

Applied Physics 1

Chapter: Physical World, Units and Measurements

Practice Set 2: Fresh Question Bank with Solutions and Numericals

For Engineering Students (Short, Broad, Numerical and Objective, Exam Oriented)

Plan of this set: (1) very short answers, (2) short theory questions, (3) dimensions and derivations, (4) unit conversion numericals, (5) instruments and errors numericals, (6) significant figures, (7) objective questions with answer key, (8) exam tips and formula sheet. All questions here are new and different from Set 1.

1. Very Short Answer Questions (1 to 2 marks)

Q1. Define the metre.

Ans: The length of the path travelled by light in vacuum in $1/299\,792\,458$ of a second.

Q2. Define the second.

Ans: The duration of $9\,192\,631\,770$ periods of the radiation from the hyperfine transition of the caesium-133 atom.

Q3. How is the kilogram defined today?

Ans: By fixing the Planck constant at $h = 6.62607015 \times 10^{-34} \text{ J s}$ (earlier it was the mass of a platinum-iridium cylinder).

Q4. What is a mole?

Ans: The amount of substance containing exactly $6.02214076 \times 10^{23}$ elementary entities (Avogadro number).

Q5. State the SI and CGS units of pressure.

Ans: SI: pascal (N/m^2). CGS: dyne/ cm^2 .

Q6. Write the dimensional formula of velocity gradient.

Ans: $(dv/dx) = [L T^{-1}] / [L] = [T^{-1}]$.

Q7. What is the least count of an ordinary metre scale?

Ans: $1 \text{ mm} = 0.1 \text{ cm}$.

Q8. Name the error caused by viewing a scale from an inclined position.

Ans: Parallax error (a personal, systematic error).

Q9. What is a gross error?

Ans: A mistake caused by carelessness, such as misreading the scale, wrong recording or a faulty connection.

Q10. Which type of error is reduced by taking the mean of many readings?

Ans: Random error.

Q11. How many significant figures are there in 2.0×10^{-3} ?

Ans: Two.

Q12. Give one quantity that has units but no dimensions.

Ans: Plane angle (radian). Strain and refractive index have neither units nor dimensions.

2. Short Answer Questions (3 to 5 marks)

Q13. Differentiate between CGS and SI systems of units.

CGS system	SI system
Base units: centimetre, gram, second	Base units: metre, kilogram, second, ampere, kelvin, mole, candela
Only three mechanical base units	Seven base units, two supplementary units
Units: dyne, erg, dyne/cm ²	Units: newton, joule, pascal
Used in older books and some branches of physics	Internationally accepted for science and engineering

Q14. Define dimensional variables, dimensional constants, dimensionless variables and dimensionless constants with examples.

- **Dimensional variables:** have dimensions and change in value (velocity, force, work).
- **Dimensional constants:** have dimensions but a fixed value (G, h, speed of light c).
- **Dimensionless variables:** no dimensions but change in value (angle, strain, specific gravity).
- **Dimensionless constants:** pure numbers (π , e, $\frac{1}{2}$, 2).

Q15. State the uses (advantages) of dimensional analysis.

1. To check the dimensional correctness of a physical equation.
2. To convert a quantity from one system of units to another.
3. To derive the relation between quantities when the dependence is a product of powers.
4. To find the dimensions and units of constants in an equation (for example G, h, a and b in van der Waals equation).

Q16. Give the basic rules followed by dimensions in an equation.

- Only quantities with the same dimensions can be added, subtracted or equated.
- Dimensions of a product or quotient are obtained by multiplying or dividing the dimensions.
- The argument of sin, cos, log or exponential must be dimensionless.
- Numbers such as $\frac{1}{2}$, 2 and π carry no dimensions.

Q17. Write the practical units of length and their values.

Unit	Used for	Value in metre
Fermi	Nuclear size	10^{-15} m
Angstrom	Atomic size, wavelength of light	10^{-10} m
Micron (micrometre)	Bacteria, thin wires	10^{-6} m
Astronomical unit (AU)	Distances in the solar system	1.496×10^{11} m
Light year	Distances to stars	9.46×10^{15} m
Parsec	Large stellar distances	3.08×10^{16} m

Q18. Differentiate between systematic errors and random errors.

Systematic error	Random error
Always in the same direction (all too high or all too low)	Sometimes positive and sometimes negative
Has definite causes: faulty instrument, zero error, method	Cause unknown or unpredictable
Not reduced by repeating readings	Reduced by taking many readings and the mean
Removed by calibration and correction	Estimated by statistical methods
Affects accuracy	Affects precision

Q19. Write short notes on zero error, parallax error and least count error.

- **Zero error:** the instrument does not read zero when it should (jaws closed). True reading = observed reading – zero error. Zero correction = – zero error.
- **Parallax error:** apparent shift of the pointer or mark when the eye is not directly above it. Avoided by viewing perpendicular to the scale.
- **Least count error:** the uncertainty of one least count that is present in every reading of an instrument.

Q20. What is order of magnitude? How is it found?

Order of magnitude is the power of 10 nearest to the value of a quantity. Write the number as $N \times 10^p$ with $1 \leq N < 10$. If N is less than about 3.16 (that is, $\sqrt{10}$), the order of magnitude is p . If N is 3.16 or more, it is $p + 1$.

Examples: 2.0×10^3 m has order 10^3 ; 4.5×10^3 m has order 10^4 .

Q21. Why do we write results in scientific notation?

- It shows exactly the number of significant figures (5.00×10^3 has 3, 5×10^3 has 1).
- It avoids long strings of zeros in very large or very small numbers.
- It makes the order of magnitude and calculations with powers of 10 easy.

3. Dimensions: More Formulae and Derivations**Q22. Write the dimensional formulae of some more quantities. (Important)**

Quantity	Formula	Dimensional formula
Torque	force $\times$ distance	$[M L^2 T^{-2}]$
Moment of inertia	$m r^2$	$[M L^2 T^0]$
Angular momentum	$I \omega$	$[M L^2 T^{-1}]$
Spring constant k	F / x	$[M L^0 T^{-2}]$
Young's modulus	stress / strain	$[M L^{-1} T^{-2}]$
Gravitational potential	work / mass	$[M^0 L^2 T^{-2}]$
Acceleration due to gravity g	velocity / time	$[M^0 L T^{-2}]$
Electric charge	current $\times$ time	$[A T]$
Specific gravity	ratio of densities	Dimensionless

Q23. In the van der Waals equation $(P + a/V^2)(V - b) = RT$, find the dimensions of a and b .

- By homogeneity, a/V^2 has the dimensions of pressure $P = [M L^{-1} T^{-2}]$.
- So $a = P \times V^2 = [M L^{-1} T^{-2}][L^6] = [M L^5 T^{-2}]$.

- Also $V = b$ means b has the dimensions of volume, so $b = [L^3]$.

Q24. Check the correctness of $v = u + a t^2$ and correct it if wrong.

- LHS: $[v] = [L T^{-1}]$. RHS: $[u] = [L T^{-1}]$, but $[a t^2] = [L T^{-2}][T^2] = [L]$.
- $[L T^{-1}]$ is not equal to $[L]$, so the equation is dimensionally wrong.
- Correct form: $v = u + at$, since $[at] = [L T^{-1}]$.

Q25. Check the dimensional correctness of Bernoulli's equation $P + \frac{1}{2} \rho v^2 + \rho g h = \text{constant}$.

- $[P] = [M L^{-1} T^{-2}]$.
- $[\rho v^2] = [M L^{-3}][L^2 T^{-2}] = [M L^{-1} T^{-2}]$.
- $[\rho g h] = [M L^{-3}][L T^{-2}][L] = [M L^{-1} T^{-2}]$.

Answer: All three terms have the same dimensions, so the equation is dimensionally correct.

Q26. Show that the speed of sound $v = \sqrt{(\gamma P / \rho)}$ is dimensionally correct. (γ is dimensionless.)

$[P/\rho] = [M L^{-1} T^{-2}] / [M L^{-3}] = [L^2 T^{-2}]$. So $\sqrt{(P/\rho)} = [L T^{-1}]$, which is the dimension of velocity. Hence the formula is dimensionally correct.

Q27. Check the equation $T = 2\pi\sqrt{(m / k)}$ for a mass m on a spring of constant k .

$[m/k] = [M] / [M T^{-2}] = [T^2]$. So $\sqrt{(m/k)} = [T]$, the same as $[T]$ on the left. The equation is dimensionally correct.

Q28. Derive the expression for the frequency of vibration of a stretched string using dimensions. (Broad)

Step 1: Frequency f depends on length l , tension F and mass per unit length μ . Assume $f = k l^a F^b \mu^c$.

Step 2: Dimensions: $[f] = [T^{-1}]$, $[l] = [L]$, $[F] = [M L T^{-2}]$, $[\mu] = [M L^{-1}]$. So $[T^{-1}] = [L]^a [M L T^{-2}]^b [M L^{-1}]^c = [M^{b+c} L^{a+b-c} T^{-2b}]$.

Step 3: Compare powers.

- Time: $-2b = -1$, so $b = 1/2$.
- Mass: $b + c = 0$, so $c = -1/2$.
- Length: $a + b - c = 0$, so $a = -1$.

Answer: $f = (k / l) \sqrt{(F / \mu)}$. Experiment gives $k = 1/2$, so $f = (1 / 2l) \sqrt{(F / \mu)}$.

Q29. Using dimensions, derive Stokes' law for the viscous force F on a small sphere of radius r moving with speed v in a liquid of viscosity η . (Broad)

Assume $F = k \eta^a r^b v^c$. Dimensions: $[\eta] = [M L^{-1} T^{-1}]$, $[r] = [L]$, $[v] = [L T^{-1}]$. So $[M L T^{-2}] = [M^a L^{-a+b+c} T^{-a-c}]$.

- Mass: $a = 1$.
- Time: $-a - c = -2$, so $c = 1$.
- Length: $-a + b + c = 1$, so $b = 1$.

Answer: $F = k \eta r v$. Experiment gives $k = 6\pi$, so $F = 6\pi \eta r v$.

Q30. Derive the speed of efflux of a liquid from a hole at depth h , assuming it depends on h , density ρ and g . (Broad)

Assume $v = k h^a \rho^b g^c$. Then $[L T^{-1}] = [L]^a [M L^{-3}]^b [L T^{-2}]^c = [M^b L^{a-3b+c} T^{-2c}]$.

- Mass: $b = 0$.
- Time: $-2c = -1$, so $c = 1/2$.

- Length: $a + c = 1$, so $a = 1/2$.

Answer: $v = k\sqrt{g h}$. Experiment gives $k = \sqrt{2}$, so $v = \sqrt{2 g h}$ (Torricelli's theorem). It does not depend on density.

Q31. Derive the time period of a mass m oscillating on a spring of spring constant k_s . (Numerical)

Assume $T = K m^a k_s^b$. $[T] = [M]^a [M T^{-2}]^b = [M^{a+b} T^{-2b}]$. Comparing: $-2b = 1$, so $b = -1/2$; $a + b = 0$, so $a = 1/2$.

Answer: $T = K\sqrt{m / k_s}$. Experiment gives $K = 2\pi$.

4. Numericals: Conversion of Units

Formula: $n_2 = n_1 [M_1/M_2]^a [L_1/L_2]^b [T_1/T_2]^c$

Q32. Convert a force of 1 dyne into newton. (Numerical)

Force = $[M L T^{-2}]$. $n_2 = 1 \times (1 \text{ g} / 1 \text{ kg})^1 \times (1 \text{ cm} / 1 \text{ m})^1 \times (1)^{-2} = 10^{-3} \times 10^{-2} = 10^{-5}$.

Answer: 1 dyne = 10^{-5} N.

Q33. The viscosity of a liquid is 1 poise (CGS). Express it in SI units. (Numerical)

Viscosity = $[M L^{-1} T^{-1}]$. $n_2 = 1 \times (10^{-3})^1 \times (10^{-2})^{-1} \times (1)^{-1} = 10^{-3} \times 10^2 = 0.1$.

Answer: 1 poise = $0.1 \text{ kg m}^{-1} \text{ s}^{-1} = 0.1 \text{ Pa s}$.

Q34. One atmosphere is 1.013×10^5 Pa. Express it in dyne/cm². (Numerical)

Pressure = $[M L^{-1} T^{-2}]$. $n_2 = 1.013 \times 10^5 \times (1000)^1 \times (100)^{-1} \times (1)^{-2} = 1.013 \times 10^5 \times 10$.

Answer: 1 atm = 1.013×10^6 dyne/cm².

Q35. $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$. Find its value in CGS units. (Numerical)

$G = [M^{-1} L^3 T^{-2}]$. $n_2 = 6.67 \times 10^{-11} \times (1000)^{-1} \times (100)^3 \times (1)^{-2} = 6.67 \times 10^{-11} \times 10^{-3} \times 10^6$.

Answer: $G = 6.67 \times 10^{-8} \text{ dyne cm}^2 \text{ g}^{-2} (\text{cm}^3 \text{ g}^{-1} \text{ s}^{-2})$.

Q36. Planck's constant is $6.63 \times 10^{-34} \text{ J s}$. Express it in erg s. (Numerical)

$h = [M L^2 T^{-1}]$. $n_2 = 6.63 \times 10^{-34} \times (1000)^1 \times (100)^2 = 6.63 \times 10^{-34} \times 10^7$.

Answer: $h = 6.63 \times 10^{-27} \text{ erg s}$.

Q37. Convert 1 horse power (746 W) into erg/s. (Numerical)

1 W = 1 J/s = 10^7 erg/s. So 746 W = 746×10^7 erg/s.

Answer: 1 hp = 7.46×10^9 erg/s.

Q38. The density of mercury is 13.6 g/cm^3 . Find it in kg/m^3 . (Numerical)

Density = $[M L^{-3}]$. $n_2 = 13.6 \times (10^{-3})^1 \times (10^{-2})^{-3} = 13.6 \times 10^{-3} \times 10^6$.

Answer: 13 600 kg/m^3 .

Q39. The surface tension of water is 72 dyne/cm. Express it in N/m. (Numerical)

Surface tension = $[M T^{-2}]$. $n_2 = 72 \times (1 \text{ g} / 1 \text{ kg})^1 \times (1 \text{ s} / 100 \text{ cm})^{-2} = 72 \times 10^{-3}$.

Answer: 0.072 N/m.

Q40. A new system has units of length 10 m, mass 5 kg and time 2 s. Find the value of 1 joule in this system. (Numerical)

Work = $[M L^2 T^{-2}]$. $n_2 = 1 \times (1/5)^1 \times (1/10)^2 \times (1/2)^{-2} = 0.2 \times 0.01 \times 4 = 0.008$.

Answer: 1 J = 0.008 new units.

Q41. Express the speed of light, $3 \times 10^8 \text{ m/s}$, in km/h. (Numerical)

1 m/s = $(1/1000) \text{ km} / (1/3600) \text{ h} = 3.6 \text{ km/h}$. So $3 \times 10^8 \times 3.6 = 10.8 \times 10^8$.

Answer: 1.08×10^9 km/h.

5. Numericals: Instruments, Errors and Error Propagation

Q42. A vernier callipers has 20 vernier divisions equal to 19 main scale divisions (1 MSD = 1 mm). With the jaws closed, the 19th vernier division coincides with a main scale division. A rod reads MSR = 41 mm and VSR = 13. Find the true length. (Numerical)

- $LC = 1 \text{ MSD} / 20 = 0.05 \text{ mm}$.
- Observed reading = $41 + 13 \times 0.05 = 41.65 \text{ mm}$.
- Zero error = $-(20 - 19) \times 0.05 = -0.05 \text{ mm}$, so zero correction = $+0.05 \text{ mm}$.
- True length = $41.65 + 0.05 = 41.70 \text{ mm}$.

Answer: $41.70 \text{ mm} = 4.170 \text{ cm}$.

Q43. A screw gauge has pitch 0.5 mm and 50 circular divisions. For a wire, LSR = 2.5 mm and CSR = 32. When the studs touch, the zero of the circular scale is 4 divisions above the reference line. Find the diameter. (Numerical)

- $LC = 0.5 / 50 = 0.01 \text{ mm}$.
- Observed reading = $2.5 + 32 \times 0.01 = 2.82 \text{ mm}$.
- Zero error = $-4 \times 0.01 = -0.04 \text{ mm}$ (zero lies above the reference line, so it is negative).
- True diameter = $2.82 - (-0.04) = 2.86 \text{ mm}$.

Answer: 2.86 mm .

Q44. Five readings of the diameter of a wire are 2.52, 2.50, 2.54, 2.51 and 2.53 mm. Find the mean, mean absolute error, relative error and percentage error. (Numerical)

- Mean = $(2.52 + 2.50 + 2.54 + 2.51 + 2.53) / 5 = 12.60 / 5 = 2.52 \text{ mm}$.
- Absolute errors: 0.00, 0.02, 0.02, 0.01, 0.01 mm.
- Mean absolute error = $0.06 / 5 = 0.012 \text{ mm}$.
- Relative error = $0.012 / 2.52 = 0.0048$. Percentage error = 0.48% .

Answer: $d = (2.52 \pm 0.01) \text{ mm}$, relative error 0.0048, percentage error 0.48 %.

Q45. Two lengths are $(12.5 \pm 0.1) \text{ cm}$ and $(7.3 \pm 0.2) \text{ cm}$. Find their sum and difference. (Numerical)

Sum = $12.5 + 7.3 = 19.8 \text{ cm}$, error = $0.1 + 0.2 = 0.3 \text{ cm}$. Difference = $12.5 - 7.3 = 5.2 \text{ cm}$, error = $0.1 + 0.2 = 0.3 \text{ cm}$.

Answer: Sum = $(19.8 \pm 0.3) \text{ cm}$, difference = $(5.2 \pm 0.3) \text{ cm}$.

Q46. The radius and height of a cylinder are $r = (2.00 \pm 0.02) \text{ cm}$ and $h = (10.0 \pm 0.1) \text{ cm}$. Find the volume with error. (Numerical)

- $V = \pi r^2 h = 3.142 \times 4.00 \times 10.0 = 125.7 \text{ cm}^3$.
- Relative error = $2 (0.02 / 2.00) + 0.1 / 10.0 = 0.02 + 0.01 = 0.03$ (3 %).
- $\Delta V = 0.03 \times 125.7 = 3.8 \text{ cm}^3$.

Answer: $V = (125.7 \pm 3.8) \text{ cm}^3$, that is 3 % error.

Q47. A voltmeter reads $V = (5.0 \pm 0.1) \text{ V}$ and an ammeter reads $I = (2.0 \pm 0.05) \text{ A}$. Find the resistance $R = V / I$ with error. (Numerical)

- $R = 5.0 / 2.0 = 2.50 \Omega$.
- Relative error = $0.1 / 5.0 + 0.05 / 2.0 = 0.02 + 0.025 = 0.045$.
- $\Delta R = 0.045 \times 2.50 = 0.11 \Omega$.

Answer: $R = (2.50 \pm 0.11) \Omega$, that is 4.5 % error.

Q48. A body covers $d = (100.0 \pm 0.5)$ m in $t = (20.0 \pm 0.2)$ s. Find the speed with error. (Numerical)

- $v = 100.0 / 20.0 = 5.00$ m/s.
- Relative error $= 0.5 / 100.0 + 0.2 / 20.0 = 0.005 + 0.010 = 0.015$.
- $\Delta v = 0.015 \times 5.00 = 0.075$, about 0.08 m/s.

Answer: $v = (5.00 \pm 0.08)$ m/s.

Q49. In a pendulum experiment $l = (0.640 \pm 0.001)$ m and $T = (1.60 \pm 0.01)$ s. Find g and its error using $g = 4\pi^2 l / T^2$. (Numerical)

- $g = 4 \times 9.870 \times 0.640 / (1.60)^2 = 25.27 / 2.56 = 9.87$ m/s².
- Relative error $= 0.001 / 0.640 + 2 (0.01 / 1.60) = 0.0016 + 0.0125 = 0.0141$.
- $\Delta g = 0.0141 \times 9.87 = 0.14$ m/s².

Answer: $g = (9.87 \pm 0.14)$ m/s².

Q50. The mass of a cube is (125 ± 1) g and its side is (5.0 ± 0.1) cm. Find the density with error. (Numerical)

- Volume $= 5.0^3 = 125$ cm³, so $\rho = 125 / 125 = 1.00$ g/cm³.
- Relative error $= 1 / 125 + 3 (0.1 / 5.0) = 0.008 + 0.060 = 0.068$.
- $\Delta \rho = 0.068 \times 1.00 = 0.07$ g/cm³.

Answer: $\rho = (1.00 \pm 0.07)$ g/cm³.

Q51. The kinetic energy $K = \frac{1}{2} m v^2$ is calculated from m with 2 % error and v with 3 % error. Find the percentage error in K . (Numerical)

$$\Delta K / K = \Delta m / m + 2 (\Delta v / v) = 2 \% + 2 \times 3 \% = 8 \%$$

Answer: 8 %.

Q52. A quantity is $X = a b^2 / c^3$. The percentage errors in a , b and c are 1 %, 2 % and 3 %. Find the percentage error in X . (Numerical)

$$\Delta X / X = 1 \times (1 \%) + 2 \times (2 \%) + 3 \times (3 \%) = 1 + 4 + 9 = 14 \%$$

Answer: 14 %.

6. Significant Figures

Q53. Write the number of significant figures: 0.0305, 5.00×10^{-3} , 1.0200, 0.00002, 2500. (Numerical)

0.0305 has 3; 5.00×10^{-3} has 3; 1.0200 has 5; 0.00002 has 1; 2500 is ambiguous (2 to 4), so it is better written as 2.5×10^3 (2) or 2.500×10^3 (4).

Q54. Round off to 3 significant figures: 45.65, 2.675, 0.0123456. (Numerical)

45.65: the dropped digit is 5 and the preceding digit 6 is even, so it stays: **45.6**. 2.675: the dropped digit is 5 and the preceding digit 7 is odd, so it rises: **2.68**. 0.0123456: digits 1, 2, 3 then 4 (less than 5): **0.0123**.

Q55. Give the results with the correct number of significant figures: (a) $6.25 - 2.1$, (b) 3.14×2.0 , (c) $8.0 / 3.00$, (d) $0.0210 + 1.5$. (Numerical)

- (a) $6.25 - 2.1 = 4.15$. The least precise term has 1 decimal place, so the answer is **4.2**.
- (b) $3.14 \times 2.0 = 6.28$. The factor 2.0 has 2 significant figures, so the answer is **6.3**.
- (c) $8.0 / 3.00 = 2.666...$ The factor 8.0 has 2 significant figures, so the answer is **2.7**.

- (d) $0.0210 + 1.5 = 1.521$. The term 1.5 has 1 decimal place, so the answer is **1.5**.

Q56. Express 0.000345 and 52 000 (2 significant figures) in scientific notation. Also find the order of magnitude of 0.000345. (Numerical)

$0.000345 = 3.45 \times 10^{-4}$ and $52\,000 = 5.2 \times 10^4$. For 3.45×10^{-4} , $N = 3.45$ is more than 3.16, so the order of magnitude is $10^{-4} + 1 = 10^{-3}$.

7. Objective Questions (Multiple Choice)

- Which of the following is not a fundamental SI quantity?
(a) mass (b) time (c) force (d) electric current
- The dimensional formula of Young's modulus is
(a) $[M L T^{-2}]$ (b) $[M L^{-1} T^{-2}]$ (c) $[M L^2 T^{-2}]$ (d) $[M L^{-2} T^{-1}]$
- The SI unit of plane angle is
(a) degree (b) radian (c) steradian (d) revolution
- The dimensional formula of angular momentum is
(a) $[M L^2 T^{-1}]$ (b) $[M L T^{-1}]$ (c) $[M L^2 T^{-2}]$ (d) $[M L^2 T^0]$
- 1 dyne is equal to
(a) 10^5 N (b) 10^{-5} N (c) 10^{-3} N (d) 10^3 N
- The number of base units in SI is
(a) 3 (b) 5 (c) 7 (d) 9
- A screw gauge has pitch 1 mm and 100 circular divisions. Its least count is
(a) 1 mm (b) 0.1 mm (c) 0.01 mm (d) 0.001 mm
- If a quantity A has 3 % error, the error in A^2 is
(a) 3 % (b) 6 % (c) 9 % (d) 1.5 %
- The number of significant figures in 0.04050 is
(a) 2 (b) 3 (c) 4 (d) 5
- Dimensional analysis cannot give
(a) units of constants (b) conversion of units (c) numerical constants (d) check of equations
- Zero error in an instrument is a
(a) random error (b) systematic error (c) gross error (d) none of these
- Which quantity is dimensionless?
(a) strain (b) stress (c) pressure (d) frequency
- The dimensional formula of surface tension is
(a) $[M L T^{-2}]$ (b) $[M T^{-2}]$ (c) $[M L^{-1} T^{-2}]$ (d) $[M L^2 T^{-2}]$
- The SI unit of Planck's constant is
(a) J/s (b) J s (c) $W s^{-1}$ (d) $N m^{-1}$
- 1 fermi is equal to
(a) 10^{-10} m (b) 10^{-12} m (c) 10^{-15} m (d) 10^{-9} m

Answer key

1 - (c); 2 - (b); 3 - (b); 4 - (a); 5 - (b); 6 - (c); 7 - (c); 8 - (b); 9 - (c); 10 - (c); 11 - (b); 12 - (a); 13 - (b); 14 - (b); 15 - (c).

8. Exam Tips and Formula Sheet

- For unit conversion, first write the dimensional formula, then list M_1/M_2 , L_1/L_2 , T_1/T_2 separately before multiplying.
- For derivations, always write the three equations for M, L and T in a neat list, then state the final formula.
- State the principle of homogeneity in one line whenever you check an equation.
- In error propagation, add absolute errors for sum and difference, and relative errors for product, quotient and powers.
- Final answers must carry the correct unit and significant figures. Write the error as (value $\pm$ error) unit.
- Zero error sign: if zero reads above the reference or the error is on the negative side, the correction is added.

Formulae to remember

- $n_2 = n_1 [M_1/M_2]^a [L_1/L_2]^b [T_1/T_2]^c$
- Vernier LC = 1 MSD / N (N vernier divisions equal to N – 1 main divisions)
- Screw gauge LC = pitch / number of circular divisions
- Mean absolute error = (sum of $|a_{\text{mean}} - a_i|$) / n; percentage error = $(\Delta a / a) \times 100$
- $Z = A^p B^q / C^r$: $\Delta Z / Z = p (\Delta A / A) + q (\Delta B / B) + r (\Delta C / C)$