CBSE

UNITS & MEASUREMENT COMBINED WORKSHEET

Class 11 - Physics

Section A

1. The unit of a in van der Waal's gas equation is: **[1]**

   a) atm L^2 per mol
   b) atm L^{-1} mol^{-2}
   c) atm L^2 mol^{-2}
   d) atm L^{-2} mol^2

2. The number of significant figures in 0.06900 is **[1]**

   a) 4
   b) 5
   c) 2
   d) 3

3. The dimensions of universal gravitational constant are **[1]**

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

4. The significant digits in 0.000532 are **[1]**

   a) 5, 3, 2
   b) 2, 3
   c) 0,5,3,2
   d) 5, 3

5. In a system of units, the units of mass, length and time are 1 quintal, 1 km and 1 h respectively. In this system 1 N force will be equal to: **[1]**

   a) 1 new unit
   b) 125.7 new units
   c) 129.6 new units
   d) 10^3 new units

6. The number of significant digits in 2,076 is **[1]**

   a) 3
   b) 5
   c) 2
   d) 4

7. The frequency of vibration f of a mass m suspended from a spring of spring constant k is given by a relation f = am^xk^y, where a is a dimensionless constant. The values of x and y are **[1]**

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

8. The dimensions of impulse are equal to that of **[1]**

   a) pressure
   b) force
   c) linear momentum
   d) angular momentum

9. The force F is given by expression F = A cos (Bx) + C sin (Dt), where x is the displacement and t is the time. Then dimensions of $\frac{D}{B}$ are same as those of **[1]**

a) velocity gradient [T^{-1}]
b) angular momentum [ML^2T^{-1}]
c) velocity [LT^{-1}]
d) angular velocity [T^{-1}]

10. The mass and volume of a body are 4.237 g and 2.5 cm^3, respectively. The density of the material of the body in correct significant figures is **[1]**

a) 1.69 g cm^{-3}
b) 1.7 g cm^{-3}
c) 1.6048 g cm^{-3}
d) 1.695 g cm^{-3}

11. What are the dimensions of $\frac{A}{B}$ in the relation $F = A\sqrt{x} + Bt^2$, where F is the force, x is distance and t is time? **[1]**

a) [LT^{-2}]
b) [ML^2T^{-2}]
c) [$L^{-\frac{1}{2}}T^2$]
d) [$L^{-\frac{1}{2}}T^{-1}$]

12. If the dimensions of a physical quantity are given by $M^aL^bT^c$, then the physical quantity will be **[1]**

a) Force if a = 0, b = -1, c = -2
b) Velocity if a = 1, b = 0, c = -1
c) Pressure if a = 1, b = -1, c = -2
d) Acceleration if a = 1, b = 1, c = -2

13. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length? **[1]**

a) $\sqrt{\frac{hc}{G}}$
b) $\frac{\sqrt{hG}}{c^{5/2}}$
c) $\frac{\sqrt{hG}}{c^{3/2}}$
d) $\sqrt{\frac{Gc}{h^{3/2}}}$

14. In the relation, y = r sin (ωt + kx), the dimensional formula for kx or ωt is same as: **[1]**

a) $\frac{\omega t}{r}$
b) $\frac{r}{\omega}$
c) $\frac{r}{y}$
d) $\frac{yr}{\omega t}$

15. The equation of state of the gas is expressed as $\left(P + \frac{a}{V^2}\right)(V - b)$ = nRT, where P = pressure, V = volume, T = temperature and n, a, b, R are constants. The dimensions of a will be: **[1]**

a) [MLT^{-1}]
b) [L^6]
c) [ML^5T^{-2}]
d) [L^{-3}]

16. If 3.8 $\times$ 10^{-6} is added to 4.2 $\times$ 10^{-5} giving due regard to significant figures, then the result will be **[1]**

a) 35 $\times$ 10^{-5}
b) 4.6 $\times$ 10^{-5}
c) 45 $\times$ 10^{-5}
d) 4.58 $\times$ 10^{-5}

17. The dimensions of the quantity $\frac{hv}{c}$, where h is Planck's constant, v is the frequency and c is the velocity of light are: **[1]**

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

18. If L = 2.331 cm, B = 2.1 cm, then L + B = ? **[1]**

a) 4.43 cm
b) 4 cm

c) 4.431 cm

d) 4.4 cm

19. Which of the following five physical parameters have the same dimensions? **[1]**

i. energy density
ii. refractive index
iii. dielectric constant
iv. Young's modulus
v. magnetic field

a) iii and v

b) ii and iv

c) i and iv

d) i and v

20. Young's modulus of steel is 1.9×10^{11} N/m^2. When expressed in CGS units of dynes/cm^2, it will be equal to (1N = 10^5 dyne, 1m^2 = 10^4 cm^2) **[1]**

a) 1.9×10^{10}

b) 1.9×10^{11}

c) 1.9×10^{12}

d) 1.9×10^{13}

21. The units of Planck's constant are: **[1]**

a) Js

b) Js^2

c) J/s

d) Js^{-2}

22. 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 oil 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. The dimensions of η are **[1]**

a) $[ML^{-1}T^{-1}]$

b) $[ML^2T^{-2}]$

c) $[M^0L^0T^0]$

d) $[MLT^{-1}]$

23. Force F is given by F = at + bt^2, where t is time. What are the dimensions of a and b? **[1]**

a) $[MLT^{-3}]$ and $[MLT^{-4}]$

b) $[MLT^{-1}]$ and $[MLT^0]$

c) $[MLT^{-3}]$ and $[MLT^4]$

d) $[MLT^{-4}]$ and $[MLT^1]$

24. Which of the following is a dimensionless quantity? **[1]**

a) Specific heat

b) Strain

c) Stress

d) Quantity of heat

25. If momentum (P), area (A) and time (T) are taken to be fundamental quantities, then energy has the dimensional formula. **[1]**

a) $(P^2 A^1 T^1)$

b) $(P^1 A^{-1/2} T^1)$

c) $(P^1 A^{-1} T^1)$

d) $(P^1 A^{1/2} T^{-1})$

26. The dimensional formula of angular momentum is **[1]**

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

b) $[ML^2T^{-2}]$

c) $[MLT^{-1}]$

d) $[ML^2T^{-1}]$

27. Which of the following is a dimensional constant? **[1]**

a) refractive index
b) relative density
c) gravitational constant
d) poisson ratio

28. Unit for a fundamental physical quantity is **[1]**

a) reference standard for the given physical quantity
b) defined as average various reference standards
c) the smallest measurable value of the physical quantity
d) defined as best of various reference standards

29. The dimension of angular velocity is **[1]**

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

30. Number of degrees present in one radian is **[1]**

a) 57.3^o
b) 56.3^o
c) 58^o
d) 56^o

31. The result of rounding off 34.216 to 3 digits is **[1]**

a) 3.42
b) 34.2
c) 34.22
d) 342

32. The dimensional formula of magnetic flux is **[1]**

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

33. Which pairs do not have equal dimensions? **[1]**

a) Force and impulse
b) Elastic modulus and pressure
c) Energy and torque
d) Angular momentum and Planck's constant

34. If force (F), length (L) and time (T) be considered fundamental units, then units of mass will be: **[1]**

a) $[FLT^{-2}]$
b) $[FL^{-2}T^{-1}]$
c) $[FL^{-1}T^2]$
d) $[F^2LT^{-2}]$

35. Which of the following have same dimensions? **[1]**

a) torque and force
b) potential energy and force
c) Planck's constant and momentum
d) torque and potential energy

36. The dimension of torque is **[1]**

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

37. The number of significant digits in 900.06 is **[1]**

a) 4
b) 1
c) 3
d) 5

38. The dimensional formula of torque is **[1]**

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

39. Physical quantities are **[1]**

a) quantities such as kilos, pounds and gallons.
b) quantities such as length, mass and time.
c) quantities such as pounds, dollars and rupees.
d) quantities such as degrees, radians and steradians.

40. The dimensions of Planck's constant are: **[1]**

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

Section B

41. The wavelength λ associated with a moving particle depends upon its mass m, its velocity v and Plank's constant h. Show dimensional relation between them. **[2]**

42. In the relation p = $(a/b)e^{-(az/\theta)}$, p is the pressure, z is the distance, and θ is the temperature. What is the dimensional formula of b? **[2]**

43. A small spherical ball of radius r falls with velocity v through a liquid having coefficient of viscosity η. Find the viscous drag F on the ball assuming it depends on η, r and v. Take K = 6π. **[2]**

44. Compute the following with regards to significant figures. **[2]**

i. 4.6×0.128
ii. $\frac{0.9995\times1.53}{1.592}$
iii. 876 + 0.4382

45. The escape velocity v of a body depends upon **[2]**

i. the acceleration due to the gravity of the planet and
ii. the radius of the planet R.

Establish dimensionally the relationship between V, g and R.

46. The depth x to which a bullet penetrates a human body depends upon **[2]**

i. coefficient of elasticity η and
ii. kinetic energy E_k. By the method of dimensions, show that: $x \propto \left[\frac{E_k}{\eta}\right]^{1/3}$

47. State the principle of homogeneity of dimensions. Test the dimensional homogeneity of the following equation : **[2]**
$h = h_0 + v_0t + \frac{1}{2}gt^2$

48. Check the correctness of the relation $\tau = I\alpha$, where τ is the torque acting on a body, I is inertia and α is angular acceleration. **[2]**

49. The displacement of a progressive wave is represented by y = A sin(ωt - kx), where x is distance and t is time. Write the dimensional formula of **[2]**

i. ω and
ii. k.

50. The rotational kinetic energy of a body is given by E = $\frac{1}{2}I\omega^2$, where ω is the angular velocity of the body. Use the equation to obtain a dimensional formula for moment of inertia I. Also write its SI unit. **[2]**

51. Subtract 2.5×10^{-6} from 4.0×10^{-4} with due regard to significant figures. **[2]**

52. If force F, length L and time T are taken as fundamental units then what will be the dimensions of mass? **[2]**

53. 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). **[2]**

54. State the number of significant figures in the following : **[2]**

    i. 0.2370 g cm^{-3}
    ii. 6.320 J

55. Find the dimensional formulae of **[2]**

    i. charge
    ii. potential
    iii. resistance
    iv. capacitance.

56. A small steel ball of radius r is allowed to fall under gravity through a column of a viscous liquid of coefficient of viscosity η. After some time the velocity of the body attains a constant value v_T. The terminal velocity depends upon (i) the weight of the ball mg (ii) the coefficient of viscosity η and (iii) the radius of the ball r. By the method of dimensions, determine the relation expressing terminal velocity. **[2]**

57. A U-tube of uniform cross-section contains mercury upto a height h in either limb. The mercury in one limb is depressed a little and then released. Obtain an expression for the time period of oscillation assuming that T depends on h, ρ and g. **[2]**

58. The volume of a liquid flowing out per second from a pipe of length l and radius r is written by a student as V = $\frac{\pi P r^4}{8\eta l}$ where P is the pressure difference between two ends of pipe and η is coefficient of viscosity of the liquid having dimensional formula $[ML^{-1}T^{-1}]$. Check whether the equation is dimensionally correct or not. **[2]**

59. Solve the following and express the result to an appropriate number of significant figures. **[2]**

    i. Add 6.2g, 4.33g and 17.456g
    ii. Subtract 36.54 kg from 187.2 kg
    iii. $75.5 \times 125.2 \times 0.51$
    iv. $\frac{2.13 \times 24.78}{458.2}$

60. The number of particles crossing a unit area perpendicular to the X-axis in unit time is given by
n = $-D\frac{n_2-n_1}{x_2-x_1}$
where n_1 and n_2 are numbers of particles per unit volume for the values of x meant to be x_1 and x_2. Find the dimensions of the diffusion constant D. **[2]**

Section C

61. Round off the following numbers as indicated: **[3]**

    i. 18.35 up to 3 digits
    ii. 143.45 up to 4 digits
    iii. 18967 up to 3 digits
    iv. 12.653 up to 3 digits
    v. 248337 upto 3 digits

vi. 321.135 upto 5 digits

vii. 101.55×10^6 upto 4 digits

viii. 31.325×10^{-5} upto 4 digits

62. A planet moves around the sun in nearly circular orbit. Its period of revolution T depends upon: **[3]**

i. radius **r** of orbit
ii. mass M of the sun and
iii. the gravitational constant G.

Show dimensionally that $T^2 \propto r^3$.

Taking the proportionality constant as 2π, write the expression for T.

63. Obtain dimensions of: **[3]**

i. impulse
ii. power
iii. surface energy
iv. coefficient of viscosity
v. bulk modulus
vi. force constant

64. The velocity of sound waves v through a medium may be assumed to depend on: **[3]**

i. the density of the medium d and
ii. the modulus of elasticity E.

Deduce by the method of dimensions the formula for the velocity of sound. Take dimensional constant K = 1.

65. It is a well known fact that during a solar eclipse, the disc of the moon almost completely covers the disc of the sun. From this fact and from the information that sun's angular distance α is measured to be 1920", determine the approximate diameter of the moon. Given earth-moon distance = 3.8452×10^8 m. **[3]**

66. The frequency 'ν' of vibration of stretched string depends upon **[3]**

i. its length l,
ii. its mass per unit length 'm' and
iii. the tension T in the string

Obtain dimensionally an expression for frequency ν.

67. The velocity v of water waves depends on the wavelength λ, density of water ρ and the acceleration due to gravity g. Deduce by the method of dimensions the relationship between these quantities. **[3]**

68. The frequency v of an oscillating drop may depend upon radius r of the drop, density ρ of the liquid and surface tension S of the liquid. Establish an expression for v dimensionally. **[3]**

69. A book with many printing errors contains four different formulas for the displacement y of a particle undergoing a certain periodic motion: **[3]**

i. $y = a\sin\left(\frac{2\pi t}{T}\right)$
ii. $y = \left(\frac{a}{T}\right)\sin\frac{t}{a}$
iii. $y = (a\sqrt{2})\left(\sin\frac{2\pi t}{T} + \cos\frac{2\pi t}{T}\right)$

(a = maximum displacement of the particle, v = speed of the particle. T = time-period of motion). Rule out the wrong formulas on dimensional grounds.

70. The radius of a hydrogen atom is about 0.5 Å. What is the total atomic volume in m^3 of a mole of hydrogen **[3]**

atoms?

71. Explain this statement clearly: **[3]**

To call a dimensional quantity **large** or **small** is meaningless without specifying a standard for comparison. In view of this, reframe the following statements wherever necessary:

i. atoms are very small objects.
ii. a jet plane moves with great speed.
iii. the mass of Jupiter is very large.
iv. the air inside this room contains a large number of molecules.
v. a proton is much more massive than an electron.
vi. the speed of sound is much smaller than the speed of light.

72. Assuming that the mass M of the largest stone that can be moved by a flowing river depends upon v the velocity, ρ the density of water and on g, the acceleration due to gravity. Show that M varies with the sixth power of the velocity of flow. **[3]**

73. Check the dimensional consistency of the following equations. **[3]**

i. de-Broglie wavelength, $\lambda = \frac{h}{mv}$
ii. Escape velocity, v = $\sqrt{\frac{2GM}{R}}$

74. Reynold number N_R (a dimensionless quantity) determines the condition of laminar flow of a viscous liquid through a pipe. N_R is a function of the density of the liquid ρ, its average speed v and coefficient of viscosity η. Given that N_R is also directly proportional to D (the diameter of the pipe), show from dimensional considerations that $N_R \propto \frac{\rho v D}{\eta}$. The unit of η in SI system is kg $m^{-1}s^{-1}$. **[3]**

75. By using dimensional analysis, derive an expression for the height (h) to which a liquid of density (ρ) and surface tension (S) will rise in a capillary tube of radius (r). Given acceleration due to gravity is g and h $\propto \frac{1}{r}$. **[3]**