V PLUS U

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SUBJECT : **TOPIC:** **TIME:** **DATE:**

1. The frequency of vibration f of a mass m suspended from a spring of spring constant K is given by a relation of this type $f = Cm^xK^y$; where C is a dimensionless quantity. The value of x and y are

(a) $x = \frac{1}{2}, y = \frac{1}{2}$ (b) $x = -\frac{1}{2}, y = -\frac{1}{2}$

(c) $x = \frac{1}{2}, y = -\frac{1}{2}$ (d) $x = -\frac{1}{2}, y = \frac{1}{2}$

2. The quantities A and B are related by the relation, $m = A/B$, where m is the linear density and A is the force. The dimensions of B are of

(a) Pressure (b) Work

(c) Latent heat (d) None of the above

3. The velocity of water waves v may depend upon their wavelength λ, the density of water ρ and the acceleration due to gravity g. The method of dimensions gives the relation between these quantities as

(a) $v^2 \propto \lambda g^{-1}\rho^{-1}$ (b) $v^2 \propto g\lambda\rho$

(c) $v^2 \propto g\lambda$ (d) $v^2 \propto g^{-1}\lambda^{-3}$

4. The dimensions of physical quantity X in the equation Force $= \frac{X}{\text{Density}}$ is given by

(a) $M^1L^4T^{-2}$ (b) $M^2L^{-2}T^{-1}$

(c) $M^2L^{-2}T^{-2}$ (d) $M^1L^{-2}T^{-1}$

5. The Martians use force (F), acceleration (A) and time (T) as their fundamental physical quantities. The dimensions of length on Martians system are

(a) FT^2 (b) $F^{-1}T^2$

(c) $F^{-1}A^2T^{-1}$ (d) AT^2

6. An athletic coach told his team that muscle times speed equals power. What dimensions does he view for muscle

(a) MLT^{-2} (b) ML^2T^{-2}

(c) MLT^2 (d) L

7. The dimensions of stress are equal to

(a) Force (b) Pressure

(c) Work (d) $\frac{1}{\text{Pressure}}$

8. The dimensions of pressure are

(a) MLT^{-2} (b) $ML^{-2}T^2$

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

9. Dimensions of strain are

(a) MLT^{-1} (b) ML^2T^{-1}

(c) MLT^{-2} (d) $M^0L^0T^0$

10. Dimensions of kinetic energy are

(a) ML^2T^{-2} (b) M^2LT^{-1}

(c) ML^2T^{-1} (d) ML^3T^{-1}

11. In the following list, the only pair which have different dimensions, is

(a) Linear momentum and moment of a force

(b) Planck's constant and angular momentum

(c) Pressure and modulus of elasticity

(d) Torque and potential energy

12. If velocity v, acceleration A and force F are chosen as fundamental quantities, then the dimensional formula of angular momentum in terms of v, A and F would be

(a) $FA^{-1}v$ (b) Fv^3A^{-2}

(c) Fv^2A^{-1} (d) $F^2v^2A^{-1}$

13. Dimensions of the following three quantities are the same

(a) Work, energy, force

(b) Velocity, momentum, impulse

(c) Potential energy, kinetic energy, momentum

(d) Pressure, stress, coefficient of elasticity

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

(a) MLT^{-3} and ML^2T^{-4} (b) MLT^{-3} and MLT^{-4}

(c) MLT^{-1} and MLT^0 (d) MLT^{-4} and MLT^1

15. If the speed of light (c), acceleration due to gravity (g) and pressure (p) are taken as the fundamental quantities, then the dimension of gravitational constant is

(a) $c^2g^0p^{-2}$ (b) $c^0g^2p^{-1}$

(c) cg^3p^{-2} (d) $c^{-1}g^0p^{-1}$

16. If force (F), length (L) and time (T) are assumed to be fundamental units, then the dimensional formula of the mass will be

(a) $FL^{-1}T^{2}$ (b) $FL^{-1}T^{-2}$
(c) $FL^{-1}T^{-1}$ (d) $FL^{2}T^{2}$

17. In a system of units if force (F), acceleration (A) and time (T) are taken as fundamental units then the dimensional formula of energy is

(a) $FA^{2}T$ (b) FAT^{2}
(c) $F^{2}AT$ (d) FAT

18. Out of following four dimensional quantities, which one quantity is to be called a dimensional constant

(a) Acceleration due to gravity
(b) Surface tension of water
(c) Weight of a standard kilogram mass
(d) The velocity of light in vacuum

19. 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 1mm accuracy. The period is about 2s. The time of 100 oscillations is measured by a stop watch of least count 0.1 s. The percentage error in g is

(a) 0.1% (b) 1%
(c) 0.2% (d) 0.8%

20. The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimation of the kinetic energy obtained by measuring mass and speed

(a) 11% (b) 8%
(c) 5% (d) 1%

21. The random error in the arithmetic mean of 100 observations is x; then random error in the arithmetic mean of 400 observations would be

(a) $4x$ (b) $\frac{1}{4}x$
(c) $2x$ (d) $\frac{1}{2}x$

22. Error in the measurement of radius of a sphere is 1%. The error in the calculated value of its volume is

(a) 1% (b) 3%
(c) 5% (d) 7%

23. The radius of a sphere is (5.3 ± 0.1) cm. The percentage error in its volume is

(a) $\frac{0.1}{5.3}\times 100$ (b) $3\times\frac{0.1}{5.3}\times 100$
(c) $\frac{0.1\times 100}{3.53}$ (d) $3+\frac{0.1}{5.3}\times 100$

24. The period of oscillation of a simple pendulum in the experiment is recorded as 2.63 s, 2.56 s, 2.42 s, 2.71 s and 2.80 s respectively. The average absolute error is

(a) 0.1 s (b) 0.11 s
(c) 0.01 s (d) 1.0 s

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

1. (d) By putting the dimensions of each quantity both the sides we get $[T^{-1}]=[M]^x[MT^{-2}]^y$

Now comparing the dimensions of quantities in both sides we get $x+y=0$ and $2y=1$ $\therefore$ $x=-\frac{1}{2}, y=\frac{1}{2}$

2. (c) m = linear density = mass per unit length = $\left[\frac{M}{L}\right]$

A= force $=[MLT^{-2}]$ $\therefore$ $[B]=\frac{[A]}{[m]}=\frac{[MLT^{-2}]}{[ML^{-1}]}=[L^2T^{-2}]$

This is same dimension as that of latent heat.

3. (c) Let $v^x=kg^y\lambda^z\rho^\delta$. Now by substituting the dimensions of each quantities and equating the powers of M, L and T we get $\delta=0$ and $x=2, y=1, z=1$.

4. (c) $[X]$ = $[F]$ × $[\rho]$ = $[MLT^{-2}]\times\left[\frac{M}{L^3}\right]=[M^2L^{-2}T^{-2}]$

5. (d) Acceleration = $\frac{\text{distance}}{\text{time}^2}\Rightarrow A=LT^{-2}\Rightarrow L=AT^2$

6. (a) According to problem muscle × speed = power

$\therefore$ muscle = $\frac{\text{power}}{\text{speed}}=\frac{ML^2T^{-3}}{LT^{-1}}=MLT^{-2}$

7. (b) [Pressure] =[stress] = $[ML^{-1}T^{-2}]$

8. (c)

9. (d) Strain is dimensionless.

10. (a) Kinetic energy = $\frac{1}{2}mv^2=M[LT^{-1}]^2=[ML^2T^{-2}]$

11. (a) Linear momentum = Mass $\times$ Velocity = $[MLT^{-1}]$

Moment of a force = Force $\times$ Distance = $[ML^2T^{-2}]$

12. (b) $L\propto v^xA^yF^z$ $\Rightarrow$ $L=kv^xA^yF^z$

Putting the dimensions in the above relation

$[ML^2T^{-1}]=k[LT^{-1}]^x[LT^{-2}]^y[MLT^{-2}]^z$

$\Rightarrow$ $[ML^2T^{-1}]=k[M^zL^{x+y+z}T^{-x-2y-2z}]$

Comparing the powers of M, L and T

$z=1$ ...(i)

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

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

On solving (i), (ii) and (iii) $x=3, y=-2, z=1$

So dimension of L in terms of v, A and f

$[L]=[Fv^3A^{-2}]$

13. (d) [Pressure] = [Stress] = [coefficient of elasticity] = $[ML^{-1}T^{-2}]$

14. (b) From the principle of dimensional homogenity $[a]=\left[\frac{F}{t}\right]=[MLT^{-3}]$ and $[b]=\left[\frac{F}{t^2}\right]=[MLT^{-4}]$

15. (b) Let $[G]\propto c^xg^yp^z$

by substituting the following dimensions :

$[G]=[M^{-1}L^3T^{-2}], [c]=[LT^{-1}], [g]=[LT^{-2}]$

$[p]=[ML^{-1}T^{-2}]$

and by comparing the powers of both sides

we can get $x=0, y=2, z=-1$

$\therefore$ $[G]\propto c^0g^2p^{-1}$

16. (a) Let $m=KF^aL^bT^c$

Substituting the dimension of

$[F]=[MLT^{-2}]$, $[C]=[L]$ *and* $[T]=[T]$

and comparing both sides, we get $m=FL^{-1}T^{-2}$

17. (b) $E=KF^aA^bT^c$

$\left[ML^2T^{-2}\right]=\left[MLT^{-2}\right]^a\left[LT^{-2}\right]^b[T]^c$

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

$\therefore$ $a=1$, $a+b=2\Rightarrow b=1$

and $-2a-2b+c=-2\Rightarrow c=2$

$\therefore$ $E=KFAT^2$.

18. (d)

19. (c) $T=2\pi\sqrt{l/g}\Rightarrow T^2=4\pi^2l/g\Rightarrow g=\frac{4\pi^2l}{T^2}$

Here % error in l = $\frac{1mm}{100cm}\times100=\frac{0.1}{100}\times100=0.1\%$

and % error in $T=\frac{0.1}{2\times100}\times100=0.05\%$

$\therefore$ % error in g = % error in l + 2(% error in T)

$= 0.1 + 2 \times 0.05 = 0.2\ \%$

20. (b) $\therefore E = \frac{1}{2}mv^2$

$\therefore$ % Error in K.E.

= % error in mass + 2 × % error in velocity

$= 2 + 2 \times 3 = 8\ \%$

21. (b)

22. (b) $\because V = \frac{4}{3}\pi r^3$

$\therefore$ % error is volume $= 3 \times \%$ error in radius

$= 3 \times 1 = 3\%$

23. (b) $\because V = \frac{4}{3}\pi r^3$

$\therefore$ % error in volume

$= 3 \times \%$ error in radius.

$= \frac{3 \times 0.1}{5.3} \times 100$

24. (b) Average value $= \frac{2.63 + 2.56 + 2.42 + 2.71 + 2.80}{5}$

$= 2.62\,sec$

Now $|\Delta T_1| = 2.63 - 2.62 = 0.01$

$|\Delta T_2| = 2.62 - 2.56 = 0.06$

$|\Delta T_3| = 2.62 - 2.42 = 0.20$

$|\Delta T_4| = 2.71 - 2.62 = 0.09$

$|\Delta T_5| = 2.80 - 2.62 = 0.18$

Mean absolute error

$$\Delta T = \frac{|\Delta T_1| + |\Delta T_2| + |\Delta T_3| + |\Delta T_4| + |\Delta T_5|}{5}$$

$= \frac{0.54}{5} = 0.108 = 0.11\,sec$

25. (d) Percentage error in A

$$= \left(2 \times 1 + 3 \times 3 + 1 \times 2 + \frac{1}{2} \times 2\right)\% = 14\%$$