PHYSICS

BOOKS - GR BATHLA & SONS PHYSICS (HINGLISH)

UNITS AND DIMENSIONS

Problem

1. In British engineering system the unit of mass is slug while the unit of force is force is pound. How many kg are in a slug?

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2. If a composite physical quantity in terms of moment of inertia I, force F, velocity v, work W and length L is defined as,

$Q = \left(IFv^2 / WL^3\right)$,

find the dimensions of Q and identify it.

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3. A calorie is a unit of heat or energy and it equals about $4.2J, where 1J = 1kgm^2s^{-2}$. Suppose we employ a system of units in which the unit of mass equals αkg, the unit of length equals is βm , the unit of time is γs. Show

tthat a calorie has a magnitude $4.2\alpha^{-1}\beta^{-1}\gamma^{2}$ in terms of the new units.

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4. A gas bubble, from an exlosion under water, oscillates with a period T proportional to p^(a)d^(b)E^(c). $Where$ 'P'$isthestaticpressure$, 'd'$isthedensityofwater$'E' $isthe \rightarrow tale \neq rgyofthe\,\exp losion.\ F \in dthevaluesof$ a, b and, c`.

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5. If force, time and velocity are treated as fundamental quantities then dimensional formula of energy will be

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6. It is estimated that per minute each cm^2 of earth receives about 2 calorie of heat energy from the sun. This constant is called solar constant S. Express solar constant in SI units.

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7. Finding dimensions of resistance R and indcutance L, speculate what physcial quantities (L/R) and $\frac{1}{2}LI^2$ represent, where I is current?

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8. In the formula $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction respectively. What are the dimensions of Y in MKSQ system?

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9. A quantity X is given by $\in_0 L\frac{\Delta V}{\Delta t}$, where $\in_0$ is the permittivity of free space, L is a length, ΔV is a potential difference and Δt is a time interval. The dimensional formula for X is the same as that of -

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10. Column-1 gives three physical quantities. Select the appropriate units for the choices given in column-II. Some of the physical quantities may have more than one choice.

Column-I	Column-II
Capacitance	ohm-second
Inductance	Coulomb^2 / Joule
Magnetic induction	coulomb/volt
	newton/ampere metre
	volt-second/ampere

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11. The terms in column X are somehow related to the terms in columns Y and Z, match the following columns

correctly:

X	Y	Z
1. *Planck*	A. *Nuclear constant*	G. *Angstrom*
2. *Raoult*	B. *Mass-wave*	H. *Threshold frequency*
3. *de Broglie*	C. *Moderator*	I. *Heavy water*
4. *Einstein*	D. *Erg-second*	J. *Molecular weight*
5. *Nuclear reactor*	E. *Vapour pressure lowering*	K. $E = mc^2$
6. *Mass defect*	F. *Photoelectric effect*	L. 6.626×10^{-27}

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12. Four physical quantities are listed in column I. Their values are listed in column II in random order.

Column I	Column II
[a] *Thermal energy of air molecule at room temperature*	[e] 0.02 *eV*
[b] *Binding energy of heavy nuclei per nucleon*	[f] 2 *eV*
[c] *X-ray photon energy*	[g] 1 *keV*
[d] *Photon energy of visible light*	[h] 7 *MeV*

Match the column correctly.

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13. The diameter of a ball was measured five times with the aid of a micrometer whose absolute error $(\Delta d_{\text{inst}}) = \pm 0.01mm$. The results of measuring the diameter of the ball are $d_1 = 5.27mm, d_2 = 5.30mm, d_3 = 5.28mm, d_4 = 5.32mm$ and $d_5 = 5.28mm$. Find (a) mean value of ball diameter (b) mean absolute error (c) result of measurement (d) relative error (e) persentage error.

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14. In an experiment on determining density of a rectangular block, the dimensions of the block are

mesured with vernier callipers $(V.C = 0.01cm)$ and its mass is measured with a beam balance $(L.C. = 0.1g)$. The measured values are :

Mass$(m) = 39.3$ g

Length$(l) = 5.12$ cm

Breadth$(b) = 2.56$ cm

Thickness$(t) = 0.37$ cm

Calculate density of the block with permissible limits of error.

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15. In determination of value of acceleration due to gravity (g) by simple pendulum, the time period is measured by a topwatch (L.C. = 0.5 second) and length of

the thread is measured with metre scale (L.C. 0.1 cm) and diametre of bob is measured with vernier callipers (L.C. = 0.1 cm). The following observations are recorded :

Length of the thread $= 105.3cm$

Diameter of the bob $= 2.45cm$

Time period $= 2.07s$

Number of oscillations $= 10$

Calculate the value of g, estimate error and write the result in proper significant figures.

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16. Given that mass of sun is 2×10^{30} kg and radius of sun is $7 \times 10^{8}m$. In what range do you expect the mass

density of the sum to be ? Is it in the range of density of solid or liquid or gas ? Explain.

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17. In searle's experiment, the diameter of the wire, as measured by a screw gauge of least count 0.001 cm is 0.500 cm. The length, measured by a scale of least count 0.1cm is 110.0cm. When a weight of 40N is suspended from the wire, its extension is measured to be 0.125 cm by a micrometer of least count 0.001 cm. Find the Young's modulus of the meterial of the wire from this data.

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18. In an experiment to determine the specific heat of a metal,a $0.20kg$ block of the metal at $150.^{\circ}C$ is dropped in a copper calorimeter (of water equivalent $0.025kg$) containing $150cm^3$ of water at $27.^{\circ}C$. The final temperature is $40.^{\circ}C$. The specific heat of the metal is.

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19. In resonance apparatus for determining the velocity of sound in air, a turnning fork of frequency 320 Hz is used. A loud sound is heard when water level is at 24.8 cm and then at 78.5 cm. These lengths are called the first and second resonance lengths of air column in the resonance

apparatus. Calculate the velocity of sound in air within the limits of permissiblr error.

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20. In $u - v$ method for finding the focal length of a concave mirror. The mirror is fixed at position A marked $20.0cm$ on an optical bench and an object needle is placed at position B marked $45.0cm$ on an optical banch. For no parallax between object needle and image needle the image needle at position $C57.5cm$ on optical bench. Then percentage error in the measurement of focal length of the mirror is

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21. When a body is weighed successively in the two pans of a physical balance with unequal arms, the apparent masses are found to be M_1 and M_2. Show that the length of the arms are in the ratio $\sqrt{M_1} : \sqrt{M_2}$.

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22. If the lengths of the arms of a physical balance are l_1 and l_2 and a salesman weighs out twice to a customer articles of mass M by putting weughts first in one pan and then in the other, shown that the salesman is a loser by $M\left[\frac{(l_1 - l_2)^2}{l_1 l_2}\right]$.

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23. The pitch of a screw gauge is $1mm$ and three are 100 divisions on its circular scale. When nothing is put in between its jaws, the zero of the circular scale lies 6 divisions below the reference line. When a wire a placed between the jaws, 2 linear scale divisions are clearly visible while 62 divisions on circular scale coincide with the reference line. Determine the diameter of the wire.

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24. Least count of a vernier callipers is $0.01cm$ When the two jaws of the instrument touch each other the $5th$ division of the vernier scale coincide with a main scale division and the zero of the vernier scale lies to the left of

the zero of the main scale. Furthermore while measuring the diameter of a sphere, the zero markof the vernier scale lies between $2.4cm$ and $2.5cm$ and the $6th$ vernier division coincides with a main scale division. Calculate the diameter of the sphere.

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Problem For Practice

1. (a) Can there be a phusical quantity which has no unit and dimensions ?

(b) Can a physical quantity have unit without having dimensions?

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2. Name the smallest and largest units of length.

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3. In which system mass is derived physical quantity and what is its unit?

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4.

	Column I		Column II
(A)	Base unit	(p)	N
(B)	Derived unit	(q)	hp
(C)	Improper unit	(r)	kgwt
(D)	Practical	(s)	rad
(E)	Supplementary unit	(t)	kg

(Note : Here it is given that you have to match one to one only)

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5. Express the power of a 100 watt bulb in CGS unit.

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6. What is the weight of a body misway between the weight of 1 kg and 16 kg?

(a) on the ordinary scale

(b) on the logarithmic scale

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7. The SI and CGS units of energy are joule and erg respectivel. How many ergs are equal to one joule.

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8. Find the dimensions of Planck's constant. If its value in cgs system is 6.62×10^{-27} erg - sec, what will be its

value on mks system?

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9. Calculate the dimensions of universal gravitational constant G. What is the value of G in SI units if its value in CGS system is 6.67×10^{-8} units?

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10. The CGs unit of visosity is poise (P). Find how many poise are there in 1 MKS unit of viscosity called poiseuille (PI)?

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11. IN a new system of units called star units, 1 kg* = 10 kg , 1m* = 1km and 1s*= 1minute, what will be the value of 1J of energy in the new system?

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12. If force F, Length L and time T are chosen as fundamental quantites, the dimensional formula for Mass is

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13. What are the dimensions and SI units of van der Waal's constants a and b?

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14. Assuming that in case of motion of blunt bodies in air acrodynamic drag depends on effective area a of the body, the speed of body relative to air v and density of air σ, show by method of dimensions:

$D = K\sigma A v^2$

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15. The time of oscillation of a small drop of liquid under surface tension depends upon the density ρ, radius r and surface tension S as :

$T \propto \rho^a S^b r^c$

find out a, b and c.

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16. A large fluid star oscillates in shape under the influence of its own gravitational field. Using dimensional analysis, find the expression for period of oscillation (T) in terms of radius of star (R), mean density of fluid (ρ) and universal gravitational constant (G).

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17. (a) construct an expression for a quantity having the dimension of length starting from velocity of light c, the mass of an electron m and Planck's constant h.

(b) Evaluate the value of this length taking constant of proportionality to be unity, $m = 9.1 \times 10^{-31} kg, c = 3 \times 10^{8} m/s$ and $h = 6.63 \times 10^{-34} J - s.$

[This wavelength is called Compton wavelength and plays an important role in atomic physics.]

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18. If the speed of light $c\left(=3\times10^{8}m/s\right)$, Planck's contant $h\left(=6.6\times10^{-34}J-s\right)$ and gravitational constant $G\left(=6.67\times10^{-11}MKS\ \text{units}\right)$ are chosen as the fundamental quantities, find out the dimensions and value of units of (a) mass, and (b) time in this system.

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19. Write the dimensions of the following in terms of mass, time, length and charge

(i) magnetic flux

(ii) rigidity modulus

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20. Check the correctness of the relation $c = \frac{1}{\sqrt{\mu_0 \in_0}}$ where the symbols have their usual meaning.

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21. 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,

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22. The resistance $R = \frac{V}{I}$, where $V = (100 \pm 5.0)V$ and $I = (10 \pm 0.2)A$. Find the percentage error in R.

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23. In an experiment using post-office box, the resistance of a wire is found to be (64 ± 1) ohm. The length and radius of the wire are measured to be (156.0 ± 0.1) cm and (0.26 ± 0.001) cm. Calculate specific resistance (or resistivity) of the material of the given wire, within the limits of percentage error.

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24. Match the items (physical quantity, unit and dimensions) given in three columns below,

D.	Impedance	D.	mho	D.	$[ML^{-1}Q^{-1}]$
E.	Conductance	E.	ohm	E.	$[MLT^{-2}Q^{-1}]$
F.	Current density	F.	J/m^2	F.	$[M^{-1}L^{-3}TQ^2]$
G.	Electrical conductivity	G.	W	G.	$[M^0L^{-2}T^{-1}Q]$
H.	Electric field strength	H.	V/m	H.	$[M^{-1}L^{-2}TQ^2]$
I.	Power	I.	Wb/m^2	I.	$[ML^2T^{-1}Q^{-2}]$
J.	Energy density	K.	F/m	K.	$[M^{-1}L^{-3}T^2Q^2]$
L.	Magnetic flux density	L.	H/m	L.	$[MLQ^{-2}]$

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25. State whether the following statement is true or false.

Give very brief reason in support of your answer.

The quantity $\frac{e^2}{2\varepsilon_0 hc}$ is dimensionless. Here e, h and c are electronic charge, Planck's constant and velocity of light respectively and ε_0 is the permittivity constant of free space.

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26. Solve with due regard to significant digits:

(i) $\sqrt{6.5 - 6.32}$ (ii) $\dfrac{2.91 \times 0.3842}{0.080}$

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Objective Type Question

1. Proper symbol for kilowatt-hour is :

A. kwh

B. KWH

C. kWh

D. kWH

Answer: c

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2. The unit of atomic mass is :

A. $O = 16.0000$

B. $O^{16} = 16.0000$

C. $C = 12.0000$

D. $C^{12} = 12.0000$

Answer: d

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3. Express 1 micro in metre.

A. $10^{-9}m$

B. $10^{-12}m$

C. $10^{-6}m$

D. $10^{-5}m$

Answer: c

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4. One nanometer is equal to :

A. $10^{9}mm$

B. $10^{-6}cm$

C. $10^{-7}cm$

D. $10^{-9}cm$

Answer: c

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5. Light year is :

A. light emitted by the sum in one year

B. time taken by light to travel from the sum to the earth

C. the distance travelled by light in one year, in free space

D. the time taken by earth to go round the sun once

Answer: c

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6. Light year is a unit of

A. energy

B. intensity of light

C. time

D. distance

Answer: d

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7. How many wavelength of Kr^{86} are there is one metre

A. 1553164.13

B. 1650763.73

C. 2348123.73

D. 652189.63

Answer: b

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8. Which of the following is not unit of time ?

A. Solar year

B. Leap year

C. Light year

D. Tropical year

Answer: c

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9. One sec is defined to be equal to :

A. 1650763/73 periods of krypton clock

B. 652189.63 periods of krypton clock

C. 1650763.73 periods of cesium clock

D. 9192631770 periods of cesium clock

Answer: d

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10. Nkg^{-1} is the unit of :

A. velocity

B. force

C. acceleration

D. none of these

Answer: c

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11. What is the SI unit of force?

A. watt

B. dyne

C. newton

D. poundal

Answer: c

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12. Which of the following is not unit of length ?

A. micron

B. light year

C. angstrom

D. radian

Answer: d

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13. An atmosphere :

A. is a unit of pressure

B. is a unit of force

C. gives an idea of the composition of air

D. is the height above which there is no atmosphere

Answer: a

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14. SI unit of pressure is

A. atmosphere

B. bar

C. pascal

D. mm of Hg

Answer: c

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15. The unit of impulse is the same as that of

A. energy

B. force

C. angular momentum

D. linear momentum

Answer: d

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16. Dyne-sec stands for the unit of :

A. force

B. work

C. momentum

D. angular momentum

Answer: c

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17. Joule-second is the unit of

A. energy

B. momentum

C. angular momentum

D. power

Answer: c

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18. One kilowatt-hour is equal to :

A. 3.6×10^6 joule

B. 3.6×10^5 joule

C. 10^3 joule

D. 10^7 joule

Answer: a

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19. The unit of power is :

A. kilowatt

B. kWh

C. dyne

D. joule

Answer: a

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20. The units and dimensions of impendance are :

A. mho, $\left[ML^2T^{-1}Q^{-2}\right]$

B. ohm, $\left[ML^2T^{-3}Q^{-2}\right]$

C. ohm, $\left[ML^2T^{-2}Q^{-1}\right]$

D. ohm, $\left[MLT^{-1}Q^{-1}\right]$

Answer: b

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21. Which one of the following quantities has not been expressed in proper units?

A. Stress/strain $= N/m^2$

B. Surface tension $= N/m$

C. Energy = kg-m/s

D. Pressure $= N/m^2$

Answer: c

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22. Which of the following is dimensionally correct?

A. Pressure = momentum per unit volume

B. Pressure = momentum per unit volume per unit energy

C. Pressure = energy per unit volume

D. Pressure = energy per unit area

Answer: c

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23. Indicate which pair of physical quantities gives below has not the same units and dimensions?

A. Momentum and impulse

B. Torque and angular momentum

C. Acceleration and gravitational field strength

D. Pressure and modulus of elasticity

Answer: b

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24. Four lengths are measured as 18.425 cm, 7.21 cm, 5.04 cm and 10.3571 cm. taking significant figures into account, the sum of lengths should be :

A. 41.0321 cm

B. 41.03 cm

C. 41.032 cm

D. 41.0 cm

Answer: b

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25. The dimensional formula for force per unit linear mass density of wire is the same as that for :

A. velocity

B. acceleration

C. latent heat

D. specific heat

Answer: c

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26. The dimensions of torque are :

A. $[ML^2T^{-2}]$

B. $[MLT^{-2}]$

C. $[ML^{-1}T^{-2}]$

D. $[ML^{-2}T^{-2}]$

Answer: a

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27. The expression $[ML^2T^{-2}]$ represents

A. Power

B. kinetic energy

C. momentum

D. pressure

Answer: b

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28. The dimensional formula of angular velocity is

A. $\left[M^0LT^{-2}\right]$

B. $\left[ML^0T^{-2}\right]$

C. $\left[M^0L^0T^{-1}\right]$

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

Answer: c

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29. Planck's constant has dimensions .....

A. energy

B. momentum

C. frequency

D. angular momentum

Answer: d

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30. The dimensions of gravitational constant G are :

A. $[MLT^{-2}]$

B. $[ML^3T^{-2}]$

C. $[M^{-1}L^3T^{-2}]$

D. $[M^{-1}LT^{-2}]$

Answer: c

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31. E, m, L, G denote energy mass, angular momentum & gravitation constant respectively. The dimensions of $\frac{EL^2}{m^5G^2}$ will be that of :

A. length

B. mass

C. time

D. angle

Answer: d

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32. The dimensional formula for the modulus of rigidity is

A. $\left[ML^{-1}T^{-1}\right]$

B. $\left[ML^{-2}T^{2}\right]$

C. $\left[MLT^{-1}\right]$

D. $\left[ML^{-1}T^{-2}\right]$

Answer: d

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33. Turpentine oil is flowing through a tube of length L and radius r. The pressure difference between the two ends of the tube is p , the viscosity of the coil is given by $\eta = \frac{p(r^2 - x^2)}{4vL}$, where v is the velocity of oil at a distance x from the axis of the tube. From this relation, the dimensions of viscosity η are

A. $[M^0L^0T^0]$

B. $[MLT^{-1}]$

C. $[ML^2T^{-2}]$

D. $\left[ML^{-1}T^{-1}\right]$

Answer: b

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34. The dimension formula for surface tension is :

A. $\left[MT^2\right]$

B. $\left[ML^0T^{-2}\right]$

C. $\left[M^{-1}L^0T^{-2}\right]$

D. $\left[ML^2T^{-2}\right]$

Answer: d

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35. The volume of a liquid of density ρ and viscosity η flowing in time t through a capillary tube of length l and radius R, with a pressure difference P, across its ends is proportional to :

A. $P^2R^2t/\eta l^2$

B. $PR^4/\eta lt$

C. $PR^4t/\eta l$

D. $\eta R^4/lt$

Answer: c

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36. Which of the following is the dimensional formula for capacitance $\times (\text{potential})^2$?

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

B. $\left[ML^2T^{-2}\right]$

C. $\left[ML^{-2}T^{-3}\right]$

D. $\left[ML^{-1}T^{-2}\right]$

Answer: a

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37. Given $F = (a/t) + bt^2$ where F denotes force and t time. The diamensions of a and b are respectively:

A. $\left[MLT^{-1}\right]$ and $\left[MLT^{-4}\right]$

B. $\left[LT^{-1}\right]$ and $\left[T^{-2}\right]$

C. $[T]$ and $\left[T^{-2}\right]$

D. $\left[LT^{-2}\right]$ and $\left[T^{-2}\right]$

Answer: a

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38. The velocity of the waves on the surface of water is proptional to $\lambda^{a}\rho^{\beta}g^{\gamma}$ where λ = waver length, ρ = density and g =m acceleration due to gravity. Which of the following relation is correct?

A. $\alpha = \beta = \gamma$

B. $\beta = \gamma \neq \alpha$

C. $\gamma = \alpha \neq \beta$

D. $\alpha \neq \beta \neq \gamma$

Answer: c

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39. Which of the following pairs have the same units?

A. Wavelength and Rydberg constant

B. Relative velocity and relative density

C. Time period and velocity gradient

D. Thermal capacity and Boltzmann's constant

Answer: d

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40. The time dependence of a physical quantity P is given by $P = P_0 \exp(-\alpha t^2)$, where α is a constant and t is time. The constant α

A. is dimensionless

B. has dimensions $[T^{-2}]$

C. has dimensions $[T^2]$

D. has dimensions of P

Answer: b

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41. The velocity of water wave v may depend on 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. $V^2 \propto g^{-1}\gamma^{-1}$

B. $V^2 \propto g\lambda$

C. $V^2 \propto g\lambda\rho$

D. $V^2 \propto g^{-1}\lambda^{-3}$

Answer: b

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42. From the dimensional consideration, which of the following equation is correct

A. $T = 2\pi\sqrt{R^3/GM}$

B. $T = 2\pi\sqrt{GM/R^3}$

C. $T = 2\pi\sqrt{GM/R^2}$

D. $T = 2\pi\sqrt{R^2/GM}$

Answer: a

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43. If the time period $(T)$of vibration of a liquid drop depends on surface tension (S) , radius(r) of the drop ,

and density (ρ) of the liquid , then find the expression of T.

A. $T \propto \left(\rho r^3 / S\right)^{1/2}$

B. $T \propto \rho r S$

C. $T \propto \rho r / S$

D. $T \propto (S / \rho r)$

Answer: a

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44. A gas bubble, from an exlosion under water, oscillates with a period T proportional to p^(a)d^(b)E^(c). $Where$ 'P'$isthestaticpressure$, 'd'$isthedensityofwater$'E'

$is the \to tale \neq rgyof the \exp losion.\ F \in dthevaluesof$ a, b and, c`.

A. $a = 0, b = 1, c = 2$

B. $a = 1, b = 2, c = 3$

C. $a = 5/6, b = -1/2, c = 1/3$

D. $a = 5/6, b = -1/2, c = 1/3$

Answer: d

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45. If P represents radiation pressure , C represents the speed of light , and Q represents radiation energy striking a unit area per second , then non - zero integers

x, y, z such that $P^x Q^y C^z$ is dimensionless , find the values of $x, y,$ and z.

A. x = 1, y = 1, z = 1

B. x = -1, y = 1, z = 1

C. x = 1, y = -1, z = 1

D. x = 1, y = 1, z = -1

Answer: c

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46. A system has basic dimensions as density [D], velocity [V] and area [A]. The dimensional representation of force in this system is :

A. $[AV^2D]$

B. $[A^2VD]$

C. $[AVD^2]$

D. $[A^0VD]$

Answer: a

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47. The SI unit of temperature is :

A. degree centigrade

B. kelvin

C. degree celsius

D. degree fahrenheit

Answer: b

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48. Celsius is a unit:

A. of electric potential

B. of trigonometric angle

C. equivalent to K

D. equivalent to degree centigrade

Answer: d

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49. Practical unit of heat is :

A. calorie

B. horse power

C. joule

D. watt

Answer: a

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50. The dimensional formula of calorie are

A. $\left[M^1L^2T^{-2}\right]$

B. $\left[M^2L^1T^{-2}\right]$

C. $\left[ML^{-2}T^2\right]$

D. $\left[M^1L^1T^{-1}\right]$

Answer: a

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51. Dimensional formula for latent heat is_____

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

B. $\left[ML^2T^{-2}\right]$

C. $\left[MLT^{-2}\right]$

D. $\left[ML^2T^{-1}\right]$

Answer: a

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52. Define universal gravitational constant. Given its value with SI units.

A. watt $K^{-1}mol^{-1}$

B. joule/newton $K^{-1}mol^{-1}$

C. joule $K^{-1}mol^{-1}$

D. erg $K^{-1}mol^{-1}$

Answer: c

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53. The van der Waal's equation of state for some gases can be expressed as :

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

Where P is the pressure , V is the molar volume , and T is the absolute temperature of the given sample of gas and $a, b,$ and R are constants.

The dimensions of a are

A. $[ML^5T^{-2}]$

B. $[ML^{-1}T^{-2}]$

C. $[L^3]$

D. $[L^6]$

Answer: a

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54. The dimensional formula for coefficient of thermal conductivity is :

A. $[MLTK]$

B. $[MLT^{-2}]$

C. $[MLTK^{-1}]$

D. $[MLT^{-3}K^{-1}]$

Answer: d

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55. The unit of Stefan's constant σ is

A. $\frac{\text{watt}^4}{mK^4}$

B. $\frac{\text{calorie}}{m^2K^4}$

C. $\frac{\text{watt}}{m^2K^4}$

D. $\frac{\text{joule}}{m^2K^4}$

Answer: c

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56. Number of particles is given by $n = -D\frac{n_2 - n_1}{x_2 - x_1}$ crossing a unit area perpendicular to X-axis in unit time,

where n_1 and n_2 are number of particles per unit volume for the value of x meant to x_2 and x_1. Find dimensions of D called as diffusion constant

A. $\left[L^2T^{-1}\right]$

B. $\left[LT^{-2}\right]$

C. $\left[L^2T^4\right]$

D. $\left[LT^{-3}\right]$

Answer: a

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57. The ratio of the emu of charge to esu of charge is :

A. 3×10^{10}

B. 4.8×10^{-19}

C. $1/10$

D. $1/300$

Answer: a

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58. the density of a material is 8 g/cc. In a system in which units of length is 5 cm and of mass is 20 g, the density of material is :

A. 50

B. 40

C. 80

D. 24

Answer: a

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59. Electron volt is a unit of :

A. potential difference

B. energy

C. resistance

D. electric charge

Answer: b

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60. Which of the following quantities has the units $Kgm^2s^{-3}A^{-2}$?

A. Resistance

B. Inductance

C. Capacitance

D. Magnetic flux

Answer: a

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61. The dimensions of self-inductance are :

A. $\left[MLT^{-2}A^{-2}\right]$

B. $\left[ML^2T^{-1}A^{-2}\right]$

C. $\left[ML^2T^{-2}A^{-2}\right]$

D. $\left[ML^2T^{-2}A^2\right]$

Answer: c

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62. The dimensional formula for magnetic permeability μ is :

A. $\left[MLT^{-2}A^{-2}\right]$

B. $\left[M^0L^{-1}T\right]$

C. $\left[M^0L^2T^{-1}A^2\right]$

D. $\left[ML^2T^{-2}A^{-2}\right]$

Answer: a

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63. If L and R denote inductance and resistance respectively, then the dimension of L/R is :

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

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

C. $\left[M^2L^0T^2\right]$

D. $\left[MLT^2\right]$

Answer: b

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64. If c and R denote capacity and resistance the dimensions of CR are :

A. $\left[M^0L^0T^{-1}\right]$

B. $\left[M^1L^0T^2\right]$

C. $\left[M^0L^0T^1\right]$

D. Not expressable in terms of $[M]$, $[L]$ and $[T]$

Answer: c

Watch Video Solution

65. If C and L denote to capacity and inductance, the dimensions of LC are :

A. $\left[M^0L^0T^2\right]$

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

C. $\left[MLT^{-2}\right]$

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

Answer: a

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66. The velocity of electromegnetic waves in vacuum is given by :

A. $\sqrt{\mu_0 \varepsilon_0}$

B. $\sqrt{\mu_0 / \varepsilon_0}$

C. $\sqrt{\varepsilon_0 / \mu_0}$

D. $1 / \sqrt{\mu_0 \varepsilon_0}$

Answer: d

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67. A pressure of $10^6 \quad \mathrm{dyne} / cm^2$ is equivalent to :

A. $10^3 N/m^2$

B. $10^4 N/m^2$

C. $10^5 N/m^2$

D. $10^6 N/m^2$

Answer: c

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68. Which of the following functions of A and B may be perfomed if a and B posses different dimensions?

A. $A + B$

B. $A - B$

C. A / e^{AB}

D. A / B

Answer: d

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69. In a particular system the units of length, mass and time are chosen to be $10cm, 10g$ and $0.1s$ respectively. The unit of force in this system will be equal to

A. 0.1 N

B. 1 N

C. 10 N

D. 100 N

Answer: a

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70. The dimensions of the coefficient of ciscosity are $\left[ML^{-1}T^{-1}\right]$. To convert the CGS unit poise (P) to the MKS unit poiseuille (PI), the poise has to be multiplied by :

A. 10^{-1}

B. 10

C. 10^{9}

D. 10^{7}

Answer: a

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71. The dimensional formula of magnetic flux density is :

A. $\left[M^1L^0T^{-2}A^{-1}\right]$

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

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

D. $\left[M^1L^2T^{-2}A^{-1}\right]$

Answer: d

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72. According to Bernoulli's theorem $\frac{p}{d} + \frac{v^2}{2} + gh$ = constant is (P is pressure, d is density, h is height, v is velocity and g is acceleration due to gravity)

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

B. $\left[M^0LT^0\right]$

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

D. $\left[M^0L^2T^{-2}\right]$

Answer: d

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73. Parsec' is the unit of :

A. time

B. distance

C. frequency

D. angular acceleration

Answer: b

Watch Video Solution

74. The ratio of the dimension of Planck's constant and that of moment of inertia is the dimension of

A. frequency

B. velocity

C. angular momentum

D. time

Answer: a

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75. The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b, c are respectively :-

A. $\left[LT^{-2}\right[$, $[L]$ and $[T]$

B. $\left[L^2\right]$, $[T]$ and $\left[LT^2\right]$

C. $\left[LT^2\right]$, $[LT]$ and $[L]$

D. $[L]$, $[Lt]$ and $\left[T^2\right]$

Answer: a

Watch Video Solution

76. Find the value of x in the relation

$$Y = \frac{T^x . \cos\theta . Tau}{L^3}, where$$

Y is Young's modulu. T is time period, 'Tau' is torque and L is length.

A. zero

B. 1

C. 2

D. 3

Answer: a

Watch Video Solution

77. The speed (v) of ripples on the surface of waterdepends on surface tension (σ), density (ρ) and wavelength (λ). The square of speed (v) is proportional to

A. $\frac{\sigma}{\rho\lambda}$

B. $\frac{\rho}{\sigma\lambda}$

C. $\frac{\lambda}{\sigma\rho}$

D. $\rho\lambda\sigma$

Answer: a

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78. In the relation $V = \frac{\pi}{8}\frac{Pr^4}{nl}$, where the letters have their usual meanings , the dimensions of V are

A. $\left[M^0L^3T^0\right]$

B. $M^0L^3T^{-1}\right]$

C. $\left[M^0L^{-3}T\right]$

D. $\left[ML^3T^0\right]$

Answer: b

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79. The energy (E), angular momentum (L) and universal gravitational constant (G) are chosen as fundamental quantities. The dimensions of universal gravitational constant in the dimensional formula of Planck's constant (h) is :

A. 0

B. -1

C. $5/3$

D. 1

Answer: a

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80. Which one of the following pair of quantities has same dimension ?

A. Force and work done

B. Momentum and impulse

C. Pressure and force

D. Surface tension and stress

Answer: b

Watch Video Solution

81. Which physical quantities have same dimensions ?

A. Force and power

B. Torque and energy

C. Torque and power

D. Force and Torque

Answer: b

Watch Video Solution

82. The SI unit of electron mobility is :

A. $m^2 s^{-2} V^{-1}$

B. msV^{-1}

C. $ms^{-1} V$

D. $m^2 s^{-2} V^{-2}$

Answer: a

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83. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurment of the current and the voltage difference are 3% each, then error in the value of resistance of the wire iS :

A. 6%

B. zero

C. 1%

D. 3%

Answer: a

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84. A spectrometer gives the following reading when used to measure the angle of a prism.

Main scale reading =58.5 degree

Vernier scale reading =0.9 divisions

Given that 1 divisions on main scale corresponds to 0.5 degree. Total divisions on the vernier scale is 30 and match with 29 divisions of the main scale. the angle of the prism from the above data is :

A. 58.59°

B. 58.77°

C. 58.65°

D. 59°

Answer: c

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85. If momentum (P), area (A) and time (T) are assumed to be formula :

A. $\left[PTA^{-1/2}\right]$

B. $\left[PT^{-1}A^{1/2}\right]$

C. $\left[P^2T^{-1}A\right]$

D. $\left[PTA^{-1}\right]$

Answer: b

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86. The quantity which has the same dimensions as that of gravitational potential is :

A. latent heat

B. impulse

C. angular acceleration

D. specific heat capacity

Answer: a

Watch Video Solution

87. The percentage error in measuring M, L and T are $1\%, 1.5\%$ and 3% respectively. Then the percentage error in measuring the physical quantity with dimensions $ML^{-1}T^{-1}$ is :

A. 1%

B. 3.5%

C. 3%

D. 5.5%

Answer: d

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88. The dimensions of $\frac{1}{2} \in_0 E^2$ ($\in_0$: permittivity of free space, E: electric field) is-

A. $\left[ML T^{-1}\right]$

B. $\left[ML^2 T^{-2}\right]$

C. $\left[ML^{-1} T^{-2}\right]$

D. $\left[ML^2 T^{-1}\right]$

Answer: c

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89. A quantity X is given by $\in_0 L\frac{\Delta V}{\Delta t}$, where $\in_0$ is the permittivity of free space, L is a length, ΔV is a potential difference and Δt is a time interval. The dimensional formula for X is the same as that of -

A. Resistance

B. charge

C. voltage

D. current

Answer: d

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90. A cube has a side of length $1.2 \times 10^{-2} m$. Calculate its volume.

A. $1.7 \times 10^{-6} m^3$

B. $1.73 \times 10^{-6} m^3$

C. $1.70 \times 10^{-6} m^3$

D. $1.732 \times 10^{-6} m^3$

Answer: a

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91. Pressure depends on distance as, $P = \frac{\alpha}{\beta} \exp\left(\frac{-\alpha z}{k\theta}\right)$, where α, β are constants, z is

distance, k is Boltzmann's constant and θ is temperature.

The dimensions of β are :

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

B. $\left[M^{-1}L^{-1}T^{-1}\right]$

C. $\left[M^0L^2T^0\right]$

D. $M^{-1}L^1T^2\right]$

Answer: c

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92. A wire of length $l = 6 \pm 0.06cm$ and radius $r = 0.5 \pm 0.005cm$ and mass $m = 0.3 \pm 0.003g$.

Maximum percentage error in density is :

A. 4

B. 2

C. 1

D. 6.8

Answer: a

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93. Which of the following sets have different dimensions ?

A. Pressure, Young's modulus, stress

B. Emf, potential difference, electric potential

C. Heat, work done, energy

D. Dipole moment, electric flux electric field

Answer: d

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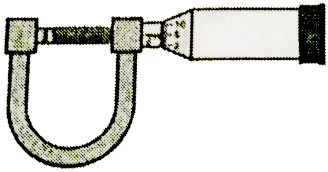
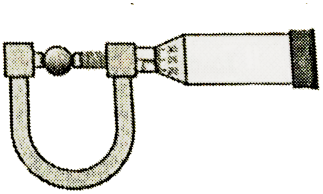
94. The circular scale of a screw gauge has 50 divisions and pitch of 0.5 mm. Find the diameter of sphere. Main scale reading is 2.





A. 1.2 mm

B. 1.25 mm

C. 2.20 mm

D. 2.25 mm

Answer: a

View Text Solution

95. A student performs an experiment for determination of $g\left[=\frac{4\pi^2 L}{T^2}\right]$, $L \approx 1m$, and he commits an error of ΔL. For T he takes the time of n oscillations with the stop watch of least count ΔT . For which of the following data , the measurement of g will be most accurate ?

A. $\Delta L = 0.5, \Delta T = 0.1, n = 20$

B. $\Delta L = 0.5, \Delta T = 0.1, n = 50$

C. $\Delta L = 0.5, \Delta T = 0.01, n = 20$

D. $\Delta L = 0.5, \Delta T = 0.05, n = 50$

Answer: d

Watch Video Solution

96. A student performs an experiment to determine the Young's modulus of a wire, exactly$2m$ long, by Searle's method. In a partcular reading, the student measures the extension in the length of the wire to be $0.8mmwithanuncerta \int yof$+- 0.05mm$ataloadofexactly$ 1.0kg

, $thestudentalsomeasuresthediameterofthewire \rightarrow be$ 04mm$withanuncerta \int yof$+-0.01mm. $Take$ g=9.8m//s^(2)` (exact). the Young's modulus obtained from the reading is

A. $(2.0 \pm 0.3) \times 10^{11} Nm^{-2}$

B. $(2.0 \pm 0.2) \times 10^{11} Nm^{-2}$

C. $(2.0 \pm 0.1) \times 10^{11} Nm^{-2}$

D. $(2.0 \pm 0.05) \times 10^{11} Nm^{-2}$

Answer: b

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97. Student $I, II, \text{ and } III$ perform an experiment for measuring the acceleration due to gravity (g) usinf a simple pendulum. They use lengths of the pendulum and // or record time for different number of oscillations . The observations are shown in the following table . Least count for length $= 0.1cm$

Student	Length of Pendulam (cm)	Number of n Oscillation (n)	Time Period (s)
I	64.0	8	16.0
II	64.0	4	16.0
III	20.0	4	9.0

Least count for time $= 0.1s$.

If E_I, E_{II} , and E_{III} are the percentage errors in g , i.,e., $\left(\frac{\Delta g}{g} \times 100\right)$ for students I,II , and III, respectively , then

A. $E_I = 0$

B. E_I is minimum

C. $E_I = E_{II}$

D. E_{II} is maximum

Answer: b

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98. A vernier calipers has $1mm$marks on the main scale. It has 20 equal divisions on the Verier scale which match with 16 main scale divisions. For this Vernier calipers, the least count is

A. 0.02 mm

B. 0.05 mm

C. 0.1 mm

D. 0.2 mm

Answer: d

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99. The density of a solid ball is to be determined in an experiment. The diameter of the ball is measured with a screw gauge, whose pitch is $0.5mm$ and there are 50 divisions on the circular scale. The reading on the main scale is $2.5mm$ and that on circular scale is 20 divisions. if the measured mass of the ball has a relative error of 2%, the relative percentage error in the density is

A. 0.9%

B. $2.4\,\%$

C. $3.1\,\%$

D. $4.2\,\%$

Answer: c

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100. In the determination if Young's modulus $\left(\left(Y = \frac{4MLg}{\pi l d^2}\right.\right.$ by using searle's method, a wire of length $L = 2m$ and diameter $d = 0.5mm$ is used. For a load $M = 2.5kg$, an extension $l = 0.25mm$ in the length of the wire is observed. Quantites D and l are measured using a screw gauge and a micrometer, respectively. they

have the same pitch of $0.5mm$. the number of divisions on their circular scale is 100. the contrubution to the maximum probable error of the Y measurement

A. due to the errors in the measurments of d and l are the same

B. due to the error in the measurements of d is twice that due to the error in the measurement of l

C. due to the erroe in the measurement of l is twice that due to the error in the measurement of d

D. due to the error in the measurement of d is four times that due to error in the measurement of l

Answer: a

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101. The diameter of a cylinder is measured using a Vernier callipers with no zero error. It is found that the zero of the Vernier scale lies between $5.10cm$ and $5.15cm$ of the main scale. The Vernier scale has 50 divisions equivalent to $2.45cm$. The 24^{th} division of the Vernier scale exactly coincides with one of the main scale divisions. the diameter of the cylinder is

A. 5.112 cm

B. 5.124 cm

C. 5.136 cm

D. 5.148 cm

Answer: b

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102. Using the expression $2d \sin\theta = \lambda$, one calculates the values of d by measuring the corresponding angles θ in the range $0 \rightarrow 90 \circ$. The wavelength λ is exactly known and error in θ is constant for all values of θ. As θ increases from $0 \circ$

A. the absolute error in d remains constant

B. the absolute error in d increases

C. the fractional error in d remains constant

D. the fractional error in d decreases

Answer: d

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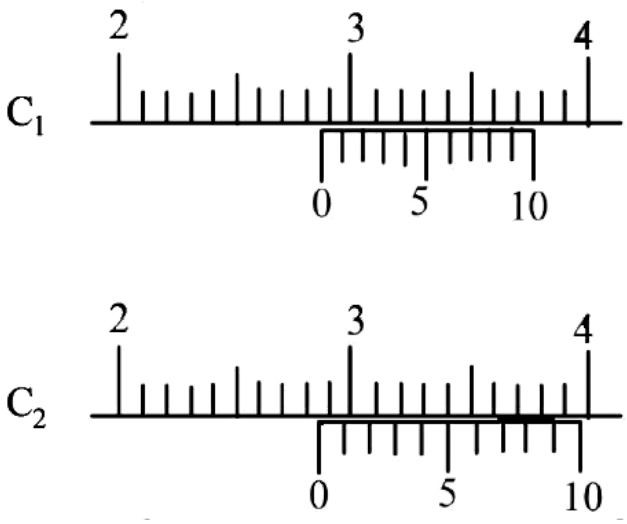
103. There are two Vernier calipers both of which have $1cm$ divided into 10 equal divisions on the main scale. The vernier scale of the calipers (c_1) has 10 equal divisions that correspond to 9 main scale divisions. The Vernier scale of the other calipers (C_2) has 10 equal divisions tgat correspond to 11 main scale divisions. the reading of the two calipers are shown in the figure. the measured values (in cm) by calipers C_1 and C_2 respectively, are



A. 2.87 and 2.87

B. 2.87 and 2.83

C. 2.85 and 2.82

D. 2.87 and 2.86

Answer: b

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More Than One Choice Is Correct

1. Which of the following pairs have the same dimensions?

A. Torque and work

B. Angular momentum and work

C. Energy and Young's modulus

D. Light year and wavelength

Answer: a, d

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2. Pressure is defined as :

A. momentum per unit area

B. momentum per unit area per unit time

C. momentum per unit volume

D. energy per unit volume

Answer: b, d

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3. The pairs of physical quantities that have the same dimensions are :

A. Reynolds number and coefficient of friction

B. latent heat and gravitational potential

C. Curie and frequency of light wave

D. Plank's constant and torque

Answer: a, b, c

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4. The unit of charge is :

A. coulomb

B. frankline

C. faraday

D. amphere $\times$ sec

Answer: a, b, c, d

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5. Which of the following is a unit of permeability ?

A. H/m

B. Wb/Am

C. ohm $\times$ s/m

D. $V \times s / m^2$

Answer: a, b, c

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6. If L, C and R represent the physical quantities indutance, capacitance and resistance respectively, the conbinations which have the dimensions of frequency are :

A. $(1/RC)$

B. (R/L)

C. $\left(1/\sqrt{LC}\right)$

D. (C/R)

Answer: a, b, c

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7. The dimensions of length are expressed as $G^x c^y h^z$, where G, c and h are the universal gravitational constant, speed of light and Planck's constant respectively, then :

A. $x = (1/2), y = (1/2)$

B. $x = (1/2), z = (1/2)$

C. $y = (-3/2), z = (1/2)$

D. $y = (1/2), z = (3/2)$

Answer: b, c

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8. A reference frame attached to the earth

A. is an inertial frame by definition

B. cannot be an inertial frame because earth is revolving round the sun

C. is an inertial frame because Newton's laws are applicable

D. cannot be an inertial frame becomes the earth is rotationg about its own axis

Answer: b, d

9. When a wave traverses a medium, the displacement of a particle located at $'x'$ at a time $'t'$ is given by $y = a\sin(bt - cx)$, where a, b and c are constants of the wave, which of the following is a quantity with dimensions?

A. $\frac{y}{a}$

B. bt

C. cx

D. $\frac{b}{c}$

Answer: a, b, c

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10. If P, Q and R are physical quantities having different dimensions, which of the following combinations can never be a meaningful quantity ?

A. $(P-Q)/R$

B. $PQ-R$

C. PQ/R

D. $(R+Q)/P$

Answer: a, d

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11. If Planck's constant (h) and speed of light in vacuum (c) are taken as two fundamental quantites, which on of the following can, in addition, be taken to express length, mass and time in terms of the three chosen fundamental quantities ?

A. Mass of electron (m_e)

B. Radius of the earth (R)

C. Charge of electron (e)

D. Mass of proton (m_P)

Answer: a, b, d

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12. The SI unit of inductance, the henry can be written as :

A. weber/ampere

B. volt -second/ampere

C. joul/$(\text{ampere})^2$

D. ohm-second

Answer: a, b, c, d

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13. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of the vacuum and $[\mu_0]$ that of the

permeability of the vacuum. If M = mass, L = length, T = time and I = electric current :

A. $[\varepsilon_0] = [M^{-1}L^{-3}T^2I]$

B. $[\varepsilon_0] = [M^{-1}L^{-3}T^4I^2]$

C. $[\mu_0] = [MLT^{-2}I^{-2}]$

D. $[\mu_0] = [ML^2T^{-1}I]$

Answer: b, c

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14. A student uses a simple pendulum of exactly $1m$ length to determine g, the acceleration due ti gravity. He uses a stop watch with the least count of $1\,\sec$ for this

and record $40\,\text{sec}\,onds$ for 20 oscillations for this observation, which of the following statement $(s)is(are)$ true?

A. Error ΔT in measuring T, the time period, is 0.05 s

B. Error ΔT in measuring T, the time period is, 1 s

C. Percentage error in the determination of g is 5%

D. Percentage error in the determination of g is 2.5 %

Answer: a, c

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15. Planck's constant h, speed of light c and gravitational constant G are used to from a unit of length L and a unit

of mass M. Then the correct option (s) is / (are)

A. $M \propto \sqrt{c}$

B. $M \propto \sqrt{G}$

C. $L \propto \sqrt{h}$

D. $L \propto \sqrt{G}$

Answer: a, c, d

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16. In terms of potential difference V, electric current I, permitivity ε_0, permeability μ_0 and speed of light c, the dimensionally correct equations (s) is (are) :

A. $\mu_0 I_2 = \varepsilon V^2$

B. $\mu_0 I = \mu_0 V$

C. $I = \varepsilon_0 V$

D. $\mu_0 c I = \varepsilon_0 V$

Answer: a, c

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17. In an experiment to determine the acceleration due to gravity g, the formula used for the time period of a periodic motion is $T = 2\pi\sqrt{\left(7\frac{R-r}{5g}\right.}$. The values of R and r are measured to be $(60 \pm 1)mm$ and $(10 \pm 1)mm$, repectively. In five

successive measurment, the time period is found to be $0.52s, 0.56s, 0.57s, 0.54s$ and $0.59s$. the least count of the watch used for the measurement of time period is $0.01s$. Which of the following satement (s) is (are) true?

A. The error in the measurement of r is 10%

B. The error in the measurement of T is 3.5%

C. The error in the measurement of T is 2%

D. The error in the determined value of g is 11%

Answer: a, b, d

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Matrix Match Type

1. Match the physical quantities in Column -I with their dimensional formula in Column -II

Column - I		Column - II	
(a)	Angular momentum	(p)	$[ML^2T^{-2}]$
(b)	Coefficient of viscosity	(q)	$[M^0L^0T^{-2}]$
(c)	Torque	(r)	$[ML^2T^{-1}]$
(d)	Angular acceleration	(s)	$[ML^{-1}T^{-1}]$

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2. Match the physical quantities is Column -I with their dimensional formula in Column -II :

Column - I		Column - II	
(a)	Pressure	(p)	$[ML^2T^{-1}]$
(b)	Coefficient of friction	(q)	$[M^{-1}L^3T^{-2}]$
(c)	Planck's constant	(r)	$[M^0L^0T^0]$
(d)	Universal gravitational constant	(s)	$[ML^{-1}T^{-1}]$

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3. Some categories of physical quantities are given in Column-I. Match the physical quantities in Column -II with the categories in Column -I.

	Column - I		Column - II
(a)	Dimensionless quantity	(p)	Moment of inertia
(b)	Scalar	(q)	Refractive index
(c)	Vector	(r)	Dielectric constant
(d)	Neither a scalar nor a vector	(s)	Area

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4. Match the units/dimensions in Column-I with the physical quantities in column -II :

Column - I		Column - II	
(a)	$[ML^2T^{-1}]$	(p)	Impulse
(b)	Joule-sec	(q)	Planck's constant
(c)	$[MLT^{-1}]$	(r)	Angular momentum
(d)	Energy per unit frequency	(s)	Linear momentum

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5. Match the units given in column-I with the physical quantities in column -II :

[Here N-newton, kg -kilogram, s-second , m-metre]

Column - I		Column - II	
(a)	N/m^2	(p)	Force constant
(b)	N/m	(q)	Surface energy of a liquid
(c)	N-m	(r)	Stress
(d)	kg/s^2	(s)	Bulk modulus

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6. Match column-I with column-II in regard to the units of the physical quantities mentioned in column-I and the units of expressions in Column -II :

Column - I		Column - II	
(a)	Frequency	(p)	$\varepsilon_0 E^2$
(b)	Energy density	(q)	$\frac{B^2}{\mu_0}$
(c)	Pressure	(r)	$\frac{1}{CR}$
(d)	Energy of a particle per unit angular momentum	(s)	$\frac{R}{L}$

[Here, ε_0 - permittivity of free space, μ_0 - permeability of free space, E - electric field strength, B - magnetic flux density, R - resistance, C - capacitance, L - inductance]

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7. Match Column-I with Column -II :

Column - I		Column - II	
(a)	Dimensionless quantity	(p)	Angle
(b)	Young's modulus	(q)	$kg\ m^{-1}\ sec^{2}$
(c)	Joule/cal	(r)	Mechanical equivalent of heat
(d)	Pascal	(s)	Thermal conductivity

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8. Match the units/dimensions in Column -I with the physical quantities /expressions in column -II.

Column - I		Column - II	
(a)	Joule/kg	(p)	$\frac{k_B T}{m}$ [k_B-Boltzmann constant, T-Absolute temperature, m-mass]
(b)	$[M^0 L^2 T^{-2} \theta^{-1}]$ (θ refers to the dimension of temperature)	(q)	Mean square velocity
(c)	$[M^0 L^2 T^{-2}]$	(r)	Latent heat
(d)	Joule/kelvin-kg	(s)	Specific heat

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9. Match Column -I with column -II :

	Column - I		Column - II
(a)	$\frac{GM_eM_s}{}$ G-universal gravitational constant M_e-mass of the earth, M_s-mass of the sun	(p)	(volt) (coulomb) (metre)
(b)	$\frac{3RT}{M}$ R-universal gas constant T-absolute temperature M-molar mass	(q)	(kilogram) $(\text{metre})^2$ $(\text{second})^{-2}$
(c)	$\frac{F^2}{q^2B^2}$ F-force q-charge, B-magnetic field	(r)	$(\text{metre})^2$ $(\text{second})^{-2}$
(d)	$\frac{GM_e}{R_e}$ G-universal gravitational constant, M_e-mass of the earth, R_e-radius of the earth	(s)	(farad) $(\text{volt})^2$ (kg)

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

List I		List II	
P	Boltzmann constant	1.	$[ML^2T^{-1}]$
Q	Coefficient of viscosity	2.	$[ML^{-1}T^{-1}]$
R	Planck constant	3.	$[MLT^{-3}K^{-1}]$
S	Thermal conductivity	4.	$[ML^2T^{-2}K^{-1}]$

A. P = 3, Q = 1, R = 2, S = 4

B. P = 3, Q = 2, R = 1, S = 4

C. P = 4, Q = 2, R = 1, S = 3

D. P = 4, Q = 1, R = 2, S = 3

Answer: A::B::C::D

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Integer Type

1. If mass, length and acceleration is taken as base quantities in a system then dimension of length in dimensional formula of energy is :

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2. In SI unit the sun of dimension of all base physical quantities in the dimensional formula of coefficient of viscosity is c. Find the value of c + 2.

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3. If length unit becomes doubled and time becomes halved then, find the factor by which the value of speed of light decrease in new system compared to old system.

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4. The ratio of magnitudes of unit for viscosity in SI to that in CGS is x. Then the value of $(x+2)/2$ is :

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5. The pitch of a screw gauge is 1 mm and there are 50 divisions on its cap. When nothing is put in between the studs, 44th division of the circular scale coincides with

the refersence line zero of the main scale is not visible. When a glass plate is placed between the studs, the main scale reads three divisions and the circular scale reads 26 divisions. The thickness of the plate is $(360 + a) \times 10^{-2}$ mm. Find 'a'.

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6. The time period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{l/g}$

The length of the pendulum is measured as $1 = 10 \pm 0.1$ cm and the time period as $T = 0.5 \pm 0.02s$. Determine percentage error in te value of g.

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7. A physical quantity P is related to four observables A, B, C and D as $P = 4\pi^2 A^3 B^2 / \left(\sqrt{C} D\right)$. The percentage error of the measurement in A, B, C and D are $1\%, 3\%, 2\%$ and 4% respectively. The percentage error is $2a\%$ and absolute error in the quantity P is $\frac{b}{2}$. Find 'a' and 'b' if value of P is 3.57.

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8. If $2x\%$ be the percentage error in specific resistance given by $\rho = \frac{\pi r^2 R}{l}$ where r is the radius having value $(0.2om0.01)$ cm, R is the resistance of (60 ± 3) ohm and l is the length of (150 ± 1.5) cm. Find x.

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9. 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 $(\text{power}/\text{area})$ 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.

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10. The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t), \quad \alpha = 0.2 s^{-1}$. The measurement of A has an error of $1.25\ \%$. If the error In

the measurement of time is $1.50\ \%$, the percentage error in the value of $E(t)$ at t = 5 s` is

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1. If force, mass and time are taken to be base physical quantities with dimensional formula [F], [M] and [T], then :

Dimensional formula for energy is :

A. $F^2M^{-1}T^{-2}$

B. $F^2M^{-1}T^2$

C. $F^2M^{-2}T^{-2}$

D. $F^2M^1T^2$

Answer: b

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2. If force, mass and time are taken to be base physical quantities with dimensional formula [F], [M] and [T], then :

Dimension of mass in velocity is :

A. -1

B. -2

C. 1

D. 2

Answer: a

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3. If force, mass and time are taken to be base physical quantities with dimensional formula [F], [M] and [T], then :

Dimension of time in pressure is :

A. 2

B. 4

C. -2

D. -4

Answer: b

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4. There is a concept that if unit of a physical quantity is large then the multiplier of the unit becomes less while expressing any fixed magnitude. If in a new system of unit, unit of time is 0.5 second and the unit of length is 4 metre. Answer the following questions.

Unit of speed becomes (compare to its initial value) :

A. one eighth

B. eight times

C. half

D. double

Answer: b

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5. There is a concept that if unit of a physical quantity is large then the multiplier of the unit becomes less while expressing any fixed magnitude. If in a new system of unit, unit of time is 0.5 second and the unit of length is 4 metre. Answer the following questions.

The value of speed of light becomes (c is intial value) :

A. c

B. $c/2$

C. $c/4$

D. $c/8$

Answer: b

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6. There is a concept that if unit of a physical quantity is large then the multiplier of the unit becomes less while expressing any fixed magnitude. If in a new system of unit, unit of time is 0.5 second and the unit of length is 4 metre. Answer the following questions.

If unit of time is doubled, the unit of length is halved and unit of mass is increased by a factor n such that a

particular force retains its value in both th system of units then the value of n is :

A. 8

B. 6

C. 4

D. 2

Answer: a

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