UNITS, DIMENSIONS AND MEASUREMENT

Revise Most Important Questions to Crack NEET 2020

Q-1 - 11487251

Which of the following is not the unit of energy ?

(A) calorie

(B) joule

(C) electron volt

(D) watt

CORRECT ANSWER: D

SOLUTION:

watt is a unit of power

Q-2 - 11745011

Newton - second is the unit of

(A) Velocity

(B) Anguler momentum

(C) Momentum

(D) Energy

CORRECT ANSWER: C

SOLUTION:

Impulse = change in momentum $= F \times t$ So the unit of momentuim will be equal to $\text{Newton} - \text{sec}$.

Q-3 - 15944345

A suitable unit for gravitational constant is

(A) $kg - m\sec^{-1}$

(B) $Nm^{-1}\sec$

(C) Nm^2kg^{-2}

(D) $kgm\sec^{-1}$

CORRECT ANSWER: C

Q-4 - 11745018

Which of the following represents a volt?

(A) $\text{Joule}/\text{second}$

(B) $\text{watt}/\text{ampere}$

(C) $\text{watt}/\text{columb}$

(D) $\text{coulomb}/\text{joule}$

CORRECT ANSWER: B

SOLUTION:

$$\frac{\text{watt}}{\text{ampere}} = \text{volt}$$

Q-5 - 15944392

Ampere - hour is a unit of

(A) Quantity of electricity

(B) Strength of electric current

(C) Power

(D) Energy

CORRECT ANSWER: A

Watch Video Solution On Doubtnut App

Q-6 - 11745025

Young's modules of a material has the same unit as

(A) Pressure

(B) Strain

(C) Compressibility

(D) Force

CORRECT ANSWER: A

SOLUTION:

$$Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\text{Force/Area}}{\text{Dimensionless}} \Rightarrow Y \equiv \text{Pressure}$$

.

Watch Video Solution On Doubtnut App

Q-7 - 9495300

A physical quantity is measured and the result is expressed as nu where u is the unit used and n is the numberical value. If the result is expressed in various units then

(A) $n \propto sizeofu$

(B) $n \propto u^2$

(C) $n \propto \sqrt{u}$

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

CORRECT ANSWER: D

Q-8 - 11487255

In $S = a + bt + ct^2$. S is measured in metres and t in seconds. The unit of c is

(A) None

(B) m

(C) ms^{-1}

(D) ms^{-2}

CORRECT ANSWER: D

SOLUTION:

ct^2 must have dimensions of $\text{Lim } pliesc$ must have dimendions of $\frac{L}{T^2}$ i.e. LT^{-2}.

Q-9 - 11745032

If in a system the force of attraction between two point masses of $1kg$ each situated $1km$ apart is taken as a unit force and is called notwen (newton written in reverse order) If $G = 6.67 \times 10^{-11} N - m^2 kg^{-2}$ in SI units, the relation of newton and nowton is

(A) $1\text{notwen} = 6.67 \times 10^{-11}\text{newton}$

(B) $1\text{newton} = 6.67 \times 10^{-17}\text{notwen}$

(C) $1\text{notwen} = 6.67 \times 10^{-17}\text{newton}$

(D)

$1 \text{newton} = 6.67$
$\times 10^{-12} \text{notwen}$

CORRECT ANSWER: C

SOLUTION:

If two point masses each of masses $1kg$ are seperated a distance $1m$ they experience a force 6.67×10^{-11} newton

We know , $F = G\frac{m_1 m_2}{r^2}$

$1 \text{notwen} = 6.67$
$\times 10^{-11} \times \frac{(1kg)^2}{(1km)^2}$

$= 6.67 \times 10^{-11}$
$\times 10^{-6} \frac{(1kg)^2}{(1m)^2}$

$= 6.67 \times 10^{-11}$
$\times 10^{-6} \text{newton}$

$1 notwen = 6.67 \times 10^{-17} newton$

Watch Video Solution On Doubtnut App

Q-10 - 11487287

Two quantities A and B have different dimensions. Which mathematical operation given below is physically meaningful?

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

(B) $A + B$

(C) $A - B$

(D) None

CORRECT ANSWER: A

SOLUTION:

Quantities having different dimensions can only be divided or multiplied but they cannot be added or subtracted.

Watch Video Solution On Doubtnut App

Q-11 - 11295567

A force F is given by $F = at + bt^2$, where t is time . What are the dimensions of a and b?

SOLUTION:

From the principle of dimensional homogenity ,

$[F] = [at]$

:.

$$[a] = \left[\frac{F}{t}\right]$$
$$= \left[\frac{MLT^{-2}}{T}\right]$$
$$= [MLT^{-3}$$

Similarly ,$[F] = [bt^2]$

:.

$$[b] = \left[\frac{F}{t^2}\right]$$

$$= \left[\frac{MLT^{-2}}{T^2}\right]$$

$$= [MLT^{-4}]$$

Watch Video Solution On Doubtnut App

Q-12 - 15944477

Which pair has the same dimensions

(A) Work and power

(B) Density and relative density

(C) Momentum and impulse

(D) Stress and strain

CORRECT ANSWER: C

Watch Video Solution On Doubtnut App

Q-13 - 11295689

The frequency f of vibrations of a mass m suspended from a spring of spring constant k is given by $f = Cm^x k^y$, where C is a dimensionnless constant. The values of x and y are, respectively,

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

(B) $-\frac{1}{2}, -\frac{1}{2}$

(C) $\frac{1}{2}, -\frac{1}{2}$

(D) $-\frac{1}{2}, \frac{1}{2}$

CORRECT ANSWER: D

SOLUTION:

$f = Cm^x k^y$. Writing dimensions on both sides.

$$\left[M^0 L^0 T^{-1}\right]$$
$$= M^x \left[M L^0 T^{-2}\right]^y$$
$$= \left[M^{x+y} T^{-2y}\right]$$

Comparing dimensions on both sides , we have

$$0 = x + y \text{ and } -1$$
$$= -2y \Rightarrow y = \frac{1}{2}, x$$
$$= -\frac{1}{2}$$

Aliter. Remembering that the frequency of oscillation of

loaded spring is

$$f = \frac{1}{2\pi} \frac{\sqrt{k}}{m}$$
$$= \frac{1}{2\pi} (k)^{1/2} m^{-1/2}$$

which gives $x = -\frac{1}{2}$ and $y = \frac{1}{2}$

Q-14 - 18253634

The speed of light in vacuum is $3 \times 10^8 m/s$. How many nanosecond does it take to travel one metre in a vacuum?

(A) $8ns$

(B) $\frac{10}{3}ns$

(C) $3.34ns$

(D) none of these

SOLUTION:

(b)

$$t = \frac{s}{v} = \frac{1}{3 \times 10^8}$$
$$= \frac{1}{3} \times 10^{-8} s$$

$$= \frac{1}{3} \times \frac{10^{-8}}{10^{-9}} ns$$

$$= \frac{10}{3} ns$$

Watch Text Solution On Doubtnut App

Q-15 - 18253652

1 revolution is equivalent to 360. The value of 1 revolution per minute is

(A) $2\pi ra / s$

(B) $0.104 rad / s$

(C) $3.14 rad / s$

(D) None of these

SOLUTION:

(b)

$$\frac{1}{\text{rev}} / (\text{min})$$

$$= \frac{1 \times 2\pi rad}{60s}$$

$$= \frac{\pi}{30} rad / s$$

$$= 0.1047 rad / s$$

Q-16 - 18253664

If $\Delta H = mL$, where m is mass of body.

$\Delta H =$ total thermal energy supplied to the body

$L =$ latent heat of fusion.

Find the dimensions of latent of fusion.

(A) $\left[ML^2T^{-2}\right]$

(B) $\left[L^2T^{-2}\right]$

(C) $\left[M^0L^0T^{-2}\right]$

(D) $\left[ML^0T^{-1}\right]$

SOLUTION:

(b)

$\Delta H = mL : [L]$

$= \frac{\left[ML^2T^{-2}\right]}{[M]}$

$= \left[L^2T^{-2}\right]$

Q-17 - 11487322

The mean time period of second's pendulum is 2.00 s and mean absolute error in the time period is 0.05s. To express maximum estimate of error, the time period should be written as

(A) $(2.00 \pm 0.01)s$

(B) $(2.00 \pm 0.025)s$

(C) $(2.00 \pm 0.05) s$

(D) $(2.00 \pm 0.10) s$

CORRECT ANSWER: C

SOLUTION:

Mean time period $T = 2.00$sec

and Mean absolute error $= \triangle T = 0.05$ sec

To express maximum estimate of error, the time period should be written as (2.00 ± 0.05) sec

Watch Video Solution On Doubtnut App

Q-18 - 10955001

The significant figures in the number 6.0023 are

(A) 2

(B) 5

(C) 4

(D) 3

CORRECT ANSWER: B

Watch Video Solution On Doubtnut App

Q-19 - 10955002

The length and breadth of a metal sheet are 3.124m and 3.002m respectively. The area of this sheet upto correct significant figure is

(A) $9.378m^2$

(B) $9.37m^2$

(C) $9.4m^2$

(D) None of these

CORRECT ANSWER: A

SOLUTION:

$A = l \times b = 3.124$
$\times 3.002$

$= 9.378248 m^2$

$= 9.378 m^2.$

(rounding off to four significant digits)

Watch Video Solution On Doubtnut App

Q-20 - 10955004

If error in measurement of radius of a sphere is 1%, what will be the error in measurement of volume?

(A) 0.01

(B) $\frac{1}{3}\%$

(C) 0.03

(D) None of these

CORRECT ANSWER: C

SOLUTION:

$$V = \frac{4}{3}\pi R^3$$

$\therefore$ (% error in V) $= 3($ % error in R)

$= 3(1\,\%\,)$
$= 3\,\%$

Watch Video Solution On Doubtnut App

Q-21 - 10955005

The density of a cube is measured by measuring its mass and length of its sides. If the maximum error in the measurement of mass and length are 4% and 3% respectively, the maximum error in the measurement of density will be

(A) 0.07

(B) 0.09

(C) 0.12

(D) 0.13

CORRECT ANSWER: D

SOLUTION:

$$\rho = \frac{m}{V} = \frac{m}{l^3} = ml^{-3}$$

$\therefore$ Maximum $\%$ error in $\rho =$ ($\%$ error in m) $+ 3($ $\%$ error in l).

Watch Video Solution On Doubtnut App

Q-22 - 18253672

The work done by a battery is $W = \varepsilon \Delta q$, where $\Delta q =$ charge transferred by battery $\varepsilon =$ emf of the battery. What are dimensions of emf of battery?

(A) $\left[A^{-2}M^{0}L^{0}T^{-2}\right]$

(B) $\left[A^{-2}ML^{2}T^{-3}\right]$

(C) $\left[A^{0}M^{2}T^{-3}\right]$

(D) $\left[A^{-1}ML^{2}T^{-3}\right]$

SOLUTION:

(d) $W = \varepsilon\Delta q$

$$\Rightarrow \varepsilon = \frac{W}{q}$$

$$= \frac{\left[ML^{2}T^{-2}\right]}{\left[M^{0}L^{0}AT\right]} \Rightarrow [\varepsilon]$$

$$= \left[ML^{2}A^{-1}T^{-3}\right]$$

Watch Video Solution On Doubtnut App

Q-23 - 11745101

If

$X = A \times B \text{ and } \Delta X$

$\Delta A \text{ and } \Delta B$

are maximum absolute error in X ,A and B respectively , then the maximum relative in X is given by

(A) $\Delta X = \Delta A + \Delta B$

(B) $\Delta X = \Delta A - \Delta B$

(C) $\frac{\Delta X}{X} = \frac{\Delta A}{A} - \frac{\Delta B}{B}$

(D) $\frac{\Delta X}{X} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$

CORRECT ANSWER: D

SOLUTION:

When two quantities are multiplied, their maximum relative errors areadded up

Hence $\frac{\Delta X}{X} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$

Q-24 - 18253667

A physical relation is $\varepsilon = \varepsilon_0 \varepsilon_r$

where $\varepsilon =$ electric permittivity of a medium

$\varepsilon_0 =$ electric permittivity of vacuum

$\varepsilon_r =$ relative permittivity of medium

What are dimensions of relative permittivity?

(A) $\left[ML^2T^{-2}\right]$

(B) $\left[M^0L^2T^{-3}\right]$

(C) $\left[M^0L^0T^0\right]$

(D) $\left[M^0L^0T^{-1}\right]$

SOLUTION:

(c) $\varepsilon = \varepsilon_0 \varepsilon_r \Rightarrow \varepsilon_r = \dfrac{\varepsilon}{\varepsilon_0}$

Relative permittivity is the ratio of ε and ε_0 hence it is dimensionsless .

i.e. $\left[M^0L^0T^0\right]$

Q-25 - 12929037

The resistance of metal is given by $V = IR$, The voltage in the resistance is $V = (8 \pm 0.5)V$ and current in the resistance is $I = (2 \pm 0.2)A$, the value fo resistance with its percentage error is

(A) $(4 \pm 16.25\ \%\ )\Omega$

(B) $(4 \pm 2.5\ \%\ )\Omega$

(C) $(4 \pm 0.04\ \%\ )\Omega$

(D) $(4 \pm 1\ \%\ )\Omega$

CORRECT ANSWER: A

SOLUTION:

$$R = \frac{V}{I}, 100 \times \frac{\Delta R}{R}$$

$$= \left[\frac{\Delta V}{V} + \frac{\Delta I}{I}\right]$$

$$\times 100$$

Resistance $= \left[R \pm \frac{\Delta R}{R} \times 100\right]$

Q-26 - 10955006

Percentage error in the measurement of mass and speed are 2% and 3% respectively. The error in the measurement of kinetic energy obtained by measuring mass and speed will be

(A) 0.12

(B) 0.1

(C) 0.08

(D) 0.05

CORRECT ANSWER: C

SOLUTION:

$$K = \frac{1}{2}mv^2$$

$\therefore$ % error in K = (% error in m) + 2(% error in v).

Q-27 - 11762053

If the dimension of a physical quantity are given by $M^a L^b T^c$, then the physical quantity will be

(A) force, if a = 0, b= -1, c =-2

(B) pressure, if a= 1, b =-1, c= -2

(C) velocity, if a = 1, b= 0, c= -1

(D) acceleration, if a= 1, b= 1, c= -2

CORRECT ANSWER: (B)

SOLUTION:

Pressure = $\frac{\text{force}}{\text{area}}$ = $\frac{MLT^{-2}}{L^2}$
$= \left[M^1L^{-1}T^{-2}\right]$

$\therefore a = 1, b = -1 c = -2$

Choice (b) is correct.

Watch Video Solution On Doubtnut App

Q-28 - 10058358

The dimension of $\left(\frac{1}{2}\right)\varepsilon_0 E^2$ (ε_0 : permittivity of free space, E electric field

(A) (a) MLT^{-1}

(B) (b) ML^2T^2

(C) (c) $ML^{-1}T^{-2}$

(D) (d) ML^2T^{-1}

CORRECT ANSWER: C

SOLUTION:

(c) Note : here $\left(\frac{1}{2}\right)\varepsilon_0E^2$ represents energy per unit volume.

$$[\varepsilon_0]\left[E^2\right] = \frac{[Energy]}{[Volume]}$$
$$= \frac{ML^2T^{-2}}{L^3}$$
$$= ML^{-1}T^{-2}$$

Watch Video Solution On Doubtnut App

The dinesity of meterial in CGS system of mass is $4 gcm^3$ in a system of unit in which unit of length is $10 cm$ and unit of mass is $100 g$ the value of density of meterial will be

(A) 0.4

(B) 40

(C) 400

(D) 0.04

CORRECT ANSWER: B

SOLUTION:

Mass

$$M = \rho V \Rightarrow \rho = \frac{M}{V}$$

$$= \frac{M}{L^3}$$

We are given $\rho = 4g / cm^3$

If unit of mass is $100g$ and the unit distance is $10cm$

$$= \frac{4\left(\frac{100g}{100}\right)}{\left(\frac{10}{10}cm\right)^2}$$

$$= \frac{\left(\frac{4}{100}\right)}{\left(\frac{1}{10}\right)^3} \frac{(100g)}{(10g)}$$

$$= 40gcm^{-1}$$

$$\left(\frac{M_1}{M_2}\right)\left(\frac{L_1}{L_2}\right)^{-3}$$

$$= 4\left(\frac{1}{100}\right)\left(\frac{1}{10}\right)^{-3}$$

$$= 40$$

Watch Video Solution On Doubtnut App

Q-30 - 11745201

In an experiment four quantities a,b,c and d are measure with percentage error 1 % , 2 % , 3 % ,and 4 % respectively quantity is P is calculate as follow

$P = \frac{a^3 b^2}{cd}$ % error in P is

(A) $14\ \%$

(B) $10\ \%$

(C) $7\ \%$

(D) $4\ \%$

CORRECT ANSWER: A

SOLUTION:

$$P = \frac{a^2 b^2}{cd}$$
$$\Rightarrow \frac{\Delta P}{P} \times 100$$
$$= 3\left(\frac{\Delta a}{a} \times 100\right)$$
$$+ 2\left(\frac{\Delta b}{b} \times 100\right)$$

$$\left(\frac{\Delta c}{c} \times 100\right) + \left(\frac{\Delta d}{d} \times 100\right)$$

$$= 3 \times 1 + 2 \times 2 + 3 + 4$$

$$= 3 + 4 + 3 + 4 = 14 \%$$

Q-31 - 10955173

Using $mass(M)$, length(L), $time(T)$ and current(A)as fundamental quantites the demension of

permeability is

(A) $[M^{-1}LT^{-2}A]$

(B) $[ML^{-2}T^{-2}A^{-1}]$

(C) $[MLT^{-2}A^{-2}]$

(D) $[MLT^{-1}A^{-1}]$

CORRECT ANSWER: C

SOLUTION:

$B = \frac{\mu_0}{2\pi}\frac{i}{r}$

but $B = \frac{F}{il}(F = ilB)$:.

$\frac{F}{il} = \frac{\mu_0}{2\pi}\frac{i}{r}$

$[\mu_0] = \left[\frac{F}{i^2}\right]$

Q-32 - 11750638

The speed of light (c), gravitational constant (G) and plank's constant (h) are taken as fundamental units in a system. The dimensions of time in this new system should be.

(A) $G^{1/2}h^{1/2}c^{1/2}$

(B) $G^{1/2}h^{1/2}c^{1/2}$

(C) $G^{1/2}h^{1/2}c^{-3/2}$

(D) $G^{1/2}h^{1/2}c^{1/2}$

CORRECT ANSWER: A

SOLUTION:

According to the method of dimensional analysis the dimension of each term on both sides of an equation must be same.

Time $\propto c^{x}G^{y}h^{x}$

$\Rightarrow T = kc^{x}G^{y}h^{z}$

Putting the dimensions in above relation

$$\Rightarrow \left[M^0L^0T^1\right] = \left[LT^{-1}\right]^x \left[M^{-1}L^3T^{-2}\right]^y \left[ML^2T^{-1}\right]^z$$

$$\Rightarrow \left[M^0L^0T^1\right] = \left[M^{-y+z}L^{x+3y+2z}T^{x-2y-z}\right]$$

Comparing the powers of M, L and T

$-y+z=0$ ...(i)

$x+3y+2z=0$ ..(ii)

$-x-2y-z=1$ ...(iii)

On solving Eqs. (i), (ii) and (iii)

$$x = -\frac{5}{2}, y = z = \frac{1}{2}$$

Hence, dimensions of time are $\left[G^{1/2}h^{1/2}c^{-5/2}\right]$.

Q-33 - 11487332

A wire has a mass $0.3 \pm 0.003g$, radius $0.5 \pm 0.005mm$ and length $6 \pm 0.06cm$. The maximum percentage error in the measurement of its density is

(A) 1

(B) 2

(C) 3

(D) 4

CORRECT ANSWER: D

SOLUTION:

Density, $\rho = \frac{M}{V} = \frac{M}{\pi r^3 L}$

$$\Rightarrow \frac{\triangle \rho}{\rho} = \frac{\triangle M}{M}$$

$$+ 2\frac{\triangle r}{r} + \frac{\triangle L}{L}$$

$$= \frac{0.003}{0.3} + 2$$

$$\times \frac{0.005}{0.5} + \frac{0.06}{6}$$

$$= 0.01 + 0.02 + 0.01$$

$$= 0.04$$

percentage error

$$= \frac{\triangle \rho}{\rho} \times 100$$

$$= 0.04 \times 100 = 4\%$$

Q-34 - 11295655

A physical quantity x depends on quantities y and z as follows :

$x = Ay + B\tan(Cz)$, where A, B and C are constants. Which of the followings do not have the same dimensions?

(A) x and B

(B) C and z^{-1}

(C) y and B/A

(D) x and A

CORRECT ANSWER: D

SOLUTION:

$$[x] = [Ay] = [B] \Rightarrow [y]$$
$$= [B/A]$$

Also , $[x] \neq [A]$ and $[Cz] =$ dimensionless
$$\Rightarrow [C] = [z^{-1}]$$

Q-35 - 18253671

The energy stored in an electric device known as capacitor is given by $U=\frac{q^2}{2C}$

where $U=$ energy stored in capacitor

$C=$ capacity of capacitor

$q=$ charge on capacitor

Find the dimensions of capacity of the capacitor

(A) $\left[A^2 M^{-1} L^{-3} T^4\right]$

(B) $\left[A M^{-1} L^{-2} T^4\right]$

(C) $\left[A^2 M^{-1} L^{-2} T^4\right]$

(D) $\left[A^0 M^0 L^{-2} T^4\right]$

CORRECT ANSWER: C

SOLUTION:

(a) $U = \frac{q^2}{2C}$

:.C=(q^(2))/(2U) :.[C]=([AT]^(2))/([ML^(2)T^(-2)])=

[A^(2)M^(-1)L^(-2)T^(4)]`

Q-36 - 18253680

Find the dimension of $\frac{R}{L}$

Here $R =$ electric resistance

$L =$ self inductance

(A) $\left[T^{-2}\right]$

(B) $\left[T^{-1}\right]$

(C) $\left[ML^{-1}\right]$

(D) $[T]$

SOLUTION:

(b) $\because \frac{L}{R}$, time constant

$\therefore \frac{[L]}{[R]} = [T] \Rightarrow \frac{[R]}{[L]}$

$= [T^{-1}]$

Watch Video Solution On Doubtnut App

Q-37 - 18253690

The optical path difference is defined as $\Delta x = \frac{2\pi}{\lambda}$.

What are dimensions of optical path difference?

(A) $[M^0 L^{-1} T^0]$

(B) $[M^1 L^1 T^0]$

(C) $[M L^0 T^1]$

(D) $[M L^{-2T}$

SOLUTION:

(a)

Q-38 - 11745259

If momentum (p), area (A) and time$(t)$are taken to be fundamental quantities then energy has the dimensional formula

(A) $\left[p^1A^{-1}t^{-1}\right]$

(B) $\left[p^2A^1t^1\right]$

(C) $\left[p^1A^{1/2}t^1\right]$

(D) $\left[p^1A^{1/2}t^{-1}\right]$

CORRECT ANSWER: D

SOLUTION:

Let enegry $E = kp^aA^bt^c$(i)

where is k a dimensionless constant proportionality

equating dimension an both sides of(i) we get

$\left[ML^2T^{-2}\right]$
$= \left[MLT^{-1}\right]^a$
$\left[M^0L^2T^0\right]^b\left[M^0L(0)T\right.$
$\left.\right]^c$

$[L] = \left[M^aL^{a+2b}T^{a+c}\right]$

Appliying the principle of homogenety of dimensions we get

$a = 1$...(ii)

$a + 2b = 2$...(iii)

$-a + c = -2$...(iv)

On solving eqs (ii), (iii) and (iv) we get

$a = 1, b = \frac{1}{2}, c =$
-1

$\therefore [E] = \left[p^1A^{1/2}c^{-2}\right]$

Watch Video Solution On Doubtnut App

Q-39 - 11745250

A student writes four different expression for the displacement y in a period motion

$$y = a\sin\frac{2\pi r}{T}$$
$$y = a\sin vt$$
$$y = \frac{a}{t}\sin\frac{t}{a}$$
$$y = \frac{a}{\sqrt{2}}\left[\sin{}'\frac{2\pi r}{T} + \cos{}'\frac{2\pi r}{T}\right]$$

where a is maximum displacement , x is the speed and T is the time period then dimensionally.

(A) 1 and 2 are wrong

(B) 2 and 3 are wrong

(C) 3 and 4 are wrong

(D) 4 and 1 are wrong

CORRECT ANSWER: B

SOLUTION:

Since LHS is displacement, so RHS should have dimensions of displacementAlso argument of a trigonomentric function should be dimensions in equation (2) argamant is not dimensions and in equation (3) a/T has not the dimensions of displacement.

Watch Video Solution On Doubtnut App

Q-40 - 11295605

In an experiment , the following observations were recorded: $L=2.820m, M=3.00kg, l=0.087cm, diameter, D=0.041cm$. Taking $g=9.81ms^{-2}$ and using the formula , $Y=\frac{4Mg}{\pi D^2 l}$, find the maximum permissible error in Y.

SOLUTION:

$Y = \frac{4MgL}{\pi D^2 l}$. So maximum permissible error in Y

$$\frac{\Delta Y}{Y} \times 100 = \left(\frac{\Delta M}{M} + \frac{\Delta g}{g} + \frac{\Delta L}{L} + \frac{2\Delta D}{D} + \frac{\Delta l}{l}\right) \times 100$$

$$= \left(\frac{1}{300} + \frac{1}{9.81} + \frac{1}{9820} + 2 \times \frac{1}{41} + \frac{1}{87}\right) \times 100$$

$$= 0.065 \times 100 = 6.5\%$$

Q-41 - 11295546

If there is a positive error of 50 $\%$ in the measurement of velocity of a body , find the error in the measurement of kinetic energy.

SOLUTION:

Kinetic energy , $E = \frac{1}{2}mv^2$

∴

$$\frac{\Delta E}{E} \times 100 = \left(\frac{\Delta m}{m} + \frac{2\Delta v}{v}\right) \times 100$$

Here

$$\Delta m = 0 \text{ and } \frac{\Delta v}{v} \times 100 = 50 \%$$

∴

$$\frac{\Delta E}{E} \times 100 = 2 \times 50$$
$$= 100\ \%$$

Watch Video Solution On Doubtnut App

Q-42 - 11487331

A physical quantity A is related to four observable a,b,c and d as follows, $A = \frac{a^2 b^3}{c\sqrt{d}}$, the percentage errors of measurement is a,b,c and d,are $1\ \%$,$3\ \%$,$2\ \%$ and $2\ \%$ respectively. What is the percentage error in the quantity A?

(A) $12\ \%$

(B) $7\ \%$

(C) $5\ \%$

(D) $14\ \%$

CORRECT ANSWER: D

SOLUTION:

Percentage error in A

$$= \left(2 \times 1 + 3 \times 3 + 1 \times 2 + \frac{1}{2} \times 2\right)\%$$

$$= 14\%$$

Watch Video Solution On Doubtnut App

Q-43 - 11487319

The period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$ where l is about 100 cm and is known to have 1 mm accuracy. The period is about 2 s. The time of 100 oscillation is measrued by a stop watch of least count 0.1 s. The percentage error is g is

(A) 0.1%

(B) $1\,\%$

(C) $0.2\,\%$

(D) $0.8\,\%$

CORRECT ANSWER: C

SOLUTION:

$$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T^2$$

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

Here $\%$ erro r is

$$l = \frac{1mm}{100cm} \times 100$$

$$= \frac{0.1}{100} \times 100 = 0.1$$

$\%$

and $\%$ error is

$$T = \frac{0.1}{2 \times 100} \times 100$$
$$= 0.05\ \%$$

$\%$ error is $g =$ $\%$ error in $l + 2($ $\%$ error in T)
$$= 0.1 + 2 \times 0.05$$
$$= 0.2\ \%$$

Watch Video Solution On Doubtnut App

Q-44 - 11745129

The focal f to a mirror is given by $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ where u and v represent object and image distance respectively then

(A) $\frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v}$

(B) $\frac{\Delta f}{f} = \frac{\Delta u}{v} + \frac{\Delta v}{u}$

(C)

$$\frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v} - \frac{\Delta(u+v)}{u+v}$$

(D)

$$\frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v} + \frac{\Delta u}{u+v} + \frac{\Delta v}{u+v}$$

CORRECT ANSWER: D

SOLUTION:

$$f = \frac{uv}{u+v}, \frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v} + \frac{\Delta(u+v)}{u+v}$$

$$= \frac{\Delta u}{u} + \frac{\Delta v}{v} + \frac{\Delta u}{u+v} + \frac{\Delta v}{u+v}$$

Q-45 - 11745130

For a cabical block, error in measurement of sides is $\pm 1\%$ and error in ,easurement of mass is $\pm 2\%$ then maximum posible error in dencity is

(A) 1%

(B) 5%

(C) 3%

(D) 7%

CORRECT ANSWER: D

SOLUTION:

$$\rho = \frac{m}{V} = \frac{m}{t^2}$$

Given

$$\frac{\Delta m}{m} = 2\,\% = \pm 2$$

$$\times 10^{-2}$$

$$\frac{\Delta l}{l} = \pm 1\,\% = \pm$$

$$\times 10^{-2}$$

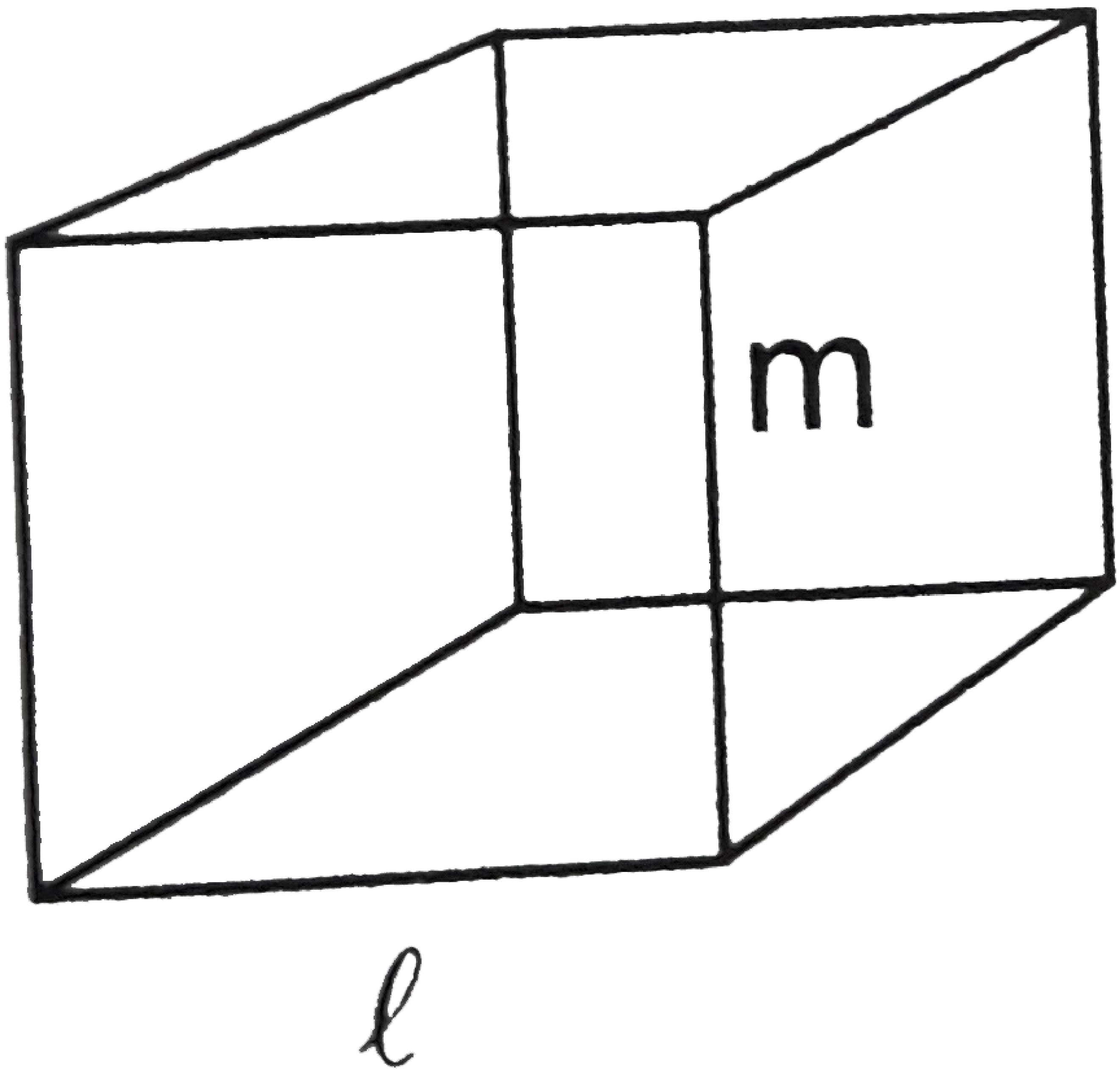
$$\frac{\Delta \rho}{\rho} = \frac{\Delta m}{m} + 3$$

$$\times 10^{-2}$$

$$= 2 \times 10^{-2} + 3$$

$$\times 10^{-2}$$

$$= 5 \times 10^{-2} = 5\,\%$$



Q-46 - 18253703

A resistor of $10 k\Omega$ has a tolerance of 10% and another resistor of $20 k\Omega$ has a tolerance of $20\ \%$. The tolerance of the series combination is rearly

(A) $10\ \%$

(B) $20\ \%$

(C) $15\ \%$

(D) $17\ \%$

SOLUTION:

(d)

$r_1 = 10k\Omega, \Delta r_1$

$$= \frac{10}{100} \times 10 = 1k\Omega$$

$r_2 = 20k\Omega, \Delta r_2$

$$= \frac{20}{100} \times 20 = 4k\Omega$$

Maximum tolerance

$= \Delta r_1 = \Delta r_2 = 1$
$+ 4 = 5$

$r_1 + r_2 = 10 + 20$
$= 30k\Omega$

% age of tolerance

$$= \frac{5}{30} \times 10 = 16.67$$

$$\% = 17\%$$

Q-47 - 18253706

A physical quantity is given by $X = [M^a L^b T^c]$. The percentage error in measurement of M, L and T are α, β, γ respectively. Then the maximum $\%$ error in the quantity X is

(A) $a\alpha + b\beta + c\gamma$

(B) $a\alpha + b\beta - c\gamma$

(C) $\frac{a}{\alpha} + \frac{b}{\beta} + \frac{c}{\gamma}$

(D) None of the above

SOLUTION:

(a) $X = \left[M^{a}L^{b}T^{c}\right]$

Maximum percentage error $= a\alpha + b\beta + c\gamma$

Watch Video Solution On Doubtnut App

Q-48 - 18253636

The time between human heart beat is $8 \times 10^{-1} s$. How many heart beats are measured in one minute.

(A) 75

(B) 60

(C) 82

(D) 64

SOLUTION:

(a)

$$n = \frac{1}{8 \times 10^{-1} s}$$

$$= \frac{1 \text{minute}}{8 \times 10^{-1} s}$$

$$= \frac{60 s}{8 \times 10^{-1} s} = \frac{600}{8}$$

$$= 75$$

Q-49 - 18253659

The expression from centripetal force depends upon mass of body, speed of the body and the radius of circular path. Find the expression for centripetal force.

(A) $F = \frac{mv^2}{2r^3}$

(B) $F = \frac{mv^2}{r}$

(C) $F = \frac{mv^2}{r^2}$

(D) $F = \frac{m^2 v^2}{2r}$

SOLUTION:

(b) $F = m^a v^b r^c$

$[MLT^{-2}]$

$= [ML^0T^0]^a$

$[M^0LT^{-1}]^b [M^0LT^0]^c$

$[MLT^{-2}]$

$= [M^a L^{b+c} T^{-b}]$

$\Rightarrow a = 1, b + c = 1$ and $b = 2$

$2 + c = 1$ and $c = -1$

$F = mv^2 r^{-1} \Rightarrow F$

$= \frac{mv^2}{r}$

Watch Video Solution On Doubtnut App

Q-50 - 18253660

The maximum staic friction on a body is $F = \mu N$.

Here $N =$ normal reaction force on the body.

$\mu =$ coefficient of static friction. The dimension of μ is

(A) $[MLT^{-2}]$

(B) $[M^0 L^0 T(0) \theta^{-1}]$

(C) dimensionless

(D) none of these

SOLUTION:

(c) $\because F = \mu N \therefore \mu = \dfrac{F}{N}$

$: [\mu] = \left[\dfrac{F}{N}\right]$

$= \dfrac{[MLT^{-2}]}{(MLT^{-2}]} =$

dimensionless

Watch Text Solution On Doubtnut App

Q-51 - 18253675

The magnetic force on a point moving charge is $F = q(v \times B)$.

Here $q =$ electric charge

$v =$ velocity of the point charge

$B =$ magnetic field

The dimensions of B is

(A) $\left[AMLT^{-1}\right]$

(B) $\left[A^{-1}MLT^{-2}\right]$

(C) $\left[A^{-1}MT^{-2}\right]$

(D) none of these

SOLUTION:

(c) $\because F = qv \times B$ or $F = qvB\sin\theta$

$$\therefore [B] = \left[\frac{F}{qv}\right]$$

$$= \frac{[MLT^{-2}]}{[ATLT^{-1}]}$$

$$= [A^{-}MT^{-2}]$$

Watch Video Solution On Doubtnut App

Q-52 - 11745133

The equation of stationary wave is $y = A \sin kt \cos \omega$,where y and x in second choose the correct option

(A) the dimensions of A and k are same

(B) the dimensions of A, k and $\omega$are same

(C) the dimensions of k and ω are same

(D) the dimensions of (kx) and (ω) are same

CORRECT ANSWER: D

SOLUTION:

kx and ωt have dimensions of angle (i.e. $\left[M^0L^0T^0\right]$)

Hence kt and omega t both are dimensionless

Q-53 - 11487301

If the speed v of a particle of mass m as function of time t is given by $v = \omega A \sin\left[\left(\frac{\sqrt{k}}{m}\right)t\right]$, where A has dimension of length.

(A) the argument of trigonometric function must be a dimensionless quntity

(B) Dimensional formula of ω is LT^{-1}

(C) Dimensional formula of k is MLT^{-2}

(D) Dimensional formula of $\sqrt{\frac{k}{m}}$ is T

CORRECT ANSWER: A

SOLUTION:

Plane angle is dimensionless

$$[WA] = [v]$$

$$[W]L = LT^{-1}$$

$$[W] = T^{-1}$$

$$\left[\sqrt{\frac{k}{m}}t\right] = 1$$

$$k = \frac{m}{t^2} = MT^{-2}$$

$$\left(\sqrt{\frac{k}{m}} = \{t\} = 1\right.$$

$$\Rightarrow \sqrt{\frac{k}{m}} = T^{-1}$$

Q-54 - 10955182

A quantity X is given by $\varepsilon_p L \frac{\delta V}{\delta t}$, where ε_p is the permitivity of free space ,L is a length , δV is a potential diffrence and δt is a time interval . The dimensional formula for X is the seme as that of

(A) resistance

(B) charge

(C) voltage

(D) current

CORRECT ANSWER: D

SOLUTION:

$$C = \frac{\Delta q}{\Delta V} = \frac{\varepsilon_0 A}{d}$$

or $\varepsilon_0 = \frac{A}{L} = \frac{\Delta q}{\Delta V}$

or $\varepsilon_0 = \frac{(\Delta q)L}{A(\Delta V)}$

$$X = \varepsilon_0 L \frac{\Delta V}{\Delta t}$$

$$= \frac{(\Delta q)L}{A(\Delta V)} L \frac{\Delta V}{\Delta t}$$

but $[A] = [L^2]$

$$:.X = \frac{\Delta q}{\Delta t} = current$$

Watch Video Solution On Doubtnut App

Q-55 - 11745147

v, T, ρ and λ denote ,surface tension, mass density and wavelength, respectively In an experiment v depends on T, p and λ respectively .The value of v is proportional to

(A) `sqrt((T)/(lambda))

(B) $\sqrt{\frac{T}{p\lambda}}$

(C) $\sqrt{\frac{\lambda}{pT}}$

(D) `sqrt((T)/(p lambda))

CORRECT ANSWER: B

SOLUTION:

$$v = KT^a p\rho^b \lambda^c$$

$$LHS = \left[M^0 LT^{-1}\right]$$

$$RHS = \left[M^0 LT^{-1}\right]$$

$$= \left[MT^{-2}\right]^a \left[ML^{-3}\right]^b$$

$$[L]^c$$

$$= \left[M^{a+b} L^{-3b+c} T^{-2a}\right]$$

According to homogeneity principal

LHS - RHS

$$\left[M^0 LT^{-1}\right]$$

$$= \left[M^{a+b} L^{-3b+c} T^{-2a}\right]$$

$$\therefore a + b = 0$$

$\therefore a = -b$...(i)

$-3b+c=1$...(ii)

$-2a=-1$...(iii)

$$\therefore c=\frac{-1}{2}$$

$$b=-a=-\frac{1}{2}$$

$$-3b+c=1$$

$$\Rightarrow -3\left(\frac{-1}{2}\right)$$

$$\because v=KT^a\rho^b\lambda^c$$

$$=KT^{\frac{1}{2}}\rho^{-\frac{1}{2}}\lambda^{-\frac{1}{2}}$$

$$=K\sqrt{\frac{T}{\rho\lambda}}$$

.

Q-56 - 11745157

A person measures two quantities as

$A=1.0m\pm0.2m, B$
$=2.0m\pm0.2m$

We should report correct value for $\sqrt{AB}$ as

(A) $1.4m \pm 0.4m$

(B) $1.41m \pm 0.15m$

(C) $1.4m + 0.3m$

(D) $1.4m \pm 0.2m$

CORRECT ANSWER: D

SOLUTION:

Given

$A = 1.0m \pm 0.2m,\ B$
$= 2.0m \pm 0.2m$

Let

$V = \sqrt{AB}$
$= \sqrt{(1.0)(2.0)}$
$= 1.414m$

Rounding off to two significant digit $Y = 1.4m$

$$\frac{\Delta Y}{Y} = \frac{1}{2}\left[\frac{\Delta A}{A} + \frac{\Delta B}{B}\right]$$

$$= \frac{1}{2}\left[\frac{0.2}{1.0} + \frac{0.2}{2.0}\right]$$

$$= \frac{0.6}{2 \times 2.0}$$

$$\Rightarrow \Delta Y = \frac{0.6Y}{2 \times 2.0}$$

$$= \frac{0.6 \times 1.4}{2 \times 2.0} = 0.20$$

Rounding off to one significant digit Thus currect value

for

$$\sqrt{AB} = r + \Delta r = 1.4 \pm 0.2m$$

Q-57 - 10058417

A student measures the time period of 100 ocillations of a simple pendulum four times. The data set is $90s$, 91 s, 95 s, and 92 s $. If the \min i\mu m \div ision$ $\in themeasur \in gclockis$ 1 s`, then the reported men time should be:

(A) (a) $92 \pm 1.8s$

(B) (b) $92 \pm 3s$

(C) (c) $92 \pm 2s$

(D) (d) $92 \pm 5.0s$

CORRECT ANSWER: A

SOLUTION:

(a)

$$\Delta T = (|\Delta T_1| + |\Delta T_2| + \Delta T_3| + |D < aT_4) \frac{|}{4}$$

$$= \frac{2 + 1 + 3 + 0}{4}$$

$$= 1.5$$

As the resolution of measuring clock is 1.5 therefore the mean time should be 92 ± 1.5

Watch Video Solution On Doubtnut App

Q-58 - 10058416

The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$.

Meared value of L is $20.0cm$ know to $1mm$ accuracy and time for 100 oscillation of the pendulum is found to be $90s$ using a wrist watch of $1s$ resolution. The accracy in the determinetion of g is :

(A) (a) $1\ \%$

(B) (b) $5\ \%$

(C) (c) $2\ \%$

(D) (d) $3\ \%$

CORRECT ANSWER: D

SOLUTION:

(d) As, $g = 4\pi^2 \frac{l}{T6(2)}$

So,

$$\frac{\Delta g}{g} \times 100 = \frac{\Delta l}{l}$$

$$\times 100 + 2\frac{\Delta T}{T} \times 100$$

$=$ (0.1)/(20) xx 100 + 2 xx (1)/(90) xx 100 = 2.72 ~=

3%`

Watch Video Solution On Doubtnut App

Q-59 - 11745248

If unit of mass become 2 times the unit of length becomes 4 time and the unit of time in the unit of Plank's Due to the unit of plank's constant because n time The value of n is

(A) 3

(B) 5

(C) 6

(D) 8

CORRECT ANSWER: D

SOLUTION:

The unit of plank's constant is joule second or kgm^2 per second

$$\frac{(\text{unit of mass})(\text{unit of length})^2}{(\text{unit of time})}$$

$$= \frac{2 \times 4^2}{4} = 8\text{times}$$

$$\therefore n = 8$$

Q-60 - 11295544

The relative density of material of a body is found by weighting it first in air and then in water . If the weight in air is $(5.00 \pm 0.05)N$ and the weight in water is $(4.00 \pm 0.05)N$. Find the relative density along with the maximum permissible percentage error.

SOLUTION:

Weight in air $= (5.00 \pm 0.05) N$

weight in water $= (4.00 \pm 0.05) N$

Loss of weight in water $= (1.00 \pm 0.1) N$

Now relative density

$$= \frac{\text{weight in air}}{\text{weight loss in water}}$$

i.e., $RD = \dfrac{5.00 \pm 0.05}{1.00 \pm 0.1}$

Now relative density with maximum permissible error

$$= \frac{5.00}{1.00} \pm \left(\frac{0.05}{5.00} + \frac{0.1}{1.00} \right) \times 100$$

$$= 5.0 \pm (1 + 10) \%$$
$$= 5.0 \pm 11 \%$$