UNITS AND MEASUREMENTS

FACT/DEFINITION TYPE QUESTIONS

1. Which of the following systems of units is not based on units of mass, length and time alone ?
(a) SI (b) MKS
(b) CGS (d) FPS

2. Number of base SI units is
(a) 4 (b) 7
(c) 3 (d) 5

3. Second is defined in terms of periods of radiation from Cesiuim 133 because
(a) it is not affected by the change of place
(b) it is not affected by the change of time
(c) it is not affected by the change of Physical conditions
(d) All of these.

4. $1°$ (degree) is equal to
(a) 17 radian
(b) 17.45×10^{-2} radian
(c) 17.45×10^{-2} radian
(d) 1.745×10^{-2} radian

5. Very large distances such as the distance of a Planet or a star from Earth can be measured by
(a) Spectrograph
(b) Millikan's oil drop method
(c) Parallax method
(d) All of these.

6. One unified atomic mass unit is equal to
(a) 12 times the mass of one carbon-12 atom
(b) $\frac{1}{12}$ of the mass of 12 atoms of C-12
(c) $\frac{1}{12}$ of the mass of one atom of C-12
(d) 12 times the mass of 12 atoms of C-12

7. Light year is
(a) light emitted by the sun in one year.
(b) time taken by light to travel from sun to earth.
(c) the distance travelled by light in free space in one year.
(d) time taken by earth to go once around the sun.

8. Length cannot be measured by
(a) fermi (b) debye
(c) micron (d) light year

9. One yard in SI unit is equal to
(a) 1.9144 metre (b) 0.9144 metre
(c) 0.09144 kilometre (d) 1.0936 kilometre

10. Which one of the following is the smallest unit?
(a) millimetre (b) angstrom
(c) fermi (d) metre

11. The prototype of the international standard kilogram supplied by the International Bureau of Weights and Measures (BIPM) are available at
(a) National Physics Laboratory
(b) National science centre
(c) CSIR
(d) None of these

12. Illuminance of a surface is measured in
(a) lumen
(b) Candela
(c) lux
(d) lux m^{-2}

13. Which of the following is not the unit of time ?
(a) Micro second (b) Leap year
(c) Lunar month (d) Parallactic second

14. Universal time is based on
(a) rotation of the earth on its axis
(b) earth's orbital motion around the Sun
(c) vibrations of cesium atom
(d) oscillations of quartz crystal

15. 1 Parsec is equal to
(a) 3.1×10^{-16} m. (b) 3.26 ly
(c) 6.3×10^{4} Au (d) 1.496×10^{11} m.

16. Which of the following can measure length upto 10^{-5} m ?
(a) Metre scale (b) Vernier callipers
(c) Spherometer (d) None of these

17. Systematic errors can be
(a) positive only
(b) negative only
(c) either positive or negative
(d) None of these

18. Instrumental errors are due to
(a) imperfect design
(b) zero error in the instrument
(c) Both (a) and (b)
(d) None of these

19. _____ is the ratio of the mean absolute error to the mean value of the quantity measured.
(a) Absolute error (b) Relative error
(c) Percentage error (d) None of these

20. Random error can be eliminated by
(a) careful observation
(b) eliminating the cause
(c) measuring the quantity with more than one instrument
(d) taking large number of observations and then their mean.

21. When two quantities are added or subtracted, the absolute error in the final result is the
(a) sum of the absolute errors in the individual quantities
(b) sum of the relative errors in the individual quantities
(c) can be (a) or (b)
(d) None of these

22. Error in the measurement of radius of a sphere is 1%. Then error in the measurement of volume is
(a) 1% (b) 5%
(c) 3% (d) 8%

23. The _____ is a measure of how closed the measured value is to the true value of quantity.
(a) Precision (b) accuracy
(c) Error (d) None of these.

24. Which of the following is not a systematic error ?
(a) Instrumental error
(b) Imperfection in experimental technique
(c) Personal error
(d) None of these

25. The smallest value that can be measured by the measuring instrument is called
(a) least count (b) parallax
(c) accuracy (d) precision

26. The _____ is the error associated with the resolution of the instrument.
(a) parallax error (b) systematic error
(c) random error (d) least count error

27. Absolute error is always
(a) positive (b) negative
(c) both (a) and (b) (d) None of these

28. The magnitude of the difference between the individual measurement and true value of the quantity is called
(a) absolute error (b) relative error
(c) percentage error (d) None of these

29. The pitch and the number of circular scale divisions in a screw gauge with least count 0.02 mm are respectively
(a) 1 mm and 100 (b) 0.5 mm and 50
(c) 1 mm and 50 (d) 0.5 mm and 100

30. A student measured the length of a rod and wrote it as 3.50 cm. Which instrument did he use to measure it?
(a) A meter scale.
(b) A vernier calliper where the 10 divisions in vernier scale matches with 9 division in main scale and main scale has 10 divisions in 1 cm.
(c) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm.
(d) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm.

31. The unit of percentage error is
(a) same as that of physical quantity
(b) different from that of physical quantity
(c) percentage error is unitless
(d) errors have got their own units which are different from that of physical quantity measured

32. If L = 2.331 cm, B = 2.1 cm, then L + B =
(a) 4.4 cm (b) 4 cm
(c) 4.43 cm (d) 4.431 cm

33. When two quantities are divided, the relative error in the result is given by
(a) the product of the relative error in the individual quantities
(b) the quotient of the relative error in the individual quantities
(c) the difference of the relative error in the individual quantities
(d) the sum of the relative error in the individual quantities

34. If $Z = A^3$, then $\frac{\Delta Z}{Z}$ = ______
(a) $\frac{\Delta A^3}{A}$ (b) $\left(\frac{\Delta A}{A}\right)^3$
(c) $3\left(\frac{\Delta A}{A}\right)$ (d) $\left(\frac{\Delta A}{A}\right)^{1/3}$

35. What is the correct number of significant figures in 0.0003026 ?
(a) Four (b) Seven
(c) Eight (d) Six

36. Which of the following is the most accurate?
(a) 200.0 m (b) 20×10^1 m
(c) 2×10^2 m (d) 0.2×10^3 m

37. The number of significant figures in 0.00060 m is
(a) 1 (b) 2
(c) 3 (d) 4

38. The sum of the numbers 436.32, 227.2 and 0.301 in appropriate significant figures is
(a) 6663.821 (b) 664
(c) 663.8 (d) 663.8

39. Number of significant figures in expression $\frac{4.327\,g}{2.51\,cm^3}$ is
(a) 2 (b) 4
(c) 3 (d) 5

40. The dimensions of force are
(a) $[ML^2T^{-1}]$ (b) $[M^2L^3T^{-2}]$
(c) $[MLT^{-2}]$ (d) None of these

41. The dimensions of speed and velocity are
(a) $[L^2T], [LT^{-1}]$ (b) $[LT^{-1}], [LT^{-2}]$
(c) [LT], [LT] (d) $[LT^{-1}], [LT^{-1}]$

42. By equating a physical quantity with its dimensional formula we get
(a) dimensional analysis (b) dimensional equation
(c) dimensional formula (d) none of these

43. Dimensional analysis can be applied to
(a) check the dimensional consistency of equations
(b) deduce relations among the physical quantities.
(c) to convert from one system of units to another
(d) All of these

44. Two quantities A and B have different dimensions which mathematical operation given below is physically meaningful?
(a) A/B (b) A + B
(c) A – B (d) A = B

45. Which is dimensionless?
(a) Force/acceleration (b) Velocity/acceleration
(c) Volume/area (d) Energy/work

46. Which of the following quantities has a unit but dimensionless?
(a) Strain (b) Reynolds number
(c) Angular displacement (d) Poisson's ratio

47. The wrong unit conversion among the following is
(a) 1 angstrom $= 10^{-10}$m
(b) 1 fermi $= 10^{-15}$m
(c) 1 light year $= 9.46 \times 10^{15}$m
(d) 1 astronomical unit $= 1.496 \times 10^{-11}$m

48. The physical quantity that does not have the dimensional formula $[ML^{-1}T^{-2}]$ is
(a) force (b) pressure
(c) stress (d) modulus of elasticity

49. The dimensions of pressure is equal to
(a) force per unit volume (b) energy per unit volume
(c) force (d) energy

50. The dimensional formula of angular velocity is
(a) $[MLT^{-1}]$ (b) $[M^0L^0T]$
(c) $[ML^0T^{-2}]$ (d) $[M^0L^0T^{-1}]$

51. The physical quantity that has no dimensions is
(a) strain (b) angular velocity
(c) angular momentum (d) linear momentum

STATEMENT TYPE QUESTIONS

52. Consider the following statements and select the correct statement(s).
I. Light year and year, both measure time.
II. Both have dimension of time.
III. Light year measures length.
(a) I and II (b) II and III
(c) II only (d) III only

53. Consider the following statements and select the correct statement(s)?
I. If $l_1 = 0.6$ cm ; $l_2 = 0.60$ cm and $l_3 = 0.600$ cm, then l_3 is the most accurate measurement.
II. $l_3 = 0.600$ cm has the least error so it is most accurate
(a) I only (b) II only
(c) Both I and II (d) None of these

54. Consider the following statements and select the correct statement(s).
I. 1 calorie = 4.18 *joule*
II. $1\,\mathring{A} = 10^{-10}$ m
III. 1 MeV = 1.6×10^{-13} *Joule*
IV. 1 newton = 10^{-5} *dyne*
(a) I, II and III (b) III and IV
(c) I only (d) IV only

55. Which the following is/are correct?
I. Pressure = energy per unit area
II. Pressure = energy per unit volume
III. Pressure = force per unit volume
IV. Pressure = momentum per unit volume per unit time
(a) I and II (b) II only
(c) III only (d) I, II, III and IV

56. Consider the following statements and select the correct option.
I. Every measurement by any measuring instrument has some error
II. Every calculated physical quantity that is based on measured values has some error
III. A measurement can have more accuracy but less precision and vice versa
(a) I and II (b) II and III
(c) II and III (d) I, II and III

57. Which of the following statements is/are correct?
I. 345.726 has six significant figures
II. 0.004289 has seven singificant figures
III. 125000 has three significant figures
IV. 9.0042 has five significant figures
(a) I only (b) II only
(c) I, III and IV (d) II, III and IV

58. Which of the following statements is/are correct ?
I. Change of units does not change the number of significant digits
II. All the non– zero digits are significant
III. All the zero between two non-zero digits are significant
(a) I only (b) II only
(c) II and III (d) I, II and III

MATCHING TYPE QUESTIONS

59. Match the columns I and II.

	Column I		Column II
(A)	Practical unit	(1)	radian
(B)	Base unit	(2)	light year
(C)	Derived unit	(3)	kg-ms^{-1}
(D)	Complementary unit	(4)	second

(a) (A)→(4); (B)→(2); C→(1); (D)→(3)
(b) (A)→(2); (B)→(4); C→(3); (D)→(1)
(c) (A)→(3); (B)→(2); C→(4); (D)→(1)
(d) (A)→(2); (B)→(4); C→(1); (D)→(3)

60.

	Column-I		Column-II
(A)	Distance between earth & stars	(1)	micron
(B)	Inter-atomic distance in a solid	(2)	angstrom
(C)	Size of the nucleus	(3)	light year
(D)	Wavelength of infrared laser	(4)	fermi
		(5)	kilometre

(a) (A)→(1); (B)→(3); C→(4); (D)→(2)
(b) (A)→(3); (B)→(2); C→(4); (D)→(1)
(c) (A)→(5); (B)→(2); C→(3); (D)→(1)
(d) (A)→(2); (B)→(4); C→(1); (D)→(3)

61.

Column I	Column II
(A) Length	(1) burette
(B) Volume	(2) Vernier callipers
(C) Diameter of a thin wire	(3) screw gauge
(D) Mass	(4) common balance

(a) (A)→(4); (B)→(2); C→(1); (D)→(3)
(b) (A)→(3); (B)→(2); C→(4); (D)→(1)
(c) (A)→(4); (B)→(2); C→(3); (D)→(1)
(d) (A)→(2); (B)→(1); C→(3); (D)→(4)

62. Match the following column I and II.

Column I	Column II
(A) 1 Fermi	(1) 3.08×10^{16} m
(B) 1 Astronomical unit	(2) 9.46×10^{15} m
(C) 1 Light year	(3) 1.496×10^{11} m
(D) 1 Parsec	(4) 10^{-15} m

(a) (A)→(4); (B)→(2); C→(1); (D)→(3)
(b) (A)→(3); (B)→(2); C→(4); (D)→(1)
(c) (A)→(4); (B)→(3); C→(2); (D)→(1)
(d) (A)→(2); (B)→(1); C→(3); (D)→(4)

63.

Column I	Column II
(A) Meter scale	(1) 3.08×10^{16} m
(B) Vernier callipers	(2) 10^{-5} m
(C) Screw gauge	(3) 10^{-3}m to 10^{2}m
(D) Parallax method	(4) 10^{-4} m

(a) (A)→(3); (B)→(4); C→(2); (D)→(3)
(b) (A)→(3); (B)→(2); C→(4); (D)→(1)
(c) (A)→(4); (B)→(3); C→(2); (D)→(1)
(d) (A)→(2); (B)→(1); C→(3); (D)→(4)

64.

Column I	Column II
(A) Size of atomic nucleus	(1) 10^{11} m
(B) Distance of the sun from Earth	(2) 10^{7} m
(C) Radius of Earth	(3) 10^{-15} m
(D) Size of proton	(4) 10^{-14} m

(a) (A)→(3); (B)→(4); C→(1); (D)→(3)
(b) (A)→(4); (B)→(1); C→(2); (D)→(3)
(c) (A)→(4); (B)→(3); C→(2); (D)→(1)
(d) (A)→(2); (B)→(1); C→(3); (D)→(4)

65.

Column I	Column II
(A) Rotation period of Earth	(1) 10^{9}s
(B) Average human life – span	(2) 10^{17}s
(C) Travel time for light from Sun to Earth	(3) 10^{5}s
(D) Age of universe	(4) 10^{2}s

(a) (A)→(3); (B)→(4); C→(1); (D)→(3)
(b) (A)→(4); (B)→(1); C→(2); (D)→(3)
(c) (A)→(3); (B)→(1); C→(4); (D)→(2)
(d) (A)→(2); (B)→(1); C→(3); (D)→(4)

66.

Column I	Column II
(A) Mean absolute error	(1) $\Delta a_{mean}/ a_{mean}$
(B) Relative error	(2) $\left(\frac{\Delta a_{mean}}{a_{mean}}\right)\times 100$
(C) Percentage error	(3) $\sum_{i=1}^{n} \lvert \Delta a_i \rvert / n$
(D) Absolute error	(4) $a_n - a_{mean}$

(a) (A)→(3); (B)→(1); C→(2); (D)→(4)
(b) (A)→(1); (B)→(2); C→(4); (D)→(3)
(c) (A)→(3); (B)→(2); C→(4); (D)→(1)
(d) (A)→(2); (B)→(4); C→(1); (D)→(3)

67.

Column I	Column II
(A) Joule	(1) MLT^{-2}
(B) Newton	(2) $ML^{-1}T^{-2}$
(C) Hertz	(3) $ML^{2}T^{-2}$
(D) Pascal	(4) $M^0L^0T^{-1}$

(a) (A)→(4); (B)→(2); C→(1); (D)→(3)
(b) (A)→(1); (B)→(2); C→(4); (D)→(3)
(c) (A)→(3); (B)→(2); C→(4); (D)→(1)
(d) (A)→(2); (B)→(4); C→(1); (D)→(3)

68.

Column - I	Column - II
(A) Force	(1) T^{-1}
(B) Angular velocity	(2) MLT^{-2}
(C) Torque	(3) $ML^{-1}T^{-2}$
(D) Stress	(4) $ML^{-1}T^{-1}$
	(5) ML^2T^{-2}

(a) (A)→(3); (B)→(4); C→(1); (D)→(3)
(b) (A)→(2); B→(1); (C)→(5); (D)→(4)
(c) (A)→(3); (B)→(1); C→(4); (D)→(2)
(d) (A)→(2); (B)→(1); C→(3); (D)→(4)

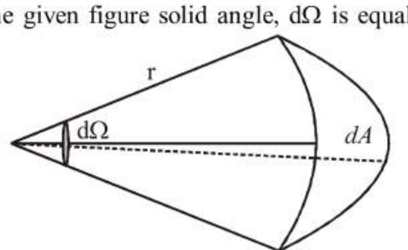
69. Match the columns I and II.

Column I	Column II
(A) Angle	(1) ML^2T^{-3}
(B) Power	(2) $M^0L^0T^0$
(C) Work	(3) ML^2T^{-2}
(D) Force	(4) MLT^{-2}

(a) (A)→(3); (B)→(4); C→(1); (D)→(3)
(b) (A)→(2); B→(1); (C)→(5); (D)→(4)
(c) (A)→(3); (B)→(1); C→(4); (D)→(2)
(d) (A)→(2); (B)→(1); C→(3); (D)→(4)

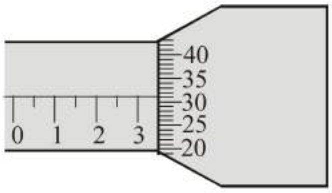
DIAGRAM TYPE QUESTIONS

70. For the given figure solid angle, $d\Omega$ is equal to



(a) r^2dA steradian (b) dA/r^2 steradian
(c) $\frac{r^2}{dA}$ steradian (d) dA/r steradian

71. The accompanying diagram represents a screw gauge. The circular scale is divided into 50 divisions and the linear scale is divided into millimeters. If the screw advances by 1 mm when the circular scale makes 2 complete revolutions, the least count of the instrument and the reding of the instrument in figure are respectively.



(a) 0.01 mm and 3.82 mm
(b) 0.02 mm and 3.70 mm
(c) 0.11 mm and 4.57 mm
(d) 1.0 mm and 5.37 mm

ASSERTION- REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

72. **Assertion :** Now a days a standard *metre* is defined in terms of the wavelength of light.
Reason : Light has no relation with length.

73. **Assertion :** Parallax method cannot be used for measuring distances of stars more than 100 light years away.
Reason : Because parallax angle reduces so much that it cannot be measured accurately.

74. **Assertion :** A.U. is much bigger than Å.
Reason : A.U. stands for astronomical unit and A stands for Angstrom.

75. **Assertion :** When we change the unit of measurement of a quantity, its numerical value changes.
Reason : Smaller the unit of measurement smaller is its numerical value.

76. **Assertion :** The cesium atomic clocks are very accurate
Reason : The vibration of cesium atom regulate the rate of cesium atomic clock.

77. **Assertion:** In the measurement of physical quantities direct and indirect methods are used.
Reason : The accuracy and precision of measuring instruments along with errors in measurements should be taken into account, while expressing the result.

78. **Assertion :** The error in the measurement of radius of the sphere is 0.3%.The permissible error in its surface area is 0.6%.
Reason : The permissible error is calculated by the formula $\frac{\Delta A}{A} = \frac{4\Delta r}{r}$

79. **Assertion :** Absolute error may be negative or positive.
Reason : Absolute error is the difference between the real value and the measured value of a physical quantity.

80. **Assertion :** The number of significant figures depends on the least count of measuring instrument.
Reason : Significant figures define the accuracy of measuring instrument.

81. **Assertion :** Out of three measurements $l = 0.7$ m; $l = 0.70$ m and $l = 0.700$ m, the last one is most accurate.
Reason : In every measurement, only the last significant digit is not accurately known.

82. **Assertion :** Number of significant figures in 0.005 is one and that in 0.500 is three
Reason : This is because zeros are not significant.

83. **Assertion:** 'Light year' and 'Wavelength' both measure distance.
Reason : Both have dimension of time.

84. **Assertion :** Dimensional constants are the quantities whose values are constant.
Reason : Dimensional constants are dimensionless.

85. **Assertion :** Avogadro's number is the number of atoms in one gram mole.
Reason : Avogadro's number is a dimensionless constant.

86. **Assertion :** Energy cannot be divided by volume.
Reason : Dimensions for energy and volume are different.

87. **Assertion :** Angle and strain are dimensionless.
Reason : Angle and strain have no unit.

88. **Assertion :** In the equation momentum, $P = \frac{\text{mass}}{\text{area}} x$, the dimensional formula of x is LT^{-2}.
Reason : Quantities with different dimensions can be multiplied.

89. **Assertion :** Force cannot be added to pressure.
Reason : The dimensions of force and pressure are different.

90. **Assertion :** The time period of a pendulum is given by the formula, $T = 2\pi\sqrt{g/\ell}$
Reason : According to the principle of homogeneity of dimensions, only that formula is correct in which the dimensions of L.H.S. is equal to dimensions of R.H.S.

91. **Assertion:** Formula for kinetic energy is $K = \frac{1}{2} mu^2 = ma$
Reason : Both the equation $K = \frac{1}{2} mv^2$ and $k = ma$ are dimensionally incorrect.

CRITICALTHINKING TYPE QUESTIONS

92. If unit of length and force are increased 4 times. The unit of energy
(a) is increased by 4 times
(b) is increased by 16 times
(c) is increased by 8 times
(d) remains unchanged

93. The density of a material in CGS system of units is $4 g/cm^3$. In a system of units in which unit of length is 10 cm and unit of mass is 100 g, the value of density of material will be
(a) 0.4 (b) 40 (c) 400 (d) 0.04

94. Resistance R = V/I, here V= (100 ± 5)V and I = (100 ± 0.2) A. Find percentage error in R.
(a) 5% (b) 2%
(c) 7% (d) 3%

95. Find equivalent resistance when $R_1 = (100 \pm 3)\Omega$ and $R_2 = (200 \pm 4)\Omega$ when connected in series
(a) $(300 \pm 7)\Omega$ (b) $(300 \pm 1)\Omega$
(c) $(100 \pm 7)\Omega$ (d) None of these

96. In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%, 3% and 4% respectively. Quantity P is calculated as follows

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

(a) 10% (b) 7% (c) 4% (d) 14%

97. In a vernier callipers N division of vernier coincide with $(N-1)$ divisions of main scale in which length of a division is 1 mm. The least count of the instrument in cm is
(a) N (b) $N-1$
(c) $\dfrac{1}{10N}$ (d) $(1/N)-1$

98. The least count of a stop watch is $\frac{1}{5}$ s. The time of 20 oscillations of a pendulum is measured to be 25 s. What is the maximum percentage error in this measurement ?
(a) 8 % (b) 1 %
(c) 0.8 % (d) 16 %

99. The refractive index of water measured by the relation $\mu = \dfrac{\text{real depth}}{\text{apparent depth}}$ is found to have values of 1.34, 1.38, 1.32 and 1.36; the mean value of refractive index with percentage error is
(a) 1.35 ± 1.48 % (b) 1.35 ± 0 %
(c) 1.36 ± 6 % (d) 1.36 ± 0 %

100. A wire has a mass 0.3 ± 0.003 g, radius 0.5 ± 0.005 mm and length 6 ± 0.06 cm. The maximum percentage error in the measurement of its density is
(a) 1 (b) 2
(c) 3 (d) 4

101. One centimetre on the main scale of a vernier callipers is divided into 10 equal parts. If 10 divisions of vernier coincide with 8 small divisions of the main scale, the least count of vernier callipers is
(a) 0.01 cm (b) 0.02 cm
(c) 0.05 cm (d) 0.005 cm

102. The pitch of the screw gauge is 0.5 mm. Its circular scale contains 50 divisions. The least count of the screw gauge is
(a) 0.001 mm (b) 0.01 mm
(c) 0.02 mm (d) 0.025 mm

103. Relative density of a metal may be found with the help of spring balance. In air the spring balance reads (5.00 ± 0.05) N and in water it reads (4.00 ± 0.05) N. Relative density would be
(a) (5.00 ± 0.05)N (b) (5.00 ± 11%)
(c) (5.00 ± 0.10) (d) (5.00 ± 6%)

104. A quantity is represented by $X = M^a L^b T^c$. The % error in measurement of M, L and T are a%, b% and g% respectively. The % error in X would be
(a) $(\alpha a + \beta b + \gamma c)\%$ (b) $(\alpha a - \beta b + \gamma c)\%$
(c) $(\alpha a - \beta b - \gamma c) \times 100\%$ (d) None of these

105. If $Z = A^4 B^{1/3} / CD^{3/2}$, than relative error in Z. $\dfrac{\Delta Z}{Z}$ is equal to

(a) $\left(\dfrac{\Delta A}{A}\right)^4 + \left(\dfrac{\Delta B}{B}\right)^{1/3} - \left(\dfrac{\Delta C}{C}\right) - \left(\dfrac{\Delta D}{D}\right)^{3/2}$

(b) $4\left(\dfrac{\Delta A}{A}\right) + \left(\dfrac{1}{3}\right)\left(\dfrac{\Delta B}{B}\right) + \left(\dfrac{\Delta C}{C}\right) + \left(\dfrac{3}{2}\right)\left(\dfrac{\Delta D}{D}\right)$

(c) $4\left(\dfrac{\Delta A}{A}\right) + \dfrac{1}{3}\left(\dfrac{\Delta B}{B}\right) - \left(\dfrac{\Delta C}{C}\right) - \left(\dfrac{3}{2}\right)\left(\dfrac{\Delta D}{D}\right)$

(d) $\left(\dfrac{\Delta A}{A}\right)^4 + \dfrac{1}{3}\left(\dfrac{\Delta B}{B}\right) + \left(\dfrac{\Delta C}{C}\right) + \dfrac{3}{2}\left(\dfrac{\Delta D}{D}\right)$

106. A force F is applied onto a square plate of side L. If the percentage error in determining L is 2% and that in F is 4%, the permissible percentage error in determining the pressure is
(a) 2% (b) 4%
(c) 6% (d) 8%

107. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\dfrac{L}{g}}$. Measured value of L is 20.0 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 s using a wrist watch of 1s resolution. The accuracy in the determination of g is
(a) 1% (b) 5%
(c) 2% (d) 3%

108. In a simple pendulum experiment, the maximum percentage error in the measurement of length is 2% and that in the observation of the time-period is 3%. Then the maximum percentage error in determination of the acceleration due to gravity g is

(a) 5% (b) 6%
(c) 1% (d) 8%

109. Diameter of a steel ball is measured using a Vernier callipers which has divisions of 0.1 cm on its main scale (MS) and 10 divisions of its vernier scale (VS) match 9 divisions on the main scale. Three such measurements for a ball are given below:

S.No.	MS(cm)	VS divisions
1.	0.5	8
2.	0.5	4
3.	0.5	6

If the zero error is – 0.03 cm, then mean corrected diameter is

(a) 0.52 cm (b) 0.59 cm
(c) 0.56 cm (d) 0.53 cm

110. The respective number of significant figures for the number 23.023, 0.0003 and 2.1×10^{-3} are respectively.

(a) 5, 1 and 2 (b) 5, 1 and 5
(c) 5, 5 and 2 (d) 4, 4 and 2

111. The value of resistance is 10.845 Ω and the value of current is 3.23 A. The potential difference is 35.02935 volt. Its value in significant number would be

(a) 35 V (b) 35.0 V
(c) 35.03 V (d) 35.029 V

112. Mass of a body is 210 gm and its density is 7.981 g/cm^3 what will be its volume, with regard to significant digits?

(a) 26.312 cm^3 (b) 26 cm^3
(c) 27 cm^3 (d) 26.3 cm^3

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

(a) $[M L T^{-4}]$ and $[M L T^{-1}]$
(b) $[M L T^{-1}]$ and $[M L T^{0}]$
(c) $[M L T^{-3}]$ and $[M L T^{-4}]$
(d) $[M L T^{-3}]$ and $[M L T^{0}]$

114. The frequency of vibration of a string is given by $f = \frac{n}{2L}\sqrt{\frac{T}{m}}$, where T is tension in the string, L is the length, n is number of harmonics. The dimensional formula for m is

(a) $[M^0 L T]$ (b) $[M^1 L^{-1} T^{-1}]$
(c) $[M^1 L^{-1} T^0]$ (d) $[M^0 L T^{-1}]$

115. Which of the following pairs has same dimensions?

(a) Angular momentum and Plank's constant
(b) Dipole moment and electric field
(c) Both (a) and (b)
(d) None of these.

116. If P,Q, 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) $(PR – Q^2) / R$

117. Dimensions of specific heat are

(a) $[ML^2 T^{-2} K]$ (b) $[ML^2 T^{-2} K^{-1}]$
(c) $[ML^2 T^2 K^{-1}]$ (d) $[L^2 T^{-2} K^{-1}]$

118. The dimensions of torque are

(a) $[MLT^{-2}]$ (b) $[ML^2T^{-2}]$
(c) $[ML^2T^{-1}]$ (d) $[M^2L^2T^{-2}]$

119. The ratio of the dimensions of Planck's constant and that of the moment of inertia is the dimensions of

(a) time (b) frequency
(c) angular momentum (d) velocity

120. Identify the pair whose dimensions are equal.

(a) Torque and work (b) Stress and energy
(c) Force and stress (d) Force and work.

121. The physical quantities not having same dimensions are

(a) torque and work
(b) momentum and Planck's constant
(c) stress and Young's modulus
(d) speed and $(\mu_0\varepsilon_0)^{-1/2}$

122. Which one of the following represents the correct dimensions of the coefficient of viscosity ?

(a) $[ML^{-1}T^{-1}]$ (b) $[MLT^{-1}]$
(c) $[ML^{-1}T^{-2}]$ (d) $[ML^{-2}T^{-2}]$

123. The density of a material in CGS system is 8 g / cm^3. In a system of a unit in which unit of length is 5 cm and unit of mass is 20 g. The density of material is

(a) 8 (b) 20
(c) 50 (d) 80

124. The dimensional formula for magnetic flux is

(a) $[ML^2T^{-2}A^{-1}]$ (b) $[ML^3T^{-2}A^{-2}]$
(c) $[M^0L^{-2}T^2A^{-2}]$ (d) $[ML^2T^{-1}A^2]$

125. 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) $[FL^2T^2]$

126. Which one of the following represents the correct dimensions of the gravitational constant?

(a) $[M^{-1}L^3T^{-2}]$ (b) $[MLT^{-1}]$
(c) $[ML^{-1}T^{-2}]$ (d) $[ML^{-2}T^{-2}]$

127. The dimensions of magnetic field in M, L, T and C (coulomb) is given as

(a) $[MLT^{-1} C^{-1}]$ (b) $[MT^2 C^{-2}]$
(c) $[MT^{-1} C^{-1}]$ (d) $[MT^{-2} C^{-1}]$

128. The dimensions of coefficient of self inductance are

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

(c) $[MLT^{-2}A^{-2}]$ (d) $[MLT^{-2}A^{-1}]$

129. In C.G.S. system the magnitude of the force is 100 dynes. In another system where the fundamental physical quantities are in kilogram, metre and minute, the magnitude of the force is

(a) 0.036 (b) 0.36 (c) 3.6 (d) 36

130. The division of energy by time is X. The dimensional formula of X is same as that of

(a) momentum (b) power

(c) torque (d) electric field

131. The Solar constant is defined as the energy incident per unit area per second. The dimensional formula for solar constant is

(a) $[M^0L^0T^0]$ (b) $[MLT^{-2}]$

(c) $[ML^2T^{-2}]$ (d) $[ML^0T^{-3}]$

132. Which of the following is a dimensional constant?

(a) Refractive index (b) Dielectric constant

(b) Relative density (d) Gravitational constant

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

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

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

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

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

134. $[MLT^{-1}] + [MLT^{-1}] =$ ....

(a) $[M^oL^oT^o]$ (b) $[MLT^{-1}]$

(c) $2[MLT^{-1}]$ (d) None of these

135. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be

(a) $[EV^{-1}T^{-2}]$ (b) $[EV^{-2}T^{-2}]$

(c) $[E^{-2}V^{-1}T^{-3}]$ (d) $[EV^{-2}T^{-1}]$

136. The dimensions of mobility are

(a) $[M^{-2}T^2A]$ (b) $[M^{-1}T^2A]$

(c) $[M^{-2}T^3A]$ (d) $[M^{-1}T^3A]$

137. If force (F), velocity (V) and time (T) are taken as fundamental units, then the dimensions of mass are

(a) $[F\ V\ T^{-1}]$ (b) $[F\ V\ T^{-2}]$

(c) $[F\ V^{-1}\ T^{-1}]$ (d) $[F\ V^{-1}\ T]$

138. If the capacitance of a nanocapacitor is measured in terms of a unit '*u*' made by combining the electric charge '*e*', Bohr radius 'a_0', Planck's constant 'h' and speed of light '*c*' then

(a) $u = \dfrac{e^2h}{a_0}$ (b) $u = \dfrac{hc}{e^2a_0}$

(c) $u = \dfrac{e^2c}{ha_0}$ (d) $u = \dfrac{e^2a_0}{hc}$

139. If electronic charge e, electron mass m, speed of light in vacuum c and Planck's constant h are taken as fundamental quantities, the permeability of vacuum μ_0 can be expressed in units of

(a) $\left(\dfrac{h}{me^2}\right)$ (b) $\left(\dfrac{hc}{me^2}\right)$

(c) $\left(\dfrac{h}{ce^2}\right)$ (d) $\left(\dfrac{mc^2}{he^2}\right)$

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (a) SI is based on seven fundamental units.
2. (b) 3. (d) 4. (c) 5. (c) 6. (c)
7. (c) 1 light year = speed of light in vacuum × no. of seconds in one year = $(3 \times 10^8) \times (365 \times 24 \times 60 \times 60)$ $= 9.467 \times 10^{15}$ m.
8. (b) 9. (b)
10. (c) 1 fermi = 10^{-5} metre
11. (a)
12. (c) Illuminance is intensity of illumination measured in lux.
13. (d) Parallactic second is the unit of distance.
14. (c)
15. (b) 1 parsec = 3.08×10^{16} m
1 ly = 9.46×10^{15} m

$$\therefore \frac{1\,\text{Parsec}}{1\,\text{ly}} = \frac{30.8\times10^{15}}{9.46\times10^{15}} = 3.26$$

∴ 1 Parsec = 3.26 ly
16. (c) 17. (c) 18. (c)
19. (b) 20. (d) 21. (a)
22. (c) $V = \frac{4}{3}\pi r^3$;

$$\frac{\Delta V}{V}\times100 = 3\left(\frac{\Delta r}{r}\right)\times100 = 3\times1\% = 3\%$$

23. (b) 24. (d) 25. (a)
26. (d) 27. (c) 28. (a)
29. (c) Least count of a screw gauge

$$= \frac{\text{Pitch}}{\text{Number of circular scale divisions}}$$

$$= \frac{1\text{ mm}}{50} = 0.02\text{ mm}$$

Therefore the pitch and no. of circular scale divisions are 1mm and 50 respectively.
30. (b) Measured length of rod = 3.50 cm
For vernier scale with 1 Main Scale Division = 1 mm
9 Main Scale Division = 10 Vernier Scale Division,
Least count = 1 MSD – 1 VSD = 0.1 mm
31. (c)
32. (a) $L + B = 2.331 + 2.1 \cong 4.4$ cm
Since minimum significant figure is 2.
33. (d) If z = AB then

$$\frac{\Delta z}{z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$$

34. (c) 35. (a) 36. (a)
37. (b) According to rules of significant figures.
38. (b)
39. (c) In multiplication or division the final result should return as many significant figures as there are in the original number with the least significant figures.
40. (c) Force, F = m × a and $a = \frac{L}{T^2}$
41. (d) speed = $\frac{\text{distance}}{\text{time}}$ and velocity = $\frac{\text{displacement}}{\text{time}}$
42. (b) 43. (d) 44. (a)
45. (d) Both energy and work have same unit.
∴ energy/work is a pure number.
46. (c) Angular displacement has unit (degree or radian) but it is dimensionless.
Note : vice-versa is not possible.
47. (d) 1 astronomical unit = 1.496×10^{11}m
48. (a) Force $F = ma = M\left(\frac{v}{t}\right) = MLT^{-2}\left[\because v = \frac{L}{T}\right]$
Force has dimensional formula $[MLT^{-2}]$
49. (b) $\frac{\text{Energy}}{\text{Volume}} = \frac{ML^2T^{-2}}{L^3}$
$= [ML^{-1}T^{-2}]$ = Pressure
50. (d) Angular velocity $\omega = \frac{\theta}{t} = [M^0L^0T^{-1}]$
51. (a) Strain = $\frac{\text{Change in length}}{\text{Original length}}$
Hence no dimension.

STATEMENT TYPE QUESTIONS

52. (d) 53. (c)
54. (a) 1 newton = 10^5 *dyne*
55. (b) Pressure = $\frac{\text{force}}{\text{area}} = \frac{\text{energy}}{\text{volume}} = ML^{-1}T^{-2}$
56. (d) 57. (c) 58. (d)

MATCHING TYPE QUESTIONS

59. (b) (A)→(2); (B)→(4); C→(3); (D)→(1)
60. (b) (A)→(3); (B)→(2); C→(4); (D)→(1)
61. (d) (A)→(2); (B)→(1); C→(3); (D)→(4)
62. (c) (A)→(4); (B)→(3); C→(2); (D)→(1)
63. (a) (A)→(3); (B)→(4); C→(2); (D)→(3)
64. (b) (A)→(4); (B)→(1); C→(2); (D)→(3)
65. (c) (A)→(3); (B)→(1); C→(4); (D)→(2)
66. (a) (A)→(3); (B)→(1); C→(2); (D)→(4)

67. (c) (A)→(3); (B)→(2); C→(4); (D)→(1)
68. (b) (A)→ (3); B→(1); (C)→(4); (D)→(2)
69. (d) (A)→(2); B→(1); C→(3); (D)→(4)

DIAGRAM TYPE QUESTIONS

70. (b) 71. (a)

ASSERTION- REASON TYPE QUESTIONS

72. (c) Light has well defined relation with length.
73. (a) As the distance of star increases, the parallax angle decreases, and great degree of accuracy is required for its measurement. Keeping in view the practical limitation in measuring the parallax angle, the maximum distance of a star we can measure is limited to 100 light year.
74. (b) A.U. (Astronomical unit) is used to measure the average distance of the centre of the sun from the centre of the earth, while angstrom is used to measure very short distances. 1 A.U. = 1.5×10^{11}m; $1Å = 10^{-10}$m.
75. (c) We know that $Q = n_1u_1 = n_2u_2$ are the two units of measurement of the quantity Q and n_1, n_2 are their respective numerical values. From relation $Q_1 = n_1u_1 = n_2u_2$, nu = constant $\Rightarrow n \propto 1/u$ *i.e.*, smaller the unit of measurement, greater is its numerical value.
76. (b) 77. (a)
78. (c) Area $A = 4\pi r^2$

Fractional error $\frac{\Delta A}{A} = \frac{2\Delta r}{r}$

$\frac{\Delta A}{A} \times 100 = 2 \times 0.3\% = 0.6\%$

79. (a) 80. (b)
81. (b) The last number is most accurate because it has greatest significant figure (3).
82. (c) Since zeros placed to the left of the number are never significant, but zeros placed to right of the number are significant
83. (c) Light year and wavelength both represent the distance, so both have dimension of length not of time.
84. (c) Dimensional constants are not dimensionless.
85. (c) Avogadro number (N) represents the number of atoms in 1 gram mole of an element, i.e. it has the dimensions of mol^{-1}.
86. (d)
87. (c) Angle is dimensionless, but it has unit radian.
88. (d) $P = \frac{\text{mass}}{\text{area}} x$

$\therefore \quad x = \frac{P \times \text{area}}{\text{mass}} = \frac{MLT^{-1}}{M} \times L^2 = L^3T^{-1}$

Quantities with different dimensions can be multiplied.

89. (a) Addition and subtraction can be done between quantities having same dimensions.
90. (d) Let us write the dimension of various quantities on two sides of the given relation.

L.H.S. = T = [T]

R.H.S. $= 2\pi\sqrt{g/\ell} = \sqrt{\frac{LT^{-2}}{L}} = [T^{-1}]$

[$\therefore$ 2π has no dimension]. As dimensions of L.H.S is not equal to dimensions of R.H.S. Therefore according to principle of homogeneity the relation

$T = 2\pi\sqrt{g/\ell}$ is not valid

91. (d) Mass × acceleration (ma) = F (force)

CRITICAL THINKING TYPE QUESTIONS

92. (b) The work done = force × displacement

$\therefore$ unit, $u_1 = Fs$

and $u_2 = 4F \times 4s = 16u$.

93. (b) In CGS system, $d = 4\frac{g}{cm^3}$

The unit of mass is 100g and unit of length is 10 cm, so

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

$$= \frac{4}{100} \times (10)^3 \cdot \frac{100g}{(10cm)^3} = 40 \text{ unit}$$

94. (c)
95. (a)
96. (d) $P = \frac{a^3b^2}{cd}$, $\frac{\Delta P}{P} \times 100\% = 3\frac{\Delta a}{a} \times 100\% + 2\frac{\Delta b}{b} \times$

$100\% + \frac{\Delta c}{c} \times 100\% + \frac{\Delta d}{d} \times 100\%$.

$= 3 \times 1\% + 2 \times 2\% + 3\% + 4\% = 14\%$

97. (c) $L.C. = \frac{\text{value of 1 division of main scale}}{\text{number of division on main scale}}$

$= \frac{1}{N}\text{mm} = \frac{1}{10N}\text{cm}$

98. (c) The percentage error $= \frac{1}{5} \times \frac{100}{25} = 0.8\%$
99. (a) The mean value of refractive index,

$\mu = \frac{1.34 + 1.38 + 1.32 + 1.36}{4} = 1.35$

and

$\Delta\mu = \frac{|(1.35 - 1.34)| + |(1.35 - 1.38)| + |(1.35 - 1.32)| + |(1.35 - 1.36)|}{4}$

$= 0.02$

Thus $\frac{\Delta\mu}{\mu} \times 100 = \frac{0.02}{1.35} \times 100 = 1.48$

100. (d) Density, $\rho = \frac{M}{V} = \frac{M}{\pi r^2 \ell}$

$$\therefore \quad \frac{\Delta\rho}{\rho}\times 100 = \left[\frac{\Delta M}{M}+\frac{2\Delta r}{r}+\frac{\Delta \ell}{\ell}\right]\times 100$$

$$= \left[\frac{0.003}{0.3}+2\frac{0.005}{0.5}+\frac{0.06}{6}\right]\times 100$$

$$= 4$$

101. (b) The value of 1 division of main scale $= \frac{1}{10} = 0.1$ cm

The value of 1 division of vernier scale $= \frac{8\times 0.1}{10}$

$= 0.08$ cm

Thus L.C. $= 0.1 - 0.08$

$= 0.02$ cm

102. (b) Least count $= \frac{0.5}{50} = 0.01$ mm

103. (d) Relative density $= \frac{\text{Weight of body in air}}{\text{Loss of weight in water}}$

$$= \frac{5.00}{5.00-4.00} = \frac{5.00}{1.00}$$

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

$$= (0.01+0.05)\times 100$$

$$= 0.06\times 100 = 6\%$$

$\therefore$ Relative density $= 5.00 \pm 6\%$

104. (a) $X = M^a L^b T^c$;

$$\frac{\Delta X}{X}\times 100 = \left(\frac{a\,\Delta M}{M}+\frac{b\,\Delta L}{L}+\frac{c\,\Delta T}{T}\right)\times 100$$

$$= (a\,\alpha + b\,\beta + c\,\gamma)\%$$

105. (b)

106. (d) As, pressure $P = \frac{F}{A} = \frac{F}{L^2}$

$$\%\text{ Error} = \frac{\Delta F}{F}\times 100 + 2\frac{\Delta L}{L}\times 100$$

$$= 4 + 2\times 2 = 8\%$$

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

So, $\frac{\Delta g}{g}\times 100 = \frac{\Delta l}{l}\times 100 + 2\frac{\Delta T}{T}\times 100$

$$= \frac{0.1}{20}\times 100 + 2\times\frac{1}{90}\times 100 = 2.72 \simeq 3\%$$

108. (d) As we know, time period of a simple pendulum

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

The maximum percentage error in g

$$\frac{\Delta g}{g}\times 100 = \frac{\Delta L}{L}\times 100 + 2\left(\frac{\Delta T}{T}\times 100\right)$$

$$= 2\% + 2(3\%) = 8\%$$

109. (b) Least count $= \frac{0.1}{10} = 0.01$ cm

$d_1 = 0.5 + 8\times 0.01 + 0.03 = 0.61$ cm

$d_2 = 0.5 + 4\times 0.01 + 0.03 = 0.57$ cm

$d_3 = 0.5 + 6\times 0.01 + 0.03 = 0.59$ cm

Mean diameter $= \frac{0.61+0.57+0.59}{3}$

$= 0.59$ cm

110. (a) Number of significant figures in 23.023 = 5

Number of significant figures in 0.0003 = 1

Number of significant figures in $2.1\times 10^{-3} = 2$

111. (b) The significant number in the potential, $V = iR$; should be the minimum of either i or R. So corresponding to $i = 3.23\ A$, we have only three significant numbers in $V = 35.02935\ V$. Thus the result is $V = 35.0\ V$.

112. (b)

113. (c) $[at] = [F]$ amd $[bt^2] = [F]$

$\Rightarrow [a] = MLT^{-3}$ and $[b] = MLT^{-4}$

114. (c) Clearly, $m = \frac{n^2 T}{4f^2 L^2}$; $[m] = \frac{MLT^{-2}}{T^{-2}.L^2}$

115. (a) **116. (a)**

117. (d) $s = \frac{Q}{m\theta} = \frac{ML^2T^{-2}}{MK} = [L^2\,T^{-2}\,K^{-1}]$

118. (b) [Torque] = [Force] [distance]

$= MLT^{-2}.\,L = ML^2T^{-2}$

119. (b) $\frac{\text{Planck's constant}}{\text{Moment of inertia}} = \frac{\frac{2\pi I\omega}{n}}{I}$ $\left[\text{As } \frac{nh}{2\pi} = I\omega\right]$

$$= \frac{2\pi I(2\pi f)}{nI} = \left(\frac{4\pi^2}{n}.f\right) = [T^{-1}]$$

120. (a) Both have the dimension $M^1L^2T^{-2}$.

121. (b) $[\text{momentum}] = [M][L][T^{-1}] = [MLT^{-1}]$

Planck's constant $= \frac{E}{\nu} = \frac{[M][LT^{-1}]^2}{T^{-1}} = ML^2T^{-1}$

122. (a) From stokes law

$$F = 6\pi\eta rv \Rightarrow \eta = \frac{F}{6\pi rv}$$

$$\therefore \eta = \frac{MLT^{-2}}{[L][LT^{-1}]} \Rightarrow \eta = [ML^{-1}T^{-1}]$$

123. (c) $n_1u_1 = n_2u_2$

$\therefore \quad n_2 = n_1\frac{u_1}{u_2} = 8\left[\frac{M_1}{M_2}\right]\left[\frac{L_2}{L_1}\right]^3$

$= 8\left[\frac{1}{20}\right]\left[\frac{5}{1}\right]^3 = 50.$

124. (a) Dimension of Magnetic flux
= Dimension of voltage × Dimension of time
$= [ML^2T^{-3}A^{-1}][T] = [ML^2T^{-2}A^{-1}]$

$\because$ Voltage $= \frac{\text{Work}}{\text{Charge}}$

125. (a) Let $m = KF^aL^bT^c$
Substituting the dimensions of
$[F] = [MLT^{-2}]$, $[L] = [L]$ and $[T] = [T]$ and comparing both side, we get $m = FL^{-1}T^2$

126. (a) $F = \frac{GMm}{R^2}$

$\therefore G = \frac{FR^2}{Mm} \Rightarrow G = [ML^3T^{-2}]$

127. (c) We know that $F = q\,v\,B$

$\therefore \quad B = \frac{F}{qv} = \frac{MLT^{-2}}{C \times LT^{-1}} = MT^{-1}C^{-1}$

128. (a) Energy stored in an inductor, $U = \frac{1}{2}LI^2$

$\Rightarrow L = \frac{2U}{I^2} \quad \therefore [L] = \frac{[ML^2T^{-2}]}{[A]^2} = [ML^2T^{-2}A^{-2}]$

129. (c) $n_2 = n_1\left(\frac{M_1}{M_2}\right)^1\left(\frac{L_1}{L_2}\right)^1\left(\frac{T_1}{T_2}\right)^{-2}$

$= 100\left(\frac{gm}{10^3 gm}\right)^1\left(\frac{cm}{m}\right)^1\left(\frac{sec}{min}\right)^{-2}$

$= 100\left(\frac{gm}{10^3 gm}\right)^1\left(\frac{cm}{10^2 cm}\right)^1\left(\frac{sec}{60 sec}\right)^{-2}$

$n_2 = \frac{3600}{10^3} = 3.6$

130. (b) Power $= \frac{\text{Energy}}{\text{time}}$

131. (d) Energy incident per unit area per second

$= \frac{\text{Energy}}{\text{area} \times \text{second}} = \frac{ML^2T^{-2}}{L^2T} = MT^{-3}$

132. (d)

133. (d) Pressure $= \frac{MLT^{-2}}{L^2} = [ML^{-1}T^{-2}]$

$\Rightarrow a = 1, b = -1, c = -2.$

134. (b)

135. (b) Let surface tension
$s = E^aV^bT^c$

$\frac{MLT^{-2}}{L} = (ML^2T^{-2})^a\left(\frac{L}{T}\right)^b(T)^C$

Equating the dimension of LHS and RHS
$ML^0T^{-2} = M^aL^{2a+b}T^{-2a-b+c}$
$\Rightarrow a = 1, 2a + b = 0, \quad -2a - b + c = -2$
$\Rightarrow a = 1, b = -2, c = -2$
Hence, the dimensions of surface tension are $[E V^{-2} T^{-2}]$

136. (b) Mobility $\mu = \frac{\text{drift velocity}}{\text{electric field}}\frac{V_d}{E} = \frac{(ms^{-1})}{(Vm^{-1})} = \frac{m^2s^{-3}}{V}$

$\left(\because \text{Volt} = V = \frac{\text{joule(J)}}{\text{coulomb(C)}}\right)$

$= \frac{m^2s^{-1}C}{J} = \frac{m^2s^{-1}As}{kg\,m^2s^{-2}}$ [Coulomb, c = As]

$= kg^{-1}s^2A = M^{-1}T^2A$

137. (d) Force = mass × acceleration

$\Rightarrow [\text{Mass}] = \left[\frac{\text{force}}{\text{acceleration}}\right]$

$= \left[\frac{\text{force}}{\text{velocity / time}}\right] = [FV^{-1}T]$

138. (d) Let unit 'u' related with e, a_0, h and c as follows.
$[u] = [e]^a[a_0]^b[h]^c[C]^d$
Using dimensional method,
$[M^{-1}L^{-2}T^{+4}A^{+2}] = [A^1T^1]^a[L]^b[ML2T^{-1}]^c[LT^{-1}]^d$
$[M^{-1}L^{-2}T^{+4}A^{+2}] = [M^cL^{b+2c+d}T^{a-c-d}A^a]$
$a = 2, b = 1, c = -1, d = -1$

$\therefore \quad u = \frac{e^2a_0}{hc}$

139. (c) Let μ_0 related with e, m, c and h as follows.
$\mu_0 = ke^am^bc^ch^d$
$[MLT^{-2}A^{-2}] = [AT]^a[M]^b[LT^{-1}]^c[ML^2T^{-1}]^d$
$= [M^{b+d}L^{c+2d}T^{a-c-d}A^a]$
On comparing both sides we get
$a = -2$ ...(i)
$b + d = 1$ ...(ii)
$c + 2d = 1$ ...(iii)
$a - c - d = -2$ ...(iv)
By equation (i), (ii), (iii) & (iv) we get,
$a = -2, b = 0, c = -1, d = 1$

$\therefore [\mu_0] = \left[\frac{h}{ce^2}\right]$