undetermined. If, however, we use directed length dimensions, then V_x will be dimensioned as $\frac{L_x}{T}$, V_y as $\frac{L_y}{T}$, S as L_x and D as L_y . The dimensional equation becomes :

$L_x = \left(\frac{L_x}{T}\right)^a \left(\frac{L_y}{T}\right)^b (L_y)^c$ and we may solve completely as $a = 1, b = -1$ and $c = 1$. The increase in deductive power gained by the use of directed length dimensions is apparent.

10. Which of the following is not a physical quantity

(A) Height of a boy (B) Weight of a boy
(C) Fever of a boy (D) Speed of a running boy

PUV060

11. From the concept of directed dimension what is the formula for a range (R) of a cannon ball when it is fired with vertical velocity component V_y and a horizontal velocity component V_x assuming it is fired on a flat surface. [Range also depends upon acceleration due to gravity, g and k is numerical constant]

(A) $R = \frac{k(V_x V_y)}{g}$ (B) $R = \frac{k(V_x)^2}{g}$ (C) $R = \frac{k(V_x)^3}{V_y g}$ (D) $R = \frac{k(V_y)^3}{V_x g}$

PUV061

12. A conveyer belt of width D is moving along x -axis with velocity V . A man moving with velocity U on the belt in the direction perpendicular to the belt's velocity with respect to belt wants to cross the belt. The correct expression for the drift (S) suffered by man is given by (k is numerical constant)

(A) $S = k \frac{UD}{V}$ (B) $S = k \frac{VD}{U}$ (C) $S = k \frac{U^2 D}{V^2}$ (D) $S = k \frac{V^2 D}{U^2}$

PUV062

SECTION-IV

- This section contains **ONE** question of matching type.
- This section contains **One** table (having 3 columns and 4 rows)
- Based on table, there are **THREE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 if only (all) the correct option(s) is (are) chosen.

Partial Marks : +3 if all the four options are correct but **ONLY** three options are chosen.

Partial Marks : +2 if three or more options are correct but **ONLY** two options are chosen, both of which are correct options.

Partial Marks : +1 if two or more options are correct but **ONLY** one option is chosen and it is a correct option.

Zero Marks : 0 if none of the options is chosen (i.e. the question is unanswered).

Negative Marks : -2 in all other cases.

For Example: If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

Answer Q.13, Q.14 and Q.15 by appropriately matching the information given in the three columns of the following table.

L , M and T are units of length, Mass and Time respectively in a system of units.

Column-1	Column-2	Column-3
(I) $L = 10\text{ m}$	(i) $M = 100\text{ gm}$	(P) $T = 0.1\text{ sec.}$
(II) $L = 10\text{ cm}$	(ii) $M = 10\text{ kg}$	(Q) $T = 10\text{ ms}$
(III) $L = 0.1\text{ mm}$	(iii) $M = 10\text{ gm}$	(R) $T = 10\text{ sec.}$
(IV) $L = 1\text{ km}$	(iv) $M = 1\text{ tonne}$	(S) $T = 0.01\text{ sec.}$

13. In which of the following combinations unit of force is 10^6 dyne. [$F = ma$]
 (A) (IV) (i) (P) (B) (II) (iii) (S) (C) (III) (iv) (P) (D) (I) (ii) (Q)

PUV063

14. In which of the following system, unit of energy is 10^9 erg ? [$E = F \times S$]
 (A) (III) (i) (S) (B) (IV) (iii) (R) (C) (II) (iv) (Q) (D) (I) (iii) (P)

PUV064

15. In which of the following system, unit for coefficient of viscosity is 100 poiseuille ? [$\eta = \frac{F}{6\pi r v}$]
 (A) (III) (ii) (S) (B) (II) (i) (Q) (C) (III) (iii) (R) (D) (IV) (iv) (P)

PUV065

SECTION-V

- This section contains **THREE** questions.
- Each question contains two columns, **Column-I** and **Column-II**.
- **Column-I** has **four** entries (A), (B), (C) and (D).
- **Column-II** has **five** entries (P), (Q), (R), (S) and (T).
- Match the entries in **Column-I** with the entries in **column-II**.
- One or more entries in **Column-I** may match with one or more entries in **Column-II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below:

(A) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)(B) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)(C) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)(D) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

- For each entry in **column-I**, darken the bubbles of all the matching entries. For example, if entry (A) in **Column-I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (B), (C) and (D).
- For each question, marks will be awarded in one of the following categories :

For each entry in **Column-I**

Full Marks : +2 if only the bubble(s) corresponding to all the correct match(es) is (are) darkened.

Zero Marks : 0 if none of the bubbles is darkened.

Negative Marks : -1 in all other cases.

- 16.** In a new system of units known as *RMP*, length is measured in 'retem', mass is measured in 'marg' and time is measured in 'pal'.

$$100 \text{ retem} = 1.0 \text{ meter}$$

$$1.0 \text{ marg} = 10^{-3} \text{ kilogram}$$

$$10 \text{ pal} = 1.0 \text{ second}$$

In the given table some unit conversion factors are given. Suggest suitable match.

Column-I	Column-II
(A) One SI unit of force	(P) 10^2 units of <i>RMP</i>
(B) One SI unit of potential energy	(Q) 10^3 units of <i>RMP</i>
(C) One SI unit of power	(R) 10^4 units of <i>RMP</i>
(D) One SI unit of momentum	(S) 10^5 units of <i>RMP</i>
	(T) 10^6 units of <i>RMP</i>

PUV066

17. Two particles A and B start from origin of a coordinate system towards point $P(10, 20)$ and $Q(20, 10)$ respectively with speed $5\sqrt{5}$ each. Both continue their motion for 10 s and then stop. There after particle B moves towards particle A with speed $2\sqrt{2}$ and after particle B meets particle A , they both return to origin following a straight line path with speed $5\sqrt{5}$. Match the items of column-I with suitable items of Column-II.

Column-I

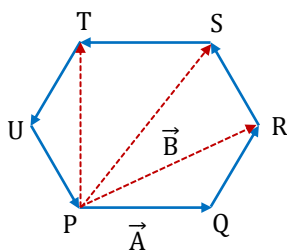
- (A) Initial velocity vector of A
 (B) Initial velocity of B
 (C) Velocity vector of B while it moves towards A
 (D) Velocity vector of A and B while they return to origin

Column-II

- (P) $(-5\hat{i} - 10\hat{j})$
 (Q) $(5\hat{i} + 10\hat{j})$
 (R) $(10\hat{i} + 5\hat{j})$
 (S) $(2\hat{i} - 2\hat{j})$
 (T) $(-2\hat{i} + 2\hat{j})$

PUV067

18. In a regular hexagon two vectors $\overrightarrow{PQ} = \vec{A}$, $\overrightarrow{RP} = \vec{B}$. Express other vector's in term of them :-



Column-I

- (A) $\overrightarrow{PS}$
 (B) $\overrightarrow{PT}$
 (C) $\overrightarrow{RS}$
 (D) $\overrightarrow{TS}$

Column-II

- (P) $-2\vec{B} - 3\vec{A}$
 (Q) $-\vec{B} - \vec{A}$
 (R) $-\vec{B} - 2\vec{A}$
 (S) $-2(\vec{B} + \vec{A})$
 (T) $\vec{A}$

PUV068

Exercise - IV (JEE-Advanced PYQs)

1. Match List I with List II and select the correct answer using the codes given below the lists:

List I

- P. Boltzmann constant
Q. Coefficient of viscosity
R. Planck constant
S. Thermal conductivity

List II

1. $[ML^2T^{-1}]$
2. $[ML^{-1}T^{-1}]$
3. $[MLT^{-3}K^{-1}]$
4. $[ML^2T^{-2}K^{-1}]$

[JEE Advanced-2013]

Codes:

	P	Q	R	S		P	Q	R	S
(A)	3	1	2	4	(B)	3	2	1	4
(C)	4	2	1	3	(D)	4	1	2	3

PUV069

2. To find the distance d over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance depends on the mass density ρ of the fog, intensity (power/area) S of the light from the signal and its frequency f . The engineer finds that d is proportional to $S^{1/n}$. The value of n is.

[JEE Advanced-2014]

PUV070

3. In terms of potential difference V , electric current I , permittivity ϵ_0 , permeability μ_0 and speed of light c , the dimensionally correct equation(s) is(are)–

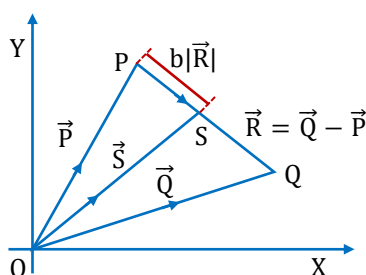
[JEE Advanced-2015]

- (A) $\mu_0 I^2 = \epsilon_0 V^2$ (B) $\epsilon_0 I = \mu_0 V$ (C) $I = \epsilon_0 cV$ (D) $\mu_0 cI = \epsilon_0 V$

PUV071

4. Three vectors $\vec{P}$, $\vec{Q}$ and $\vec{R}$ are shown in the figure. Let S be any point on the vector $\vec{R}$. The distance between the points P and S is $b|\vec{R}|$. The general relation among vectors $\vec{P}$, $\vec{Q}$ and $\vec{S}$ is:

[JEE Advanced-2017]



- (A) $\vec{S} = (1 - b)\vec{P} + b^2\vec{Q}$ (B) $\vec{S} = (b - 1)\vec{P} + b\vec{Q}$
(C) $\vec{S} = (1 - b)\vec{P} + b\vec{Q}$ (D) $\vec{S} = (1 - b^2)\vec{P} + b\vec{Q}$

PUV072

5. Two vectors $\vec{A}$ and $\vec{B}$ are defined as $\vec{A} = a\hat{i}$ and $\vec{B} = a(\cos \omega t \hat{i} + \sin \omega t \hat{j})$, where a is a constant and $\omega = \pi/6 \text{ rad s}^{-1}$. If $|\vec{A} + \vec{B}| = \sqrt{3}|\vec{A} - \vec{B}|$ at time $t = \tau$ for the first time, the value of τ , in seconds, is ____.

[JEE Advanced-2018]

PUV073

PARAGRAPH FOR QUESTION NO. 6 & 7

In electromagnetic theory, the electric and magnetic phenomena are related to each other. Therefore, the dimensions of electric and magnetic quantities must also be related to each other. In the questions below, $[E]$ and $[B]$ stand for dimensions of electric and magnetic fields respectively, while $[\epsilon_0]$ and $[\mu_0]$ stand for dimensions of the permittivity and permeability of free space respectively. $[L]$ and $[T]$ are dimensions of length and time respectively. All the quantities are given in SI units.

[JEE Advanced-2018]

6. The relation between $[E]$ and $[B]$ is :-

(A) $[E] = [B][L][T]$ (B) $[E] = [B][L]^{-1}[T]$ (C) $[E] = [B][L][T]^{-1}$ (D) $[E] = [B][L]^{-1}[T]^{-1}$

PUV074

7. The relation between $[\epsilon_0]$ and $[\mu_0]$ is :-

(A) $[\mu_0] = [\epsilon_0][L]^2[T]^{-2}$ (B) $[\mu_0] = [\epsilon_0][L]^{-2}[T]^2$
(C) $[\mu_0] = [\epsilon_0]^{-1}[L]^2[T]^{-2}$ (D) $[\mu_0] = [\epsilon_0]^{-1}[L]^{-2}[T]^2$

PUV075

8. Let us consider a system of units in which mass and angular momentum are dimensionless. If length has dimension of L , which of the following statement (s) is/are correct ?

[JEE Advanced-2019]

(A) The dimension of force is L^{-3} (B) The dimension of energy is L^{-2}
(C) The dimension of power is L^{-5} (D) The dimension of linear momentum is L^{-1}

PUV076

9. Sometimes it is convenient to construct a system of units so that all quantities can be expressed in terms of only one physical quantity. In one such system, dimensions of different quantities are given in terms of a quantity X as follows: [position] = $[X^a]$; [speed] = $[X^b]$; [acceleration] = $[X^c]$; [linear momentum] = $[X^d]$; [force] = $[X^e]$. Then

[JEE Advanced-2020]

(A) $\alpha + p = 2\beta$ (B) $p + q - r = \beta$ (C) $p - q + r = \alpha$ (D) $p + q + r = \beta$

PUV077

10. A physical quantity $\vec{S}$ is defined as $\vec{S} = (\vec{E} \times \vec{B}) / \mu_0$, where $\vec{E}$ is electric field, $\vec{B}$ is magnetic field and μ_0 is the permeability of free space. The dimensions of $\vec{S}$ are the same as the dimensions of which of the following quantity/quantities ?

[JEE Advanced-2021]

(A) $\frac{\text{Energy}}{\text{Charge} \times \text{current}}$ (B) $\frac{\text{Force}}{\text{Length} \times \text{Time}}$
(C) $\frac{\text{Energy}}{\text{Volume}}$ (D) $\frac{\text{Power}}{\text{Area}}$

PUV078

11. In a particular system of units, a physical quantity can be expressed in terms of the electric charge e , electron mass m_e , Planck's constant h , and Coulomb's constant $k = \frac{1}{4\pi\epsilon_0}$, where ϵ_0 is the permittivity of vacuum. In terms of these physical constants, the dimension of the magnetic field is $[B] = [e]^\alpha [m_e]^\beta [h]^\gamma [k]^\delta$. The value of $\alpha + \beta + \gamma + \delta$ is _____. **[JEE Advanced-2022]**

PUV079

12. Young's modulus of elasticity Y is expressed in terms of three derived quantities, namely, the gravitational constant G , Planck's constant h and the speed of light c , as $Y = c^\alpha h^\beta G^\gamma$. Which of the following is the correct option ? **[JEE Advanced-2023]**

(A) $\alpha = 7, \beta = -1, \gamma = -2$

(B) $\alpha = -7, \beta = -1, \gamma = -2$

(C) $\alpha = 7, \beta = -1, \gamma = 2$

(D) $\alpha = -7, \beta = 1, \gamma = -2$

PUV167

ANSWER KEY

Exercise – I (JEE-Main Pattern)

Section-A	Q.	1	2	3	4	5	6	7	8	9	10
	A.	4	3	4	4	4	2	2	4	1	3
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	3	1	4	1	1	1	4	1	3	5
Section-B	Q.	1	2	3	4	5	6	7	8	9	10
	A.	4	3350	3	2	2	1	4	5	3	6

Exercise – II (JEE-Main PYQs)

Question	1	2	3	4	5	6	7	8	9	10
Answer	3	2	3	3	2	4	4	2	4	1
Question	11	12	13	14	15	16	17	18	19	20
Answer	1	2	180	2	4	4	1	1	3	4
Question	21	22	23	24						
Answer	2	1	4	1						

Exercise – III (JEE-Advanced Pattern)

Section-I	Q.	1	2	3			
	A.	B	C	B			
Section-II	Q.	4	5	6			
	A.	BC	BD	CD			
Section-III	Q.	7	8	9	10	11	12
	A.	B	C	A	C	A	B
Section-IV	Q.	13	14	15			
	A.	BC	BD	B			
Section-V	Q.	16			17		
	A.	(A-Q), (B-S), (C-R), (D-R)			(A-Q), (B-R), (C-T), (D-P)		
	Q.	18					
	A.	(A-S), (B-P), (C-R), (D-T)					

Exercise - IV (JEE-Advanced PYQs)

Question	1	2	3	4	5	6	7	8	9	10
Answer	C	3	AC	C	2	C	D	ABD	AB	BD
Question	11	12								
Answer	4	A								