Q1. The ratio of two quantities is dimensionless but not unitless. Which of the following is a valid example?

A. Angle in radians
B. Relative density
C. Temperature ratio in kelvin
D. Refractive index

Answer: C
Explanation:
The ratio of two temperatures in kelvin is dimensionless because the units cancel, but it is not unitless since kelvin is a base unit.

Q2. The SI unit of the coefficient of viscosity (written as "eta") is:

A. Pa·s
B. N·s/m
C. $kg \cdot m^{-1} \cdot s^{-2}$
D. $dyne \cdot s/cm^2$

Answer: A
Explanation:
Viscosity η = (Force / Area) × (dx / dv)
= $(N / m^2) \times s = Pa \cdot s$

Q3. Which of the following pairs has the same dimensions but different SI units?

A. Work and torque
B. Pressure and energy

C. Power and energy
D. Impulse and force

Answer: A
Explanation:
Work and torque both have the same dimensions: [M L^2 T^{-2}]

Work has SI unit: joule (J = N·m)

Torque also has unit N·m, but represents rotational effect and is a vector
So, dimensions are same, but physical meaning and usage are different.

Q4. Which of the following physical quantities has an SI unit that is not derived, i.e., it is a base unit?

A. Luminous intensity
B. Electric potential
C. Heat
D. Velocity

Answer: A
Explanation:
Luminous intensity is a base physical quantity. Its SI unit is candela (cd), which is a base unit.

Q5. The SI unit of solid angle is:

A. Radian
B. Steradian
C. Degree
D. Dioptre

Answer: B
Explanation:
Solid angle is measured in steradians (sr), the SI unit for 3D angular measure.

Q6. A student writes the unit of Planck's constant as "erg·s". What is the equivalent SI unit?

A. J·s
B. N·s
C. $kg \cdot m^2/s$
D. W·s

Answer: A
Explanation:
1 erg = 10^{-7} joule
So, erg·s = 10^{-7} J·s
Hence, the correct SI unit of Planck's constant is joule·second (J·s)

Q7. The dimensional formula of pressure is:

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

Answer: D
Explanation:
Pressure = Force / Area
= (Mass × Acceleration) / Area
= $[M\ L\ T^{-2}] / [L^2] = [M\ L^{-1}\ T^{-2}]$

Q8. Which of the following is dimensionally consistent?

A. $v^2 = u^2 + 2as$
B. $v = u + at^2$
C. $v^2 = u^2 + 2a$
D. $s = ut + at$

Answer: A
Explanation:
Check each term's dimensions:

$v^2 = [L^2\ T^{-2}]$

$u^2 = [L^2\ T^{-2}]$

$2as = [L\ T^{-2}] \times [L] = [L^2\ T^{-2}]$
All terms have same dimensions.

Q9. The dimensional formula of surface tension is:

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

Answer: C
Explanation:
Surface tension = Force / Length
$= [M\ L\ T^{-2}] / [L] = [M\ L^0\ T^{-2}]$

Q10. Which of the following physical quantities has the same dimensional formula as energy?

A. Force

B. Torque
C. Pressure
D. Power

Answer: B
Explanation:
Energy = $[M\ L^2\ T^{-2}]$
Torque = Force × Distance = $[M\ L\ T^{-2}] \times [L] = [M\ L^2\ T^{-2}]$

Q11. Which quantity has the same dimensions as impulse?

A. Force
B. Energy
C. Momentum
D. Pressure

Answer: C
Explanation:
Impulse = Force × Time = $[M\ L\ T^{-2}] \times [T] = [M\ L\ T^{-1}]$
Momentum = Mass × Velocity = $[M] \times [L\ T^{-1}] = [M\ L\ T^{-1}]$

Q12. Which of the following equations is dimensionally incorrect?

A. $T = 2\pi \sqrt{(L/g)}$
B. $E = mc^2$
C. $F = ma^2$
D. $v = u + at$

Answer: C
Explanation:
$F = ma^2 \Rightarrow$ Dimensions $= M \times (L\ T^{-2})^2 = [M\ L^2\ T^{-4}]$
But Force = $[M\ L\ T^{-2}]$, so mismatch → Incorrect.

Q13. What is the dimensional formula of Planck's constant?

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

Answer: A
Explanation:
Energy = h × frequency → $[M\ L^2\ T^{-2}] = h \times [T^{-1}]$
So, $h = [M\ L^2\ T^{-1}]$

Q14. The dimensional formula of angular momentum is:

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

Answer: B
Explanation:
Angular momentum = Moment of inertia × Angular velocity
$= [M\ L^2] \times [T^{-1}] = [M\ L^2\ T^{-1}]$

Q15. Which quantity is dimensionless?

A. Strain
B. Stress
C. Energy
D. Force

Answer: A
Explanation:

Strain = Change in length / Original length → [L] / [L] = No units
Hence, dimensionless.

Q16. The unit of a quantity is given as joule-second. Identify the physical quantity.

A. Planck's constant
B. Work
C. Energy
D. Angular momentum

Answer: D
Explanation:
Angular momentum = Moment of inertia × Angular velocity
= $[M L^2] \times [T^{-1}] = [M L^2 T^{-1}]$ → Joule-second

Q17. Which of the following quantities has the dimensional formula $[M^0 L^0 T^0]$?

A. Relative density
B. Density
C. Pressure
D. Force

Answer: A
Explanation:
Relative density = Density of substance / Density of water
→ No units → Dimensionless

Q18. Dimensional formula of gravitational constant (G) is:

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

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

Answer: A
Explanation:
$F = G (m_1 m_2 / r^2) \Rightarrow G = F \times r^2 / m^2$
$= [M L T^{-2}] \times [L^2] / [M^2] = [M^{-1} L^3 T^{-2}]$

Q19. Which of the following quantities has same dimensions as work?

A. Moment of inertia
B. Power
C. Torque
D. Momentum

Answer: C
Explanation:
Torque = Force × Perpendicular distance
$= [M L T^{-2}] \times [L] = [M L^2 T^{-2}] \rightarrow$ Same as Work

Q20. The true value of a quantity is 9.80 m/s^2, and the measured value is 9.65 m/s^2. The absolute error is:

A. 0.05
B. 0.10
C. 0.15
D. 0.25

Answer: C
Explanation:
Absolute error = |True - Measured| = |9.80 - 9.65| = 0.15

Q21. If the absolute error in measuring length is 0.02 m and the length is 2.00 m, then the percentage error is:

A. 1%
B. 0.5%
C. 0.02%
D. 2%

Answer: B
Explanation:
Percentage error = (0.02 / 2.00) × 100 = 1%

Q22. Which of the following has maximum possible error when added?

A. 10.2 + 3.58
B. 100.03 + 0.004
C. 23.1 + 5.342
D. 3.2 + 1.75

Answer: A
Explanation:
Final result should match the least precise decimal place (1 decimal). Max error comes from large rounding.

Q23. If two quantities A = 5.0 ± 0.1 and B = 2.0 ± 0.2, then the error in A + B is:

A. ±0.1
B. ±0.2
C. ±0.3
D. ±0.02

Answer: C
Explanation:

In addition: total error = error in A + error in B = 0.1 + 0.2 = ±0.3

Q24. If A = 10 ± 0.2 and B = 5 ± 0.1, the maximum relative error in A/B is:

A. 0.02
B. 0.03
C. 0.04
D. 0.05

Answer: D
Explanation:
Relative error = (ΔA/A) + (ΔB/B) = (0.2/10) + (0.1/5) = 0.02 + 0.02 = 0.04 (or 4%)

Q25. If A = 4.0 ± 0.2 and we calculate A^2, the percentage error is:

A. 5%
B. 10%
C. 20%
D. 40%

Answer: B
Explanation:
If y = A^n, % error = n × (% error in A)
% error in A = (0.2/4.0)×100 = 5%
So, % error in A^2 = 2×5 = 10%

Q26. The least count of a scale that reads up to 1 mm is:

A. 0.1 mm
B. 0.5 mm
C. 1 mm
D. 10 mm

Answer: C
Explanation:
Least count = smallest division readable = 1 mm

Q27. A student measures the diameter of a wire as 2.00 mm, 2.02 mm, and 1.98 mm. The mean diameter is:

A. 2.01 mm
B. 2.00 mm
C. 1.99 mm
D. 2.02 mm

Answer: B
Explanation:
Mean = (2.00 + 2.02 + 1.98)/3 = 2.00 mm

Q28. For the same readings in Q27, the absolute error in each measurement is:

A. 0.01 mm
B. 0.02 mm
C. 0.04 mm
D. 0.10 mm

Answer: B
Explanation:
|2.02 - 2.00| = 0.02, |1.98 - 2.00| = 0.02
Average error = (0.02 + 0.02 + 0)/3 = 0.013 ≈ 0.02 mm

Q29. If Z = A × B, then fractional error in Z is:

A. ΔA + ΔB

B. $\Delta A/A + \Delta B/B$
C. $A \times \Delta B + B \times \Delta A$
D. None

Answer: B
Explanation:
For multiplication/division: fractional error in $Z = \Delta A/A + \Delta B/B$

Q30. If a measurement is 2.50 cm, how many significant figures does it have?

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

Answer: C
Explanation:
Trailing zero after decimal counts → 2.50 has 3 significant figures

Q31. The quantity 0.00340 has how many significant figures?

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

Answer: B
Explanation:
Leading zeros don't count. 3, 4, and final 0 after decimal → 3 sig figs

Q32. Which of the following is dimensionally incorrect?

A. Velocity = Distance / Time
B. Work = Force × Distance
C. Power = Work × Time
D. Acceleration = Velocity / Time

Answer: C
Explanation:
Power = Work / Time, not × Time ⇒ Incorrect dimensions.

Q33. If length = 4.0 ± 0.2 m and time = 2.0 ± 0.1 s, what is the error in speed?

A. 0.1 m/s
B. 0.2 m/s
C. 0.3 m/s
D. 0.4 m/s

Answer: B
Explanation:
Speed = L/T
Relative error = 0.2/4.0 + 0.1/2.0 = 0.05 + 0.05 = 0.10
Speed = 2.0 m/s
Absolute error = 10% of 2.0 = 0.2 m/s

Q34. If density is calculated from m/V, and m has 3% error, V has 2% error, then error in density is:

A. 1%
B. 2%
C. 5%
D. 6%

Answer: C
Explanation:
% error in density = 3% + 2% = 5%

Q35. If $R = A^2B / C^3$, the % error in R is:

A. $2(\Delta A/A) + \Delta B/B + 3(\Delta C/C)$
B. $\Delta A + \Delta B - \Delta C$
C. $\Delta A^2 + \Delta B^2 - \Delta C^3$
D. $\Delta A/A + \Delta B/B - \Delta C/C$

Answer: A
Explanation:
Use exponents: % error = $n(\Delta A/A) + m(\Delta B/B) + ...$
So here = $2(\Delta A/A) + \Delta B/B + 3(\Delta C/C)$

Q36. A value is measured as 5.60. Rounding it to 2 significant digits gives:

A. 5.5
B. 5.6
C. 6.0
D. 5.0

Answer: B
Explanation:
First two digits: 5.6 → Already 2 significant figures

Q37. The mean absolute error is best described as:

A. Minimum possible error
B. Average of all errors
C. Largest error
D. Standard deviation

Answer: B

Explanation:
Mean absolute error = average of individual absolute errors.

Q38. A physical quantity X is found using:

$X = P^2Q / R$.
If % errors in P, Q and R are 2%, 1%, and 3% respectively, then % error in X is:

A. 8%
B. 7%
C. 6%
D. 5%

Answer: C
Explanation:
% error in X = 2(2%) + 1% + 3% = 6%

Q39. Which type of error cannot be reduced by taking multiple measurements?

A. Random error
B. Instrumental error
C. Systematic error
D. Personal error

Answer: C
Explanation:
Systematic error stays constant in every trial → not reduced by repetition.

Q40. Which device gives least count of 0.01 cm?

A. Meter scale
B. Vernier caliper
C. Screw gauge
D. Measuring tape

Answer: B
Explanation:
Vernier caliper → typical least count = 0.01 cm

Q41. The resistance of a wire is measured as R = 5.00 ± 0.05 Ω. The percentage error in R is:

A. 1%
B. 5%
C. 10%
D. 0.5%
Answer: A
Explanation:
Percentage error = (0.05 / 5.00) × 100 = 1%

Q42. The quantity Q is given by $Q = A^2 / \sqrt{B}$. If the percentage errors in A and B are 3% and 4% respectively, then the percentage error in Q is:

A. 4%
B. 5%
C. 8%
D. 10%
Answer: C
Explanation:
% error in Q = 2 × error in A + (1/2) × error in B
= 2×3 + 0.5×4 = 6 + 2 = 8%

Q43. A student records the time of oscillation of a pendulum as 1.62 s using a stopwatch with least count 0.01 s. What is the relative error?

A. 0.62%
B. 1%
C. 0.31%
D. 0.01%
Answer: A
Explanation:
Relative error = (0.01 / 1.62) × 100 ≈ 0.62%

Q44. A student takes three readings for the diameter of a wire: 2.01 mm, 2.03 mm, and 2.00 mm. The mean and absolute error are:

A. 2.01 mm and ±0.02 mm
B. 2.01 mm and ±0.01 mm
C. 2.02 mm and ±0.03 mm
D. 2.02 mm and ±0.01 mm
Answer: A
Explanation:
Mean = (2.01 + 2.03 + 2.00)/3 = 2.01 mm
Deviation from mean: 0.00, 0.02, 0.01
Mean absolute error = (0 + 0.02 + 0.01)/3 ≈ 0.01
Maximum absolute error = 0.02 mm ⇒ Final = ±0.02 mm

Q45. If two quantities A and B have absolute errors of 0.01 and 0.02 respectively, the absolute error in (A + B) is:

A. 0.01
B. 0.02
C. 0.03
D. 0.002
Answer: C
Explanation:
For addition: total absolute error = ΔA + ΔB = 0.01 + 0.02 = 0.03