BASIC CONCEPT OF PHYSICS

QUANTITIES AND UNITS

PHYSICAL QUANTITIES:

Anything that we measure to describe the laws of physics are known as physical quantities. Physical quantities can be classified on the following bases.

I. BASED ON THEIR DIRECTIONAL PROPERTIES:

Scalars: The physical quantities which have only magnitude but no direction are called scalar quantities. e.g mass, density, volume, time etc.

Vectors: The physical quantities which have both magnitude and direction and obey laws of vector alzebra are called vector quantities. e.g. displacement, force, velocity etc.

II. BASED ON THEIR DEPENDENCY

Fundamental or base quantities: The quantities which do not depend upon other quantities for their complete definition are known as fundamental or base quantities. e.g. length, mass, time, temperature, electric current, luminous intensity and amount of substance.

Derived quantities: The quantities which can be expressed in terms of the fundamental quantities are known as derived quantities. e.g. speed (distance/time), volume, acceleration, force, pressure etc.

UNITS OF PHYSICAL QUANTITIES:

The measure of any quantity is always a multiple of some well defined standard measurement. **This standard measurement is called as unit.** Example 10 kg potato is 10 times of 1 kg which is well defined standard measurement. Thus 1 kg will be consider as a unit of mass. Again 1 kg is 1000 times of 1 gm which is again a well defined standard measurement. Thus 1 gm is also consider as a unit.

CLASSIFICATION OF UNITS:

BASIC UNITS SYSTEMS

Quantity	Name of System			
	CGS	FPS	MKS	SI
Length	centimeter	foot	meter	meter(m)
Mass	gram	pounds	kilogram	kilogram(kg)
Time	second	second	second	second(s)
Temperature	Kelvin		Kelvin	Kelvin(K)
Electric Current			ampere	ampere(A)
Luminous Intensity				candela(cd)
Amount of Substance				mole(mol)

In the above all the quantities are independent and called as fundamental quantities and their units are called as fundamental units.

In SI system there are two supplementary units.

(i) Radian (rad): Unit of plane angle

(ii) Steradian (st): Unit of Solid angle

S.I. Prefixes			
S. No.	**Prefix**	**Symbol**	**Power of 10**
1.	exa	E	18
2.	peta	P	15
3.	tera	T	12
4.	giga	G	9
5.	mega	M	6
6.	kilo	K	3
7.	hector	h	2
8.	deca	da	1
9.	deci	d	-1
10.	centi	c	-2
11.	milli	m	-3
12.	micro	μ	-6
13.	nano	n	-9
14.	pico	p	-12
15.	femto	f	-15
16.	atto	a	-18

Illustration 1: ***How many meter are there in 300 nm? How many micrometer are there in 700 nm?***

Solution:

$300 \text{ nm} = 300 \times 10^{-9} \text{ m} = 3 \times 10^{-7}\text{m}$

$700 \text{ nm} = 700 \times 10^{-9}\text{m} = 700 \times 10^{-3} \text{ μm} = 7 \times 10^{-1}\text{μm}.$

Practical units of Length	
S. No.	
1.	Light year = 9.46×10^{15}m
2.	Parsec = 3.084×10^{16}m
3.	Angstrom(Å) = 10^{-10}m
4.	Micrometer = 10^{-6}m
5.	Astronomical Unit (AU) = 1.496×10^{11}m
6.	Otto meter = 10^{-21}m.

Derived Units: The units of derived quantities or the units that can be expressed in terms of the base units are called derived units. e.g. unit of speed

Some derived units are named in honour of great scientists.

e.g. unit of force - newton (N), unit of frequency - hertz (Hz) etc.

CONVERSTION FACTORS

Some important conversions:

(i) Unit of density in SI system is $1\frac{kg}{m^3}$ convert into C.G.S. System i.e., g/cm^3.

$$1\frac{kg}{m^3}=\frac{10^3 g}{10^2\times10^2\times10^2 cm^3}=10^{-3}\ g/cm^3$$

Thus $1000\ kg/m^3 = 10^3 \times 10^{-3}\ g/cm^3$

$\Rightarrow 1\ g/cm^3 = 10^3\ kg/m^3 = 1\ g/cm^3$.

(ii) Practical unit of speed or velocity is, km/hr. Convert 1 km/hr into m/s.

$$1\frac{km}{hr}=\frac{1000m}{60\times60S}=\frac{5}{18}m/s$$

Thus 72 km/hr = $\left(72\times\frac{5}{18}\right)$ m/s = 20 m/s

$\Rightarrow$ 1 m/s = 18/5 km/hr.

(iii) In SI system unit of force is $1N = 1kg\times\frac{m}{s^2}$

In C.G.S. system unit of force is idyne = $1g \times cm/s^2$

convert 1N into 1 dyne.

$$1N = 1\ kg\ \times 1\frac{m}{s^2}=10^3\ g\times10^2\ cm/s^2$$

$= 10^5\ g\ cm/s^2 = 10^5$ dyne.

$\Rightarrow$ 1dyne = 10^{-5}N.

TRIGONOMETRY

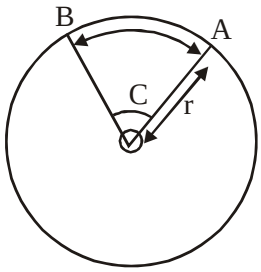
Measurement of an angle

Radian: It is the S.I. unit of plane angle.

One radian: The angle subtended at the centre of a circle by an arc equal in length of the radius of the circle

AB = *l* = length of arc

OA = OB = r = radius of the circle



If *l* = r then $\angle$ AOB = θ = 1 radian, A radian is a constant angle,

2π radian = 360°

or, 1 radian = $\frac{360}{2\pi}=57.27°$

Some Important Equations

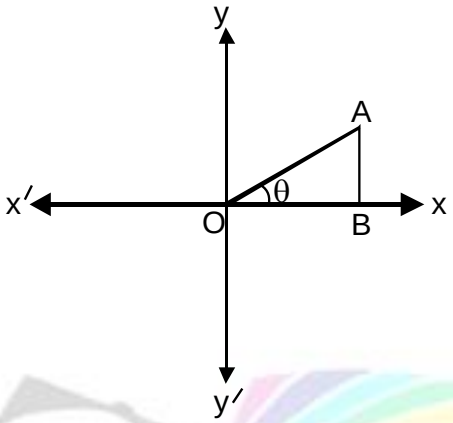
$$\text{Angle} = \frac{\text{arc}}{\text{radius}}$$

$\Rightarrow$ 1 right angle = 90 degrees (90°)

$\Rightarrow$ 1 degree = 60 minutes (60′)

$\Rightarrow$ 1 minutes = 60 seconds (60″)

Some Important Terms



OB = base = b

AB = perpendicular = p

OA = Hypotenuse = h

i. $\sin\theta = \frac{\text{perpendicular}}{\text{Hypotenuse}}$

ii. $\cos\theta = \frac{\text{Base}}{\text{Hypotenuse}}$

iii. $\tan\theta = \frac{\text{perpendicular}}{\text{base}}$

$$\tan\theta = \frac{p}{b} = \frac{AB}{OB}$$

iv. $\sec\theta = \frac{1}{\cos\theta} = \frac{h}{b}$

v. $\text{cosec}\theta = \frac{1}{\sin\theta} = \frac{h}{p}$

vi. $\cot\theta = \frac{1}{\tan\theta} = \frac{b}{p}$

vii. $\tan\theta = \frac{\sin\theta}{\cos\theta}$

viii. $\sin^2\theta + \cos^2\theta = 1$

ix. $\sin^2\theta = 1 - \cos^2\theta$

x.

VALUE OF TRIGONOMETRICAL RATIO OF SOME ANGLE

Angle (a)	sin θ	cos θ	tan θ
0°	0	1	0
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{3}}$

45°	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	1
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$
90°	1	0	∞
120°	$\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$	$-\sqrt{3}$

TRIGONOMETRICAL RATIOS OF ALLIDED ANGLES

- When the sum of two angles is equal to 90°, they are called complementary angles.
- When the sum of two angles is equal to 180°, they are called supplementary angles.
- The angle whose sum or difference with angle θ is zero or a multiple of 90° are called allied angle to θ.

SOME ALLIED ANGLES, WHICH ARE COMMONLY USED

1. $\sin(-\theta) = -\sin\theta$
   $\operatorname{cosec}(-\theta) = -\operatorname{cosec}\theta$
   $\cos(-\theta) = \cos\theta$
   $\sec(-\theta) = \sec\theta$
   $\tan(-\theta) = -\tan\theta$
   $\cot(-\theta) = -\cot\theta$
2. $\sin(90-\theta) = \cos\theta$
   $\operatorname{cosec}(90-\theta) = \sec\theta$
   $\cos(90-\theta) = \sin\theta$
3. $\sin(90+\theta) = \cos\theta$
   $\cos(90+\theta) = -\sin\theta$
   $\tan(90+\theta) = -\cot\theta$
4. a) $\sin(180°-\theta) = \sin\theta$; $\sin(180+\theta) = -\sin\theta$
   b) $\cos(180°-\theta) = -\cos\theta$; $\cos(180+\theta) = -\cos\theta$
   c) $\tan(180°-\theta) = -\tan\theta$; $\tan(180+\theta) = \tan\theta$

SOME USE FULL IDENTITIES

1. $\sin(A+B) = \sin A$ and $B + \cos A \sin B$
2. $\cos(A+B) = \cos A \cos B - \sin A \sin B$
3. $\sin(A-B) = \sin A \cos B - \cos A \sin B$
4. $\cos(A-B) = \cos A \cos B + \sin A \sin B$
5. $\sin 2A = 2 \sin A \cos A$
6. $\cos 2A = \cos^2 A - \sin^2 A = 1 - 2\sin^2 A = 2\cos^2 A - 1$.

VECTORS

INTRODUCTION

Mathematics is the language of physics. Certain physical quantities are completely described by numerical value alone and are added according to the ordinary rules of algebra. But the complete description of another set of physical quantities requires a numerical value (with units) as well as direction in space. It becomes easier to describe, understand and apply the physical principles, if one has a sound knowledge of vector algebra and calculus.

SCALARS

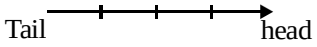
Certain physical quantities are completely described by a numerical value alone and are added according to the ordinary rules of algebra. Such quantities are called *scalars*.

e.g. If two bodies, one having of mass 5 kg and other having a mass of two kg are added together to make a composite system, the total mass of a system becomes 5kg + 2kg = 7kg.

VECTORS

The physical quantities which have magnitude and direction and which can be added according to the rules of vectors are called *vector quantities*.

Geometrically the vector is represented by a line of particular length, putting an arrow showing the direction of a vector.



The front end is called the head and the rear end is called the tail. The vectors are denoted by putting an arrow over the symbols representing them. Thus we write $\overrightarrow{AB}$, $\overrightarrow{BC}$ etc. Sometimes a vector is represented by a single letter such as $\vec{v}, \vec{F}$ etc. Quite often in printed books the vectors are represented by bold face letters like **AB., BC, v, f** etc.

Note : *Electric current has both magnitude and direction but it does not add up according to the vector's rule. Hence it is not a vector quantity.*

Various Types of Vectors

Parallel vectors: If two or more vectors are parallel to the same line, they are said to be parallel vectors. In figure (a), the vectors $\vec{P}, \vec{Q}, \vec{R}$ & $\vec{S}$ are parallel vectors. Further, $\vec{P}$ and $\vec{R}$ are like vectors or $\vec{Q}$ and $\vec{R}$ are unlike vectors.

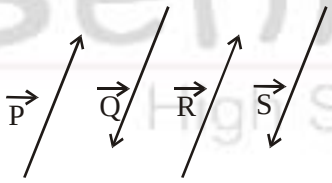


figure (a)

Equal vectors: "If two or more vectors have equal magnitude and acting in the same direction, they are said to be equal vectors". In the figure (b), the two vectors arrows have equal length and same orientation.

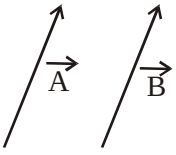


figure (b)

Hence they represent two equal vectors $\vec{A}$ & $\vec{B}$ even though they start at different initial points and end at different terminus.

Negative of a vector: If two vectors $\vec{A}$ and $\vec{B}$ are such that they have equal magnitude but opposite directions, each vector is negative of the other.

Thus or $\vec{A} = -\vec{B}$ or $\vec{B} = -\vec{A}$

Null vector: "A vector of zero magnitude is called zero vector or null vector". It is represented by $\vec{0}$. The initial point and terminus of the null vector coincide. Its direction is indeterminate.

Unit Vector: "A vector of unit magnitude is called unit vector". The unit vector in the direction of given vector is obtained by dividing the given vector with its magnitude. It is conventional to denote unit vector with a "cap". Thus if $\vec{A}$ is a given vector, the unit vector in the direction of $\hat{A}$ is written as

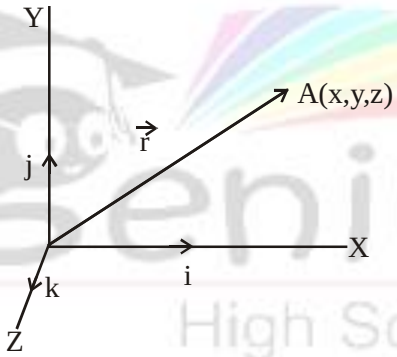
$\hat{A} = \frac{\vec{A}}{|\vec{A}|}$ (where $\hat{A}$ is read as A cap or A hat)

Note: In the right handed Cartesian coordinate system, i, j and k are chosen as unit vectors along, the X-axis, Y-axis and Z-axis respectively.

The graphical representation of Position Vector

"The vector used to specify the position of a point with respect to some fixed point (say origin 'O') is called position vector". It is denoted as $\vec{r}$.

Consider a point 'A' with coordinates x, y, z in the Cartesian coordinate system. Thus the position of 'A' can be expressed in the vector form as $\overrightarrow{OA} = \vec{r} = xi + yi + yi + zk.$ Here i, j and k are unit vectors along the X, Y and Z axes respectively. The distance of 'A' from the origin eventually becomes the magnitude of $\vec{r}$.



Displacement

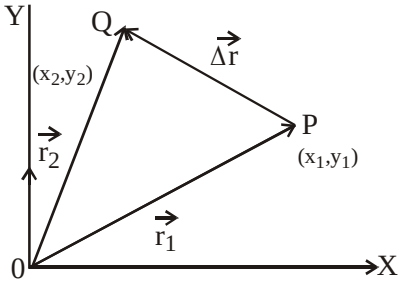
Displacement is a shortest distance between two points. It is a vector quantity.

Displacement Vector

The position of the point Q with reference to the origin is represented by the position vector $\vec{r}$. Let the coordinates of the point Q are (x_2, y_2).

Similarly $\overrightarrow{OP}$ represented by a position vector $\vec{r}_1$, let the coordinates of the point P are (x_1, y_1).

As the displacement vector is the difference of two position vectors $\vec{r}_1 = x_1\hat{i} + y_1\hat{j}$ and $\vec{r}_2 = x_2\hat{i} + y_2\hat{j}$, where $\hat{i}, \hat{j}$, are unit vectors along X, Y axis respectively. Thus, the displacement vector $\Delta\vec{r} = \vec{r}_2 - \vec{r}_1 = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{i}.$

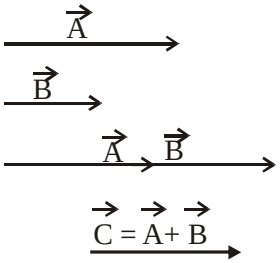


ADDITON OF VECTORS

Addition Of Vectors When They are in

(a) Same Direction

If two vectors are in the same direction, their resultant (sum) is obtained by adding their vector lengths as shown in the figure. The direction of resultant is same as the individual vectors. Addition of vectors in same direction.

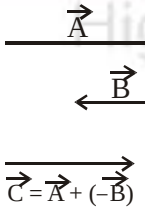


Addition Of Two Vectors In

(b) Opposite Direction

If the vectors are mutually opposite, their resultant is obtained by subtracting the length of smaller vector.

Addition of vectors in opposite from that of larger vector as shown in figure. The direction of resultant is same as that of larger vector. (Triangle law)

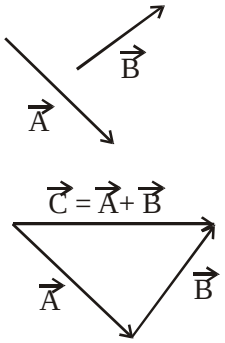


(c) Inclined Mutually

(i) Triangle Law Of Vectors

If two vectors are mutually inclined, the following procedure is adopted to find their sum. $\vec{A}$ and $\vec{B}$ are the given vectors. $\vec{B}$ is slides parallel to itself, such that its "tail" coincides with the head of $\vec{A}$ as shown in figure. Then the directed line segment drawn from the tail of $\vec{A}$ to the head of $\vec{B}$ represents the addition of $\vec{A}$ and $\vec{B}$.

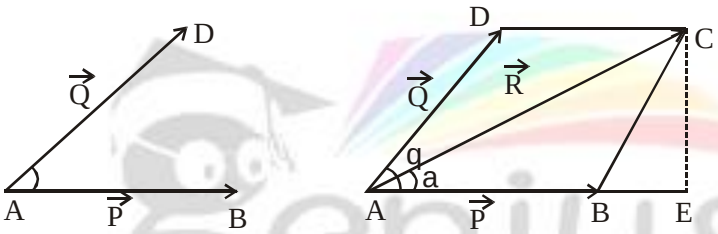
If two vectors are represented in magnitude and direction by the two sides of a triangle taken in order, the third side of the triangle taken in reverse order represents their resultant in magnitude and direction.



(ii) Parallelogram Law Of Vectors

Two vector quantities (say, velocity, acceleration, force, etc) can be added using parallelogram law. This law is useful to find both magnitude and direction of resultant.

Statement: If two vectors are represented in magnitude and direction by the adjacent sides of a parallelogram drawn from a point, the diagonal passing through that point represents their resultant both in magnitude and direction.



Explanation: $\vec{P}$ and $\vec{Q}$ are two vectors represented by $\overrightarrow{AB}$ and $\overrightarrow{AD}$. Both vectors act at the common point A and mutually inclined at angle ' θ ' as shown in figure. If the parallelogram ABCD is completed taking AB and AD as adjacent sides, then the diagonal $\overrightarrow{AC}$ represents their resultant $\left(\vec{R}\right)$ both in magnitude and direction.

Magnitude of the Resultant : The line of $\vec{P}$ action of is extended. The perpendicular drawn from 'C' meets the extension of AB at E.

From the figure, it is obvious that $\overrightarrow{BC} = \overrightarrow{AD} = \vec{Q}$ and $\angle\overrightarrow{CBE} = \theta$

$\therefore$ Length of AB = magnitude of $\vec{P} = P$

Length of BC = magnitude of $\vec{Q} = Q$

Length of AC = magnitude of $\vec{R} = R$

From triangle CBE, $BE = BC\cos\theta \Rightarrow BE = Q\cos\theta$ ..... (i)

$$\frac{EC}{BC} = \sin\theta \text{ and } EC = Q\sin\theta \quad \text{..... (ii)}$$

$$(AC)^2 = (AE)^2 + (EC)^2$$

$$\Rightarrow \quad (AC)^2 = (AB + BE)^2 + (EC)^2 \quad \Rightarrow \quad (AC)^2 = (AB)^2 + (BE)^2 + 2AB.BE + (EC)^2$$

$$\Rightarrow \quad R^2 = P^2 + Q^2\cos^2\theta + 2PQ\cos\theta + Q^2\sin^2\theta \Rightarrow R^2 = P^2 + Q^2 + 2PQ\cos\theta$$

$$\Rightarrow \quad \boldsymbol{R = \sqrt{P^2 + Q^2 + 2PQcos\theta}} \quad \text{..... (iii)}$$

Direction of the Resultant: The resultant makes angle ' α ' with $\vec{A}$ (say).

From triangle CAE: $\tan\alpha = \frac{EC}{AE} = \frac{EC}{AB + BE} \Rightarrow \tan\alpha = \frac{Q\sin\theta}{P + Q\cos\theta}$

$$\Rightarrow \quad \alpha = tan^{-1}\left[\frac{Qsin\theta}{P + Qcos\theta}\right] \qquad \text{..... (iv)}$$

The expression (iii) and (iv) gives the magnitude and direction of the resultant of $\vec{P}$ and $\vec{Q}$.

Special Cases :

(a) If $\vec{P}$ and $\vec{Q}$ are in the same direction, then $\theta = 0^\circ$, and $\cos\theta = 1$

From equation (iii) and (iv), R = P + Q and $\alpha = 0$

Hence the magnitude of resultant is sum of the magnitude of individual vectors. The direction of resultant is same as that of individual vectors.

(b) If $\vec{P}$ and $\vec{Q}$ are opposite, then $\theta = 180°$ and $\cos\theta = -1$

$\therefore R = P - Q$ i.e. $R = P - Q$ or $Q - P$ and $\alpha = 0^\circ$ or $180°$.

Thus the magnitude of resultant is equal to difference of magnitudes of individual vectors and the direction of resultant is same as that of the vector of larger magnitude.

(c) $\vec{P}$ and $\vec{Q}$ are perpendicular, then $\theta = 90°$ and $\cos\theta = 0$

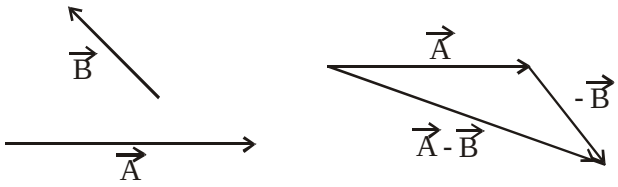
$\therefore \quad R = \sqrt{P^2 + Q^2}$ and $\alpha = \tan^{-1}(Q/P)$

(d) If $|\vec{P}| = |\vec{Q}|$, then $R = 2P\cos(q/2)$ and $\alpha = \theta/2$

$\therefore$ If the vectors have equal magnitude, then the resultant will bisect the angle between them.

Subtraction Of Vectors

The subtracting of vector $\vec{B}$ from the vector $\vec{A}$, is same as addition of $-\vec{B}$ to $\vec{A}$ as shown in figure i..e., $\vec{A} - \vec{B} = \vec{A} + (-\vec{B})$



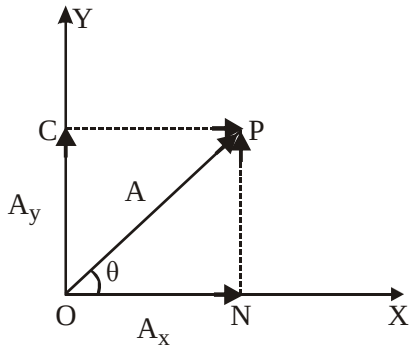
The vector $\vec{B}$ is reversed to get negative vector of $\vec{B}$. Then reversed vector $-\vec{B}$ is shifted parallel to itself such that tail of $-\vec{B}$ coincides with head of $\vec{A}$. The directed line segment $\overrightarrow{PR}$ represents the subtracting of $\vec{B}$ from $\vec{A}$.

Vector subtracting does not obey commutative law. i.e., $\vec{A} - \vec{B} \neq \vec{B} - \vec{A}$.

Resolution Of A Vector Into Two Rectangular Components

(a) The process of splitting a vector is called resolution of a vector. The parts obtained after resolution are known as components of the given vector.

(b) If the components of a given vector are perpendicular to each other, then they are called **rectangular components.** These are the most important components of a vector.



Let, $\vec{A}_x$ and $\vec{A}_y$ are the rectangular components of $\vec{A}$.

Applying triangle law of vectors to the vector triangle ONP, we get

$\vec{A}_x + \vec{A}_y = \vec{A}$

(c) This equation confirms that $\vec{A}_x$ and $\vec{A}_y$ are the components of $\vec{A}$.

In right angled triangle ONP,

$\cos\theta = \frac{A_x}{A}$ or $A_x = A\cos\theta$ (i)

$\sin\theta = \frac{A_y}{A}$ or $A_y = A\sin\theta$ (ii)

(d) Squaring and adding (1) and (2), we get

$A_x^2 + A_y^2 = A^2\cos^2\theta + A^2\sin^2\theta$

or $A_x^2 + A_y^2 = A^2(\cos^2\theta + A^2\sin^2\theta)$

$\therefore$ $A_x^2 + A_y^2 = A^2$ $[\because \cos^2 q + \sin^2 q = 1]$

or $A = \sqrt{A_x^2 + A_y^2}$

ASSIGNMENT–1

1. Which is not a fundamental quantities
   (A) Mass (B) Volume
   (C) Time (D) Length
2. Which symbol is not the symbol of fundamental unit
   (A) Calories (B) Mass
   (C) Second (D) Kg
3. Which is not accepted as a unit
   (A) 1 m (B) 1 km
   (C) 1 cm (D) 1 arm length
4. 1 nano is
   (A) 10^{-9} (B) 10^{-10}
   (C) 10^{9} (D) 10^{10}
5. 1 Pico is
   (A) 10^{10} (B) 10^{-10}
   (C) 10^{-12} (D) 10^{12}
6. μ stand for
   (A) Micro (B) Mega
   (C) Milli (D) None of these
7. The value of μ in SI unit is
   (A) 10^{6} (B) 10^{-6}
   (C) 10^{9} (D) 10^{-9}
8. Length in CGS system is
   (A) cm (B) meter
   (C) inch (D) Foot
9. SI unit stand for
   (A) Standard unit (B) Suitable unit
   (C) System of international unit (D) Systamatic unit
10. MKS system stand for
    (A) Mass km system (B) Mass kg system
    (C) Meter kg second (D) Meter kelving second
11. CGS stand for
    (A) Common gauge system (B) Centimeter gram second
    (C) Common grams system (D) Commercial gauge system
12. Time in MKS system is
    (A) Hour (B) Minutes
    (C) Second (D) Day
13. FPS stand for
    (A) Former packet system (B) Foreign packet system
    (C) Foot pound second system (D) Foot, packet system
14. Mass in FPS is
    (A) Kg (B) Gram
    (C) Pound (D) Carat
15. There are fundamental units
    (A) 6 (B) 3
    (C) 7 (D) 9

ASSIGNMENT–2

1. 36 km/h =
   (A) 10 m/s (B) 20 m/s
   (C) 12 m/s (D) 15 m/s
2. 1 Joule =
   (A) 1 newton × 1 m (B) 1 newton × 1 cm
   (C) 1 m/s × 1 kg (D) kg ms^{-1}
3. 1 Newton =
   (A) 1 m/s × 1 kg (B) 1 m/s × 1 gm
   (C) 1 m/s^2 × 1 kg (D) 1 m/s × kg
4. SI unit of acceleration is m/s^2 mass is kg and displacement is m then SI unit of work is
   (A) Joule/s (B) Joule
   (C) Kg/m^2 (D) Joule sec.
5. Planks constant is
   (A) Joule/s (B) Joule second
   (C) Joule (D) Newton sec.
6. The S.I. unit of electric potential energy is
   (A) Volt × coulomb (B) Volt/coulomb
   (C) Volt (D) Newton coulomb
7. No. of dynes in 20 N is
   (A) 20×10^5 dyne (B) 20×10^{-5} dyne
   (C) 20 dyne (D) 20×10^7 dyne
8. Find the no. of erg in 1 Joule
   (A) 10^8 (B) 10^7
   (C) 10^5 (D) 10^6
9. If g = 9.8 m/s^2, then it a value will be in km/h^2 is
   (A) 127008 (B) 137008
   (C) 12000 (D) 14000
10. Length can not be measured in
    (A) Fermi (B) Debye
    (C) Light year (D) Parsec
11. Radius of a circle is 4 m its area will be ..... (area =)
    (A) $\pi 16\ cm^2$ (B) $\pi 1600\ cm^2$
    (C) $\pi 10^4 \times 1600\ cm^2$ (D) $\pi 16 \times 10^{-4}$
12. Unit of density in CGS system =
    (A) 1 kg/m^3 (B) 1 $gm/m^{3|}$
    (C) 1 $gm/cm^{3|}$ (D) gm/volume
13. Which one is not the unit of length
    (A) Light year (B) Parsec unit
    (C) Angstrong unit (D) Radian
14. One dyne =
    (A) 10^5 N (B) 10^{-5} N
    (C) 10^{+3} N (D) 10^{-3} N
15. Which one have no unit
    (A) Density (B) Relative density
    (C) Moles (D) Angle

ASSIGNMENT–3

1. Find the number of ergs in one Joule.
   (A) 10^8 (B) 10^7
   (C) 10^5 (D) 10^6
2. Value of acceleration due to gravity is 9.8 m/sec^2 . Find its value in km/hr^2 .
   (A) 127008 (B) 137008
   (C) 120J00 (D) 14000
3. Length cannot be measured by
   (A) Fermi (B) Micro
   (C) Debye (D) Light year
4. The unit of-resistance is
   (A) Ohm (B) Volt
   (C) Mho (D) Newton.
5. Number of base SI unit is
   (A) 4 (B) 7
   (C) 3 (D) 5
6. Parsec is the unit of
   (A) time (B) distance
   (C) frequency (D) angular acceleration
7. The unit of Planck's constant is
   (A) Joule (B) Joule/ s
   (C) Joule/m (D) Joule-s
8. Faraday is the unit of
   (A) Charge (B) emf
   (C) Mass (D) Energy
9. Candela is the unit of
   (A) Electricity intensity (B) Luminous intensity
   (C) Sound intensity (D) None of-these
10. Which of the following pairs is wrong
    (A) Pressure- barometer (B) Relative density-Pyrometer
    (C) Temperature – Thermometer (D) Earthquake – Seismograph
11. The density of a material is 8 g/cc. In a unit system in which the unit length is 5 cm and unit mass is 20g, what is the density of the material?
    (A) 0.02 (B) 50
    (C) 40 (D) 12.5
12. Which relation is wrong
    (A) 1 Calorie = 4.18 Joules (B) $1\overset{o}{A} = 10^{-10}$ m
    (C) 1 MeV= 1.6 × 1 0^{-13} Joules (D) 1 Newton = 10^{-5} Dynes
13. Density of a certain substance is 3200 kg/m^3 . This density in g/cm^3 will be
    (A) 32 (B) 3.2
    (C) 320 (D) 0.32

14. A physical quantity is measured and its value is found to be nu where n = numerical value and u = unit. Then which of the following relation is true.

(A) $n \propto u^2$ (B) $n \propto u$

(C) $n \propto \sqrt{u}$ (D) $n \propto \frac{1}{u}$.

15. One Torr is eqaul to

(A) 1 cm of Hg (B) 1 N/m^2

(C) 1 mm of Hg (D) 1 atm pressure.

16. Parsec is the unit of

(A) time (B) distance

(C) frequency (D) angular acceleration

17. Which of the following pairs is wrong

(A) Pressure- barometer (B) Relative density-Pyrometer

(C) Temperature - Thermometer (D) Earthquake - Seismograph

18. The density of a material is 8 g/cc. In a unit system in which the unit length is 5 cm and unit mass is 20g, what is the density of the material?

(A) 0.02 (B) 50

(C) 40 (D) 12.5

ASSIGNMENT–4

1. If $\sin\theta = \frac{4}{9}$ then value of cos θ =

(A) $\frac{\sqrt{65}}{4}$ (B) $\frac{1}{2}$

(C) $\frac{\sqrt{65}}{9}$ (D) $\frac{\sqrt{65}}{7}$

2. Value of $\tan\theta = \frac{2}{\sqrt{5}}$, find the value of sinθ – cosθ

(A) $\frac{2-\sqrt{5}}{3}$ (B) $\sqrt{3}$

(C) 2 (D) –2

3. Value of $\sin^2 0° + \cos^2 0°$

(A) 1 (B) –1

(C) 2 (D) 0

4. Value of $\frac{\sin^4 45^o}{\cos^2 90^o}$

(A) undefined (B) 1

(C) –1 (D) $\frac{1}{2}$

5. Value of sin30° × cos60° × sin60° × cos30°

(A) –1 (B) $\frac{3}{8}$

(C) $\frac{3}{2}$ (D) 1

6. Value of $1-\sin^2 30°$

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

(C) $\frac{3}{4}$ (D) $\frac{5}{4}$

7. Which of the following is equal to $\frac{\tan\theta.\cot\theta}{\cos\theta}$

(A) $\cos\theta$ (B) $\sec\theta$

(C) $\sin\theta$ (D) $\text{cosec}\theta$

8. If $\cos\theta = \frac{m}{n}$, then what is the value of $\tan\theta$?

(A) $\frac{n}{m}$ (B) $\frac{\sqrt{n^2+m^2}}{n}$

(C) $\frac{m}{\sqrt{n^2-m^2}}$ (D) $\frac{\sqrt{n^2-m^2}}{m}$

9. Which of the following is equal to $\text{cosec}^2\theta$

(A) $1-\cot^2\theta$ (B) $1+\cot^2\theta$

(C) $1-\tan^2\theta$ (D) $1+\tan^2\theta$

10. What is the value of $\tan^2\theta - \sec^2\theta$

(A) 1 (B) $\frac{1}{2}$

(C) –1 (D) $-\frac{1}{2}$

11. If $x = a\cos\theta$ and $y = a\sin\theta$ then which of relation exist between x, y and a.

(A) $x^2+y^2=a^2$ (B) $x^2-y^2=a^2$

(C) $xy=\frac{a}{2}$ (D) $\frac{x}{y}=a$

12. If 3 tan = 4 θ, then what is the value of $\frac{3\sin\theta+2\cos\theta}{3\sin\theta-2\cos\theta}$

(A) 1/3 (B) 3

(C) 2 (D) 1/2

13. In ΔABC, right angled at B, AB = 12cm and BC = 5 cm. What is the value of cosec A ?

(A) $\frac{12}{5}$ (B) $\frac{5}{12}$

(C) $\frac{5}{13}$ (D) $\frac{13}{5}$

14. If $\sin(A+B)=1$ and $\cos(A-B)=\frac{\sqrt{3}}{2}$, then what is the value of $\angle B$?
(A) 60° (B) 30°
(C) 45° (D)

15. In ΔABC, right angle at B and $\angle A=30°$, what is the value of AC ?
(A) $6\sqrt{3}$cm (B) 11 cm
(C) 12 cm (D) $5\sqrt{2}$cm

16. Which of the following is equal to $(1-\sin^2\theta)\sec^2\theta$
(A) 1 (B) –1
(C) 0 (D) $\frac{1}{2}$

17. Which of the following is equal to $\sqrt{\sec^2\theta+\text{cosec}^2\theta}$?
(A) $\tan\theta-\cot\theta$ (B) $\tan\theta+\cot\theta$
(C) $\sec\theta-\text{cosec}\theta$ (D) $\sec\theta+\text{cosec}\theta$

18. Which of the following is equal to $\sec^2\theta+\text{cosec}^2\theta$
(A) $\sec^2\theta\tan^2\theta$ (B) $\sec^2\theta\text{cosec}^2\theta$
(C) $\cos^2\theta\cos ec^2\theta$ (D) $\sin^2\theta\cot^2\theta$

19. Which of the following is equal to
$$\sin^2\theta+\frac{1}{(1+\tan^2\theta)}$$
(A) 1 (B) 0
(C) –1 (D) $\frac{1}{2}$

ASSIGNMENT–5

1. Among this the scalar quantity is
(A) Speed (B) Velocity
(C) Displacement (D) none of these
2. Among this the Vector quantity is
(A) Mass (B) Time
(C) Displacement (D) Distance
3. Which is not a scaler quantity
(A) Work (B) Energy
(C) Volume (D) Velocity
4. Find which is scaler quantity
(A) Velocity (B) Acceleration
(C) Distance (D) Displacement
5. A vector is repressed as $\overrightarrow{AB}$ then which is correct statements
(A) B lies at head (B) B lies at trail
(C) A lies at head (D) None of these

6. The vector are shown as following figure find the correct statement

$\overrightarrow{A}$ $\overrightarrow{B}$ $\overrightarrow{C}$ $\overleftarrow{D}$

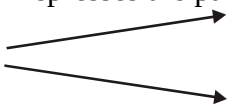
(A) ABCD are collinear (B) ABCD are non-collinear
(C) BCD have same magnitude (D) None of these

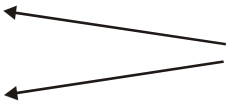
7. True vector are shown in figure find the correct options

4N $\rightarrow$ $\leftarrow$ 4N

(A) $\vec{A} = \vec{B}$ (B) $\vec{A} = -\vec{B}$
(C) $\vec{A} - \vec{B} = 0$ (D) None of these

8. Which represses the parallel vector

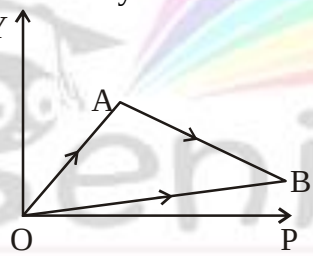
(A) 

(B) 

(C) 

(D) None of these

9. The displacement vector is represented by



(A) $\overrightarrow{OA}$ (B) $\overrightarrow{OB}$
(C) $\overrightarrow{AB}$ (D) $\overrightarrow{BA}$

10. What is the maximum number of rectangular components into which a vector can be split in its own plane?
(A) 2 (B) 3
(C) 4 (D) Infinite

11. The minimum number of vectors of equal magnitude required to produce a zero resultant is
(A) 2 (B) 3
(C) 4 (D) More than 4

12. A vector does not change if
(A) It is rotated through an arbitrary angle
(B) It is multiplied by an arbitrary scalar
(C) It is cross multiplied by a unit vector
(D) It is slided parallel to it self

13. Find the minimum number of unparallel vector producing zero resultant.
(A) 1 (B) 3
(C) 2 (D) 4

14. Find the number of non-colinear vector producing zero resultant.
(A) 3 (B) 4
(C) 2 (D) 1

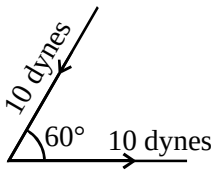
ASSIGNMENT–6

1. The vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A}+\vec{B}|=|\vec{A}-\vec{B}|$ then the angle between the two vectors $\vec{A}$ and $\vec{B}$ will be

   (A) 0° (B) 60°
   (C) 90° (D) 180°

2. Two forces each numerically equal to 10 dynes are acting as shown in the following figure, then the resultant is

   (A) 10 dynes
   (B) 20 dynes
   (C) $10\sqrt{3}$ dynes
   (D) 5 dynes



3. A truck travelling due north at 30 m/s turns west and travels at the same speed; then the change in velocity is

   (A) 60 m/s north-west (B) $30\sqrt{2}$ m/s north-west
   (C) $30\sqrt{2}$ m/s south-west (D) 60 m/s south-west

4. A particle is moving eastward with a velocity of 5 m/s. In 10 seconds, the velocity changes to 5 m/s northwards. The average acceleration in this time is

   (A) Zero (B) $\frac{1}{\sqrt{2}}$ m/sec^2 towards north-west
   (C) $\frac{1}{\sqrt{2}}$ m/sec^2 towards north-east (D) $\frac{1}{2}$ m/sec^2 towards north

5. A person moves 20 metres north, then $20\sqrt{2}$ metres east, then 30 metres south-west. His displacement from the original position is

   (A) $10\sqrt{2}$ metres south-west (B) 28 metres south
   (C) 10 metres west (D) 15 metres east

6. If the sum of two unit vectors is a unit vector, then the magnitude of their difference is

   (A) $\sqrt{2}$ (B) $\sqrt{3}$
   (C) $\frac{1}{\sqrt{2}}$ (D) $\sqrt{5}$

7. The vector $\vec{P}$ makes 120° with the x-axis and the vector $\vec{Q}$ makes 30° with the y-axis. What is their resultant?

   (A) P + Q (B) P – Q
   (C) $\sqrt{P^2+Q^2}$ (D) $\sqrt{P^2-Q^2}$

8. At what angle should the two unit vectors be inclined so that their resultant is also a unit vector?

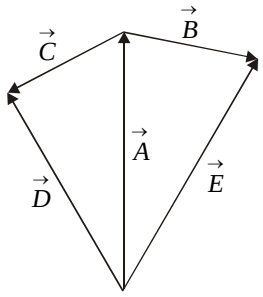
   (A) 30° (B) 60°
   (C) 120° (D) 150°

9. Two vectors A and B are such that A+B=C and $A^2+B^2 = C^2$. Which of the following statements is correct?
   (A) A is parallel to B (B) A is perpendicular to B
   (C) A and B are equal in magnitude (D) B is parallel to A

10. The resultant of $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{B}$ and has magnitude half of $\vec{A}$. What is the angle between $\vec{A}$ and $\vec{B}$?
   (A) 30° (B) 60°
   (C) 120° (D) 150°

ASSIGNMENT–7

1. What is the maximum number of rectangular components into which a vector can be split in its own plane?
   (A) 2 (B) 3
   (C) 4 (D) Infinite
2. The minimum number of vectors of equal magnitude required to produce a zero resultant is
   (A) 2 (B) 3
   (C) 4 (D) More than 4
3. A vector does not change if
   (A) It is rotated through an arbitrary angle
   (B) It is multiplied by an arbitrary scalar
   (C) It is cross multiplied by a unit vector
   (D) It is slid parallel to it self
4. In the figure, $\vec{E} - \vec{D} + \vec{C}$ equals



   (A) $\vec{A}$ (B) $-\vec{A}$
   (C) $\vec{B}$ (D) $-\vec{B}$
5. Two vectors P and Q are in a plane but the vector R is not in their plane. In such a case $\vec{P}+\vec{Q}+\vec{R}$
   (A) Can be zero (B) Can not be zero
   (C) Lies in the same plane as P or R (D) Lines in the same plane as R
6. If $\vec{a}, \vec{b}$ and $\vec{c}$ are non-coplanar $m\vec{a}+n\vec{b}$ and + $k\vec{c}=\vec{0}$, where *m*, *n* and *k* are constants then
   (A) At one of *m*, *n* or *k* must be zero (B) *m*, *n* and *k* may be non-zero
   (C) All of *m*, *n* and *k* must be zero (D) *m*, *n* and *k* must be infinite.

7. Vector sum of two forces of 10N and 6N cannot be:
   (A) 4 N (B) 8 N
   (C) 12 N (D) 2 N

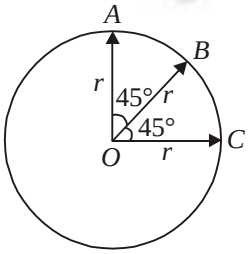
8. At what angle the two vectors of magnitudes (A + B) and (A – B) must act, so that the resultant is $\sqrt{A^2+B^2}$?
   (A) $\cos^{-1}\frac{A^2-B^2}{A^2+B^2}$ (B) $\cos^{-1}\frac{A^2+B^2}{B^2-A^2}$
   (C) $\cos^{-1}\frac{A^2-B^2}{2(A^2+B^2)}$ (D) $\cos^{-1}\frac{A^2+B^2}{2(B^2-A^2)}$

9. Resultant of the two vector $\vec{F}_1$ and $\vec{F}_2$ is of magnitude P. If $\vec{F}_2$ is reversed, then resultant is of magnitude Q. What is the value of $P^2 + Q^2$?
   (A) $F_1^2+F_2^2$ (B) $F_1^2-F_2^2$
   (C) $2(F_1^2-F_2^2)$ (D) $2(F_1^2+F_2^2)$

10. The resultant of two forces acting at an angle of 150° is 10kg wt. and is perpendicular to one of the forces. The other force is .....
   (A) $10\sqrt{3}$ kg. wt. (B) $20\sqrt{3}$ kg. wt.
   (C) 20 kg. wt. (D) $20/\sqrt{3}$ kg. wt.

11. Given that $\vec{R}=\vec{P}+\vec{Q}$. And $\vec{R}$ makes angle α with $\vec{P}$ and β with $\vec{Q}$. Which of the following relations is correct?
   (A) α cannot be less than β (B) α < β if P < Q
   (C) α < β if P > Q (D) α < β if P = Q

12. The resultant of the three vectors $\overrightarrow{OA}, \overrightarrow{OB},$ and $\overrightarrow{OC}$ shown in figure.



   (A) *r* (B) 2r
   (C) $r(1+\sqrt{2})$ (D) $r(\sqrt{2}-1)$

13. A car with a vertical wind shield moves along in a rain storm at speed of 40 km h^{-1}. The rain drops fall vertically with a terminal speed of 20m s^{-1}. The angle at which the rain drops strike the wind shield is
   (A) $\tan^{-1}(2/3)$ (B) $\tan^{-1}(3/2)$
   (C) $\tan^{-1}(5/9)$ (D) $\tan^{-1}(9/5)$

14. What is the maximum number of rectangular components into which a vector can be split in space
   (A) Two (B) Three
   (C) Four (D) Any number

15. A particle is moving eastwards with a velocity of 5 ms^{-1} in 10 seconds the velocity changes to 5 ms^{-1} north-wards. The average acceleration in this time is

(A) Zero
(B) $1/\sqrt{2}$ m/s^2 towards North-West
(C) $1/\sqrt{2}$ m/s^2 towards South-West
(D) $1/\sqrt{2}$ m/s^2 towards North-East

16. If $\vec{A} = \vec{B} - \vec{C}$, then the angle between $\vec{A}$ and $\vec{B}$ is

(A) $\cos^{-1}[(A^2 + B^2 - C^2)/2AB)]$
(B) $\sin^{-1}[(A^2 + B^2 - C^2)/2AB)]$
(C) $\tan^{-1}[(A^2 + B^2 - C^2)/2AB)]$
(D) None of these

17. The component of a vector is

(A) Always less than its magnitude
(B) Always greater than its magnitude
(C) Always equal to its magnitude
(D) None of these

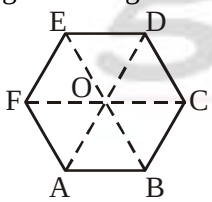
18. If the sum of two unit vectors is a unit vector, then the magnitude of their difference is

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

19. The vector of length l is turned through the angle θ about its tail. What is the change in the position vector of its head?

(A) $l \cos(\theta/2)$
(B) $2l \sin(\theta/2)$
(C) $2l \cos(\theta/2)$
(D) $l \sin(\theta/2)$

20. ABCDEF is a regular hexagon. What is the value of $\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF}$



(A) 0
(B) $2\overrightarrow{AO}$
(C) $4\overrightarrow{AO}$
(D) $6\overrightarrow{AO}$

21. If $\vec{a} + \vec{b} = \vec{c}$ and a =2, b = 3 and c = 4, then $|\vec{c} - \vec{b} + \vec{a}|$ is equal to

(A) 4
(B) 6
(C) 8
(D) None of these

22. If $\vec{a} - \vec{b} + \vec{c}$ and a = 2, b = 3 and c = 4, then angle between $\vec{a}$ & $\vec{c}$

(A) $\cos^{-1}\left[\frac{-11}{10}\right]$
(B) $\cos^{-1}\left(\frac{11}{16}\right)$
(C) $\cos^{-1}\left(\frac{21}{12}\right)$
(D) None of these

KEYS

Assignment – 1

1. (B)	2. (A)	3. (D)
4. (A)	5. (C)	6. (A)
7. (B)	8. (A)	9. (C)
10. (C)	11. (B)	12. (C)
13. (C)	14. (C)	15. (C)

Assignment – 2

1. (A)	2. (A)	3. (C)
4. (B)	5. (B)	6. (A)
7. (A)	8. (B)	9. (A)
10. (B)	11. (A)	12. (C)
13. (D)	14. (B)	15. (B)

Assignment – 3

1. (B)	2. (A)	3. (C)
4. (A)	5. (B)	6. (B)
7. (B)	8. (D)	9. (B)
10. (B)	11. (B)	12. (D)
13. (B)	14. (D)	15. (C)
16. (B)	17. (B)	18. (B)

Assignment – 4

1. (C)	2. (A)	3. (A)
4. (A)	5. (B)	6. (C)
7. (B)	8. (A)	9. (B)
10. (C)	11. (A)	12. (B)
13. (D)	14. (B)	15. (C)
16. (A)	17. (B)	18. (B)
19. (A)		

Assignment – 5

1. (A)	2. (C)	3. (D)
4. (C)	5. (A)	6. (D)
7. (B)	8. (C)	9. (C)
10. (D)	11. (A)	12. (D)
13. (C)	14. (C)	

Assignment – 6

1. (C)	2. (A)	3. (C)
4. (C)	5. (A)	6. (B)
7. (A)	8. (B)	9. (A)
10. (D)		

Assignment – 7

1. (D)	2. (A)	3. (D)
4. (C)	5. (B)	6. (C)
7. (D)	8. (D)	9. (D)
10. (C)	11. (C)	12. (C)
13. (B)	14. (C)	15. (D)
16. (B)	17. (C)	18. (A)
19. (D)	20. (C)	21. (B)
22. (B)		

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