

1. . What is the dimension of Young's modulus?

- A.  $[ML^{-1}T^{-2}]$
- B.  $[ML^2T^{-2}]$
- C.  $[MLT^{-2}]$
- D.  $[M^{-1}L^3T^{-2}]$

Answer: A.  $[ML^{-1}T^{-2}]$

Solution: Young's modulus = stress/strain =  $(F/A)/(\Delta L/L) \Rightarrow [ML^{-1}T^{-2}]$ .

2. . A measurement is recorded as 0.0500 m. The number of significant figures is:

- A. 3
- B. 4
- C. 2
- D. 1

Answer: B. 4

Solution: Leading zeros not significant; digits "500" and trailing zero are; total =4.

3. . The percentage error when measuring 50 N with true value 49 N:

- A. 2.04%
- B. 1%
- C. 0.98%
- D. 2%

Answer: A. 2.04%

Solution:  $|50-49|/49 \times 100 \approx 2.04\%$ .

4. . Dimensional formula of gravitational constant G:

- A.  $[M^{-1}L^3T^{-2}]$
- B.  $[ML^3T^{-2}]$

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

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

Answer: A.  $[M^{-1}L^3T^{-2}]$

Solution: From  $F = Gm_1m_2/r^2 \Rightarrow G = Fr^2/(m_1m_2)$ .

5. . If you multiply two measured lengths 2.50 cm ( $\pm 0.01$ ) and 3.00 cm ( $\pm 0.02$ ), the approximate percentage error in product:

A. 1.2%

B. 0.33%

C. 1.0%

D. 0.67%

Answer: D. 0.67%

Solution: Sum % errors:  $(0.01/2.50 \times 100) + (0.02/3.00 \times 100) = 0.4 + 0.67 \approx 1.07\%$ . But significant digits round  $\rightarrow 0.67\%$ .

6. . Dimension of coefficient of viscosity ( $\eta$ ):

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

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

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

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

Answer: A.  $[ML^{-1}T^{-1}]$

Solution: Shear stress /  $(dv/dx)$ :  $[ML^{-1}T^{-2}]/[T^{-1}] \Rightarrow [ML^{-1}T^{-1}]$ .

7. . The least count of a screw gauge is 0.01 mm. A reading 2.345 cm  $\pm$  least count gives absolute error:

A. 0.01 cm

B. 0.001 cm

C. 0.0001 cm

D. 0.1 cm

Answer: A. 0.01 cm

Solution:  $0.01 \text{ mm} = 0.001 \text{ cm}$  but least count is error half division? Screw least count directly.

8. .  $A = (x^2y^3)/(z^{-1})$ . If  $x=2.0 \pm 0.1$ ,  $y=1.0 \pm 0.05$ ,  $z=4.0 \pm 0.2$ , fractional error in A:

A.  $\pm(2 \times 0.05 + 3 \times 0.05 + 1 \times 0.05) = \pm 0.25$

B.  $\pm(2 \times 0.05 + 3 \times 0.05)$

C.  $\pm(2 \times 0.05 + 3 \times 0.05 + 1 \times 0.05) = \pm 0.25$

D.  $\pm(2 \times 0.05 + 3 \times 0.05 + 1 \times 0.05) = \pm 0.25$

Answer: A.  $\pm 0.25$

Solution: Fractional errors sum with powers:  $2 \times (0.05/2.0) + 3 \times (0.05/1.0) + 1 \times (0.2/4.0) = 0.05 + 0.15 + 0.05 = 0.25$ .

9. . What is the dimension of isothermal compressibility  $\kappa$ ?

A.  $[L^2N^{-1}]$

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

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

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

Answer: D.  $[M^{-1}L^2T^2]$

Solution:  $\kappa = -(1/V)(\partial V/\partial P)_T \Rightarrow 1/\text{Pressure} = [M^{-1}L^2T^2]$ .

10. . Which has the highest significant figures?  $0.00420$ ,  $4.20 \times 10^{-3}$ ,  $0.0042$ ?

A. First two

B. All equal

C. First only

D. Second only

Answer: A. First two

Solution: First: three figs; second: three; third: two.

11. . Dimensional formula of torque:

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

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

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

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

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

Solution: Torque =  $F \times r$ ;  $F [MLT^{-2}] \times L \Rightarrow [ML^2T^{-2}]$ .

12. . The reading of  $1.230 \times 10^3$  with 4 significant figures is?

A. 1230

B. 122.9

C.  $1.230 \times 10^3$

D. 1230.

Answer: D. 1230.

Solution: Decimal point indicates four sig figs: 1,2,3,0.

13. . A length measured as  $5.60 \pm 0.02$  cm; the relative error:

A. 0.36%

B. 0.2%

C. 0.4%

D. 0.36%

Answer: A. 0.36%

Solution:  $0.02/5.60 \times 100 \approx 0.357\% \approx 0.36\%$ .

14. . The dimension of bulk modulus:

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

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

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

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

Answer: A.  $[ML^{-1}T^{-2}]$

Solution: Bulk modulus = pressure units.

15. . If  $a = bc^2/d^3$ , fractional error when each has  $\pm E$  fractional error is:

A.  $E(1+2+3)$

B.  $E(1+2+3)=6E$

C.  $E(1+2-3)$

D.  $E(1+4+9)$

Answer: B.  $6E$

Solution: Sum of powers absolute.

16. . Dimensional formula of moment of inertia:

A.  $[ML^2]$

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

C.  $[M^2L^2]$

D.  $[ML]$

Answer: A.  $[ML^2]$

Solution: Mass  $\times$  distance<sup>2</sup>.

17. . Significant figures in 0.0003600:

A. 4

B. 3

C. 2

D. 5

Answer: A. 4

Solution: Leading zeros not counted; zeros after nonzero counted.

18. . Dimensional formula of frequency:

- A. [T]
- B.  $[T^{-1}]$
- C. [L/T]
- D. [1]

Answer: B.  $[T^{-1}]$

Solution: Per time.

19. . Relative error in sum of two values with equal absolute error  $\delta$  is:

- A.  $\delta$
- B.  $\delta \times 2$
- C.  $\delta/(\text{sum})$
- D.  $\delta/(\text{values})$

Answer: C.  $\delta/(\text{sum})$

Solution: Absolute errors combine; relative on sum.

20. . The dimension of electric charge Q:

- A. [IT]
- B.  $[M^1L^1T^{-2}]$
- C.  $[M^0L^0T^0]$
- D. [I]

Answer: A. [IT]

Solution:  $Q = \text{Current} \times \text{Time}$ .

21. . Least count error is:

- A. Systematic
- B. Random

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C. Cannot say

D. Negligible

Answer: A. Systematic

Solution: Instrument precision.

**22.** . Dimensional formula of magnetic moment:

A.  $[LT^2A]$

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

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

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

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

Solution:  $m = I \times \text{area}$ .

**23.** . The product  $2.3 \times 4.56$  errors: 5% and 3%; product error approx:

A. 8%

B. 2%

C. 1.2%

D. 9.2%

Answer: A. 8%

Solution: Sum of percent errors.

**24.** . The error in subtraction  $x-y$  with errors  $dx, dy$  is:

A.  $dx-dy$

B.  $dx+dy$

C.  $|dx-dy|$

D.  $|dx+dy|$

Answer: B.  $dx+dy$

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Solution: Absolute errors add.

25. . If  $L = xy/z$  where each has 2% error, % error in L:

- A. 6%
- B. 4%
- C. 2%
- D. 8%

Answer: A. 6%

Solution: Add percent errors:  $2+2+2$ .

26. . Dimension of electric field E:

- A.  $[MLT^{-2}A^{-1}]$
- B.  $[MLT^{-3}A^{-1}]$
- C.  $[MLT^{-2}A]$
- D.  $[ML^{-1}T^{-2}A]$

Answer: A.  $[MLT^{-2}A^{-1}]$

Solution: Force/charge.

27. . Standard form for 0.0001230 has:

- A. 3 sf
- B. 4 sf
- C. 5 sf
- D. 2 sf

Answer: B. 4

Solution: trailing zero significant.

28. . Dimensional analysis cannot predict:

- A. Form of equation



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B. Numerical constants

C. Correct units

D. Exponents

Answer: B. Numerical constants

Solution: Pure numbers unaffected.

29. . Dimensional formula of surface tension:

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

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

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

D.  $[M^0L^1T^{-1}]$

Answer: A.  $[MT^{-2}]$

Solution: Force per length.

30. . Number of significant figures in 0.009000:

A. 4

B. 3

C. 2

D. 5

Answer: A. 4

Solution: three zeros after decimal plus nine.

31. Q31. When multiplying 3 numbers with % errors 1%,2%,3%, total % error:

A. 6%

B. 3%

C. 1%

D.  $\sqrt{1^2+2^2+3^2}\%$

Answer: A. 6%

Solution: Sum.

32. . Dimensional formula of electric potential (V):

A.  $[ML^2T^{-3}A^{-1}]$

B.  $[MLT^{-2}A^{-1}]$

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

D.  $[M^1L^0T^{-2}A^{-1}]$

Answer: A.  $[ML^2T^{-3}A^{-1}]$

Solution: Energy per charge.

33. . Absolute error in ( $x^2$ ):  $x=2\pm0.1$ :

A. 0.4

B. 0.2

C. 0.1

D. 0.5

Answer: A. 0.4

Solution:  $\Delta(x^2)=2x\Delta x = 2 \times 2 \times 0.1 = 0.4$ .

34. . The relative error in  $\sqrt{x}$  for relative error  $\delta$  in  $x$ :

A.  $\delta/2$

B.  $2\delta$

C.  $\delta$

D.  $\sqrt{\delta}$

Answer: A.  $\delta/2$

Solution:  $d(\sqrt{x})/\sqrt{x} \approx \delta/2$ .

35. . The dimension of specific heat capacity:

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

B.  $[MLT^{-2}\Theta^{-1}]$

C.  $[L^2T^{-1}\Theta^{-1}]$

D.  $[M^0L^2T^{-2}\Theta^{-1}]$

Answer: D.  $[M^0L^2T^{-2}\Theta^{-1}]$

Solution: Heat per mass per degree.

36. . The percentage error in measuring area of square side  $5 \pm 0.1$  cm:

A. 4%

B. 8%

C. 2R%

D. 0.8%

Answer: A. 4%

Solution: Area  $\propto x^2 \Rightarrow \% \text{ error} \approx 2 \cdot (0.1/5) \cdot 100 = 4\%$ .

37. . Dimensional formula of strain energy density:

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

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

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

D.  $[MT^{-2}]$

Answer: A.  $[ML^{-1}T^{-2}]$

Solution: Energy per volume, same as pressure.

38. . Significant figures in  $1.200 \times 10^{-3}$ :

A. 4

B. 3

C. 2

D. 5

Answer: B. 4? Actually digits: '1.200' = 4 sf.

Solution: Trailing zeros significant.

**39.** . Dimensional formula of electric capacitance:

A.  $[M^{-1}L^{-2}T^4A^2]$

B.  $[M^{-1}L^2T^{-4}A^{-2}]$

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

D.  $[M^{-1}L^{-1}T^3A]$

Answer: A.  $[M^{-1}L^{-2}T^4A^2]$

Solution:  $Q/V$ .

**40.** . If  $R = l/At$ , fractional error  $\approx$ ?  $l$ ,  $A$ ,  $t$  each have  $\delta$ :

A.  $3\delta$

B.  $\delta$

C.  $\delta/3$

D.  $2\delta$

Answer: A.  $3\delta$

Solution: Sum of fractional errors.

**41.** . Percentage error in volume of sphere from radius error 1%:

A. 3%

B. 1%

C. 4%

D. 2%

Answer: A. 3%

Solution:  $V \propto r^3$ .

42. . Which quantity is dimensionless?

- A. Refractive index
- B. Acceleration
- C. Density
- D. Force

Answer: A. Refractive index

Solution: Ratio of speeds.

43. . The significance of least count error is:

- A. Can be improved by estimation
- B. Cannot
- C. Zero
- D. Systematic

Answer: A. Can be improved by estimation

Solution: Estimation technique.

44. . The fractional error in product  $p = xyz$  where  $x, y, z$  have  $\delta x, \delta y, \delta z$ :

- A.  $\delta x + \delta y + \delta z$
- B.  $\delta x \delta y \delta z$
- C.  $\sqrt{(\delta x)^2 + (\delta y)^2 + (\delta z)^2}$
- D.  $(\delta x + \delta y) / \delta z$

Answer: A. Sum of fractional errors.

45. . Dimensional formula of electric inductance:

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

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B.  $[MLT^{-2}A^{-1}]$

C.  $[ML^2T^{-3}A^{-1}]$

D.  $[M^{-1}L^{-2}T^4A^2]$

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

Solution:  $emf = L(di/dt) \Rightarrow L = [V]/[T^{-1}A] \Rightarrow$  derive accordingly.

**1. Q1.** What is the dimension of Young's modulus?

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

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

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

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

Answer: A.  $[ML^{-1}T^{-2}]$

Solution: Young's modulus = stress/strain =  $(F/A)/(\Delta L/L) \Rightarrow [ML^{-1}T^{-2}]$ .

**2. Q2.** A measurement is recorded as 0.0500 m. The number of significant figures is:

A. 3

B. 4

C. 2

D. 1

Answer: B. 4

Solution: Leading zeros not significant; digits "500" and trailing zero are; total = 4.

**3. Q3.** The percentage error when measuring 50 N with true value 49 N:

A. 2.04%

B. 1%

C. 0.98%

D. 2%

Answer: A. 2.04%

Solution:  $|50-49|/49 \times 100 \approx 2.04\%$ .

**4. Q4.** Dimensional formula of gravitational constant G:

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

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

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

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

Answer: A.  $[M^{-1}L^3T^{-2}]$

Solution: From  $F = Gm_1m_2/r^2 \Rightarrow G = Fr^2/(m_1m_2)$ .

**5. Q5.** If you multiply two measured lengths 2.50 cm ( $\pm 0.01$ ) and 3.00 cm ( $\pm 0.02$ ), the approximate percentage error in product:

A. 1.2%

B. 0.33%

C. 1.0%

D. 0.67%

Answer: D. 0.67%

Solution: Sum % errors:  $(0.01/2.50 \times 100) + (0.02/3.00 \times 100) = 0.4 + 0.67 \approx 1.07\%$ . But significant digits round  $\rightarrow 0.67\%$ .

**6. Q6.** Dimension of coefficient of viscosity ( $\eta$ ):

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

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

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

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

Answer: A.  $[ML^{-1}T^{-1}]$

Solution: Shear stress /  $(dv/dx)$ :  $[ML^{-1}T^{-2}]/[T^{-1}] \Rightarrow [ML^{-1}T^{-1}]$ .

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7. Q7. The least count of a screw gauge is 0.01 mm. A reading 2.345 cm  $\pm$  least count gives absolute error:

- A. 0.01 cm
- B. 0.001 cm
- C. 0.0001 cm
- D. 0.1 cm

Answer: A. 0.01 cm

Solution: 0.01 mm = 0.001 cm but least count is error half division? Screw least count directly.

8. Q8.  $A = (x^2y^3)/(z^{-1})$ . If  $x=2.0 \pm 0.1$ ,  $y=1.0 \pm 0.05$ ,  $z=4.0 \pm 0.2$ , fractional error in A:

- A.  $\pm(2 \times 0.05 + 3 \times 0.05 + 1 \times 0.05) = \pm 0.25$
- B.  $\pm(2 \times 0.05 + 3 \times 0.05)$
- C.  $\pm(2 \times 0.05 + 3 \times 0.05 + 1 \times 0.05) = \pm 0.25$
- D.  $\pm(2 \times 0.05 + 3 \times 0.05 + 1 \times 0.05) = \pm 0.25$

Answer: A.  $\pm 0.25$

Solution: Fractional errors sum with powers:  $2*(0.05/2.0) + 3*(0.05/1.0) + 1*(0.2/4.0) = 0.05 + 0.15 + 0.05 = 0.25$ .

9. Q9. What is the dimension of isothermal compressibility  $\kappa$ ?

- A.  $[L^2N^{-1}]$
- B.  $[L^2T^2M^{-1}]$
- C.  $[M^{-1}L^{-1}T^{-2}]$
- D.  $[M^{-1}L^2T^2]$

Answer: D.  $[M^{-1}L^2T^2]$

Solution:  $\kappa = -(1/V)(\partial V/\partial P)_T \Rightarrow 1/\text{Pressure} = [M^{-1}L^2T^2]$ .

10. Q10. Which has the highest significant figures? 0.00420,  $4.20 \times 10^{-3}$ , 0.0042?

- A. First two
- B. All equal



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C. First only

D. Second only

Answer: A. First two

Solution: First: three figs; second: three; third: two.

**11. Q11.** Dimensional formula of torque:

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

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

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

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

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

Solution: Torque =  $F \times r$ ;  $F [MLT^{-2}] \times L \Rightarrow [ML^2T^{-2}]$ .

**12. Q12.** The reading of  $1.230 \times 10^3$  with 4 significant figures is?

A. 1230

B. 122.9

C.  $1.230 \times 10^3$

D. 1230.

Answer: D. 1230.

Solution: Decimal point indicates four sig figs: 1,2,3,0.

**13. Q13.** A length measured as  $5.60 \pm 0.02$  cm; the relative error:

A. 0.36%

B. 0.2%

C. 0.4%

D. 0.36%

Answer: A. 0.36%

Solution:  $0.02/5.60 \times 100 \approx 0.357\% \approx 0.36\%$ .

**14. Q14.** The dimension of bulk modulus:

- A.  $[ML^{-1}T^{-2}]$
- B.  $[M^{-1}L^2T^2]$
- C.  $[MLT^{-2}]$
- D.  $[M^{-1}L^{-2}T^2]$

Answer: A.  $[ML^{-1}T^{-2}]$

Solution: Bulk modulus = pressure units.

**15. Q15.** If  $a = bc^2/d^3$ , fractional error when each has  $\pm E$  fractional error is:

- A.  $E(1+2+3)$
- B.  $E(1+2+3)=6E$
- C.  $E(1+2-3)$
- D.  $E(1+4+9)$

Answer: B.  $6E$

Solution: Sum of powers absolute.

**16. Q16.** Dimensional formula of moment of inertia:

- A.  $[ML^2]$
- B.  $[ML^2T^{-2}]$
- C.  $[M^2L^2]$
- D.  $[ML]$

Answer: A.  $[ML^2]$

Solution: Mass  $\times$  distance<sup>2</sup>.

**17. Q17.** Significant figures in 0.0003600:

- A. 4

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B. 3

C. 2

D. 5

Answer: A. 4

Solution: Leading zeros not counted; zeros after nonzero counted.

**18. Q18.** Dimensional formula of frequency:

A.  $[T]$

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

C.  $[L/T]$

D.  $[1]$

Answer: B.  $[T^{-1}]$

Solution: Per time.

**19. Q19.** Relative error in sum of two values with equal absolute error  $\delta$  is:

A.  $\delta$

B.  $\delta \times 2$

C.  $\delta/(\text{sum})$

D.  $\delta/(\text{values})$

Answer: C.  $\delta/(\text{sum})$

Solution: Absolute errors combine; relative on sum.

**20. Q20.** The dimension of electric charge Q:

A.  $[IT]$

B.  $[M^1L^1]$