SRIGAYATRI EDUCATIONAL INSTITUTIONS
INDIA

UNITS AND MEASUREMENTS (UT-05 QB)

1. **The moon is observed from two diametrically opposite points A and B on earth. The angel θ subtended at the moon by the two directions of observation is $1^0 54^1$. Given the diameter of the earth to be about 1.276×10^7m. Compute the distance of the moon from the earth.-----m**

2. **The Temperatures of two bodies measured by a thermometer are** $t_1 = 10^0 C \pm 0.5^0 C$ **and** $t_2 = 40^0 C \pm 0.5^0 C$ **Calculate the temperature difference and the error there in ----^{0}C**

3. **The résistance R = V/I here V =** $(200 \pm 5)V$ **and** $I = (20 \pm 0.2)A$**. Find the percentage error in R.----** Ω

4. **Two resistors of resistance** $R_1 = 200 \pm 3 ohm$ **and** $R_2 = 200 \pm 4\ ohm$ **are connected in series. Find the equivalent resistance of the series combination-----ohm**

5. **The period of oscillation of a simple pendulum is** $T = 2\pi\sqrt{L/g}$ **. Measured value of L is 10.0cm known to 1mm accuracy and time for 100 oscillations of the pendulum is found to be 90 S using a wrist watch of 1 S a resolution. What is the accuracy in the determination of g?**

6. **6.74 g of a substance occupies 1.2 cm^3. Express its density by keeping the significant figures in view.**

7. **A calorie is a unit of heat or energy and it equals about 4.2 J where 1 J = 1 kg m^2 s^{-2}. Suppose we employ a system of units in which the unit of mass equals a kg, the unit of length equals bm. The unit of time is gs.**

8. **A physical quantity P is related to four observables a, b, c and d as follows.** $p = a^3 b^2 / (\sqrt{c} d)$**. The percentage errors of measurement in a, b, c and d are 2%, 3%, 4% and 2%, respectively. What is the percentage error in the quantity P? (%)**

9. **The least count of a stopwatch is 1/5s. The time for 20 oscillations of a pendulum is measured to be 25 seconds……% is the percentage error in the measurement of time.**

10. **The power of a motor is 200 W. If the unit of length is halved, that of mass is doubled and that of time is also doubled, the power of the motor in the new system is new units.**

11. **If the energy,** $E = G^p h^q c^r$ **where G is the universal gravitational constant, h is the Planck's constant and c is the velocity of light, then the values of p, q and r are, respectively**
    1) -1/2, ½ and 5/2 2) ½,-1/2 and -5/2 3) -1/2,1/2 and 3/2 4) ½, -1/2 and -3/2

12. **A cube has a side of length 1.2 ×10^{-2}m . Its volume upto correct significant figures is**
    1) $1.7 \times 10^{-6} m^3$ 2) $1.73 \times 10^{-6} m^3$ 3) $1.78 \times 10^{-6} m^3$ 4) $1.732 \times 10^{-6} m^3$

13. **The period of oscillation of a simple pendulum** $T = 2\pi\sqrt{\frac{L}{g}}$ **. Measured value of L is 10 cm}$ known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 50 s using a wrist watch of 1 s resolution. What is the accuracy in the determination of g ?**

1) 2% 2)3% 3) 4% 4) 5%

14. A physical quantity X is related to four measurable quantities a, b, c and d as given, $X = a^2b^3c^{5/2}d^{-2}$. The percentage error in the measurement of a, b, c and d are 1 %, 2 %, 2% and 4 % respectively. What is the percentage error in quantity X ?

1) 15% 2) 17% 3)21% 4) 23%

15. Two resistors of resistance $R_1 = (100 \pm 3)\Omega$ and $R_2 = (200 \pm 4)\Omega$ are connected in parallel. The equivalent resistance of the parallel combination is

1) $(66.7 \pm 1.8)\Omega$ 2) $(66.7 \pm 4.0)\Omega$ 3) $(66.7 \pm 3.0)\Omega$ 4) $(66.7 \pm 7.0)\Omega$

16. If the error in measuring the radius of the sphere is 2 % and that in measuring its mass is 3%, then the error in measuring the density of material of the sphere is

1) 5% 2)7% 3) 9% 4) 11%

17. The distance of the moon from the earth is about 60 times the radius of the earth. What will be diameter of the earth (approximately in degrees) as seen from the moon?

1) 1^0 2) 2^0 3) 4^0 4) 6^0

18. Planck's constant (h), speed of light in vacuum I and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length?

1) $\frac{\sqrt{hG}}{c^{3/2}}$ 2) $\frac{\sqrt{hG}}{c^{5/2}}$ 3) $\sqrt{\frac{hc}{G}}$ 4) $\sqrt{\frac{Gc}{h^{3/2}}}$

19. If the units of length, mass and force are chosen as fundamental units, the dimensions of time would be

1) $\left[M^{1/2}L^{-1/2}F^{1/2}\right]$ 2) $\left[M^{1/2}L^{1/2}F^{1/2}\right]$ 3) $\left[M^{1/2}L^{1/2}F^{-1/2}\right]$ 4) $\left[M^{1/2}L^{-1/2}F^{-1/2}\right]$

20. If surface tension (S), moment of inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be

1) $S^{3/2}I^{1/2}h^0$ 2) $S^{1/2}I^{1/2}h^0$ 3) $S^{1/2}I^{3/2}h^{-1}$ 4) $S^{1/2}I^{1/2}h^{-1}$

21. Let *l*, r, c and v represent inductance, resistance capacitance and voltage, respectively. The dimension of $\frac{l}{rcv}$ in SI units will be

1) $\left[\mathrm{LA}^{-2}\right]$ 2) $\left[\mathrm{LT}^{2}\right]$ 3) $\left[\mathrm{A}^{-1}\right]$ 4) [LTA]

22. The force of interaction between two atoms is given by $F = \alpha\beta \exp\left(-\frac{x^2}{\alpha kT}\right)$; where x is the distance, k is the Boltzmann constant and T is temperature and α and β are two constants. The dimension of β is

1) $M^2L^2T^{-2}$ 2) $\mathrm{M^0L^2T^{-4}}$ 3) $\mathrm{MLT^{-2}}$ 4) $\mathrm{M^2LT^{-4}}$

23. The percentage error in measuring M, L and T are 1 %, 1.5 % and 3 % respectively. Then the percentage error in measuring the physical quantity with dimensions $[ML^{-1}T^{-1}]$ is

1)1% 2) 3.5 % 3) 3% 4) 5.5 %

24. The time period of oscillation of a body is given by $T = 2\pi\sqrt{\frac{mgA}{K}}$ K represents the kinetic energy, m mass, g acceleration due to gravity and A is unknown. If $[A] = M^xL^yT^z$ then what is the value of x+y+z ?

1) 3 2) 2 3) 1 4) 5

25. The energy of a system as a function of time t is given as $E(t) = A^2\exp(-\alpha t)$, where α =0.2 s^{-1}. The measurement of A has an error of 1.25% . If the error in the measurement of time is 1.50 %, the percentage error in the value of E(t) at t=5 s is

1) 2% 2) 4% 3) 3% 4) 5%

26. We measure two quantities as A=1.0 m ±0.2 m, B=2.0 m ±0.2 m We should report correct value for $\sqrt{AB}$ as

1) $1.4\text{m} \pm 0.4\text{m}$ 2) $1.41\text{m} \pm 0.15\text{m}$ 3) $1.4\text{m} \pm 0.3\text{m}$ 4) $1.4\text{m} \pm 0.2\text{m}$

27. The length and breadth of a rectangular sheet are 16.2 cm and 10.1 cm, respectively. The area of the sheet in appropriate significant figures and error is

1) $164 \pm 3\text{cm}^2$ 2) $163.62 \pm 2.6\text{cm}^2$ 3) $163.6 \pm 2.6\text{cm}^2$ 4) $163.62 \pm 3\text{cm}^2$

28. A new system of units is proposed in which unit of A new system mass is α kg, unit of length is β m and unit of time if s. What will be value of 5J in this new system?

1) $5\alpha\beta^2\gamma^{-2}$ 2) $5\alpha^{-1}\beta^{-2}\gamma^2$ 3) $5\alpha^{-2}\beta^{-1}\gamma^{-2}$ 4) $5\alpha^{-1}\beta^2\gamma^2$

29. If E, m, *l* and G denote energy, mass, angular momentum and gravitational constant respectively, the quantity $\left(\frac{El^2}{m^5G^2}\right)$ has the dimensions of

1) mass 2) length 3) time 4) angle

30. A body travels uniformly a distance of $(13.8 \pm 0.2\text{m})$ in a time (4.0 ± 0.3) s. Its velocity with error limits is

1) $(3.5 \pm 0.6)\text{ms}^{-1}$ 2) $(3.5 \pm 0.3)\text{ms}^{-1}$ 3) $(6.1 \pm 0.6)\text{ms}^{-1}$ 4) $(6.1 \pm 0.3)\text{ms}^{-1}$

KEY

PHYSICS

1) 38.5	2) **1**	3) 3.5	4) 400 ± 7	5) 0.03	6) 5.61	7) 4.2	8) 16	9) **5**	10) **1**
11) **1**	12) **1**	13) **4**	14) **3**	15) **1**	16) **3**	17) **2**	18) **1**	19) **3**	20) **2**
21) **3**	22) **4**	23) **4**	24) **1**	25) **2**	26) **4**	27) **1**	28) **2**	29) **4**	30) **2**

1. $\theta = \frac{d}{D}$

$D = \frac{d}{\theta} = \frac{1.276x10^7}{1^0.54^1}$

D=38.5m

2. $t = t_2 - t_1$

$\Delta t = \Delta t_1 + \Delta t_2$

$T=30^0C$

$\Delta t = 1^0 C$

3. $R = \frac{V}{I}$

Ans: 3.5Ω

4. $(400 \pm 7)ohm$

$R_S = (R_1 + R_2) \pm (\Delta R_1 + \Delta R_2)$

5. $T^2 \alpha \frac{L}{g}$

$\frac{\Delta g}{g} = 2\frac{\Delta T}{T} + \frac{\Delta L}{L}$

$\frac{\Delta g}{g} = 0.03$

6. $d = \frac{m}{v}$

d=5.6166

d=5.61

7. Q=4.2J

$$H_2 = H_1\left[\frac{M_1}{M_2}(\frac{L_1}{L_2})^2(\frac{T_1}{T_2})^2\right]$$

Ans: $a^{-1}b^{-1}g^2$

8. $$\frac{\Delta P}{P} = \frac{3\Delta a}{a} + \frac{2\Delta b}{b} + \frac{1}{2}\frac{\Delta c}{c} + \frac{\Delta d}{d}$$

$$\frac{\Delta P}{P} = 16\%$$

9. T=t/n

$$\frac{dT}{T} = \frac{1}{n}\frac{dt}{t}$$

10. Power=ML^2T^{-3}

$$n_2 = n_1\left[\frac{M_1}{M_2}\right]^a\left[\frac{L_1}{L_2}\right]^b\left[\frac{T_1}{T_2}\right]^C$$

11. $$E = G^P h^q c^r$$

$$\left[M^1L^2T^{-2}\right] = \left[M^{-1}L^3T^{-2}\right]^P\left[ML^2T^{-1}\right]^q\left[LT^{-1}\right]^r$$

12. L=1.2x 10^{-2}m

V=$(1.2x10^{-2}m)^3=1.728x10^{-6}m^3$

V=$1.7x10^{-6}m^3$

13. $$T = 2\pi\sqrt{\frac{l}{g}}$$

$$\frac{\Delta g}{g} = \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$$

$$T = \frac{t}{n},\ \Delta T = \frac{\Delta t}{n}$$

$$\frac{\Delta T}{T} = \frac{\Delta t}{t}$$

$$\frac{\Delta g}{g}x100 = 0.05x100 = 5\%$$

14. $$\frac{\Delta x}{x}x100 = \left[2\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{5}{2}\frac{\Delta c}{c} + 2\frac{\Delta d}{d}\right]$$

15. $$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{\Delta R_P}{R_2} = \frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}$$

16. $$d = \frac{M}{V}$$

$$d = \frac{m}{\frac{4}{3}\pi r^3}$$

$$\frac{\Delta d}{d}x100\% = (\frac{\Delta M}{M} + 3\frac{\Delta R}{R})x100\%$$

17. $$\theta = \frac{2R_E}{60R_E}$$

18. $$\ell \alpha h^p C^q G^r$$

$M^0LT^0 = (ML^2T^{-1})^P (LT^{-1})^q (M^{-1}L^3T^{-2})^r$

19. $F=MLT^{-2}$

$T^2 = \frac{ML}{F}$

20. $P = S^X h^y I^Z$

$(MLT^{-1})=(M^{X+y+z}\ L^{2y+2z}\ T^{-2x-y})$

21. LR Circuit time$=\left[\frac{l}{r}\right]=T$

$Q=CV=(AT)$

$\left[\frac{l}{rcv}\right]=\left[\frac{T}{AT}\right]=A^{-1}$

22. $\frac{x^2}{\alpha KT} = M^0L^0T^0$

23. $\frac{\Delta X}{X}x100 = (\frac{\Delta m}{m}+\frac{\Delta L}{L}+\frac{\Delta T}{T})x100$

24. $T = (\frac{mgA}{K})^{1/2} = \left[\frac{mgA}{mv^2}\right]^{1/2} = \left[\frac{A}{VT}\right]^{1/2} = \left[\frac{A}{L}\right]^{1/2}$

25. $In(E) = 2\log(A)+(-\alpha t)$

$\frac{dE}{E} = 2\left(\frac{dA}{A}\right)+(-\alpha dt)$

$\frac{dE}{E} = 2\left(\frac{dA}{A}\right)+(\frac{dt}{t})xt$

26. $AB = (1.0m)(2.0m) = 2.0m^2$

$\sqrt{AB} = \sqrt{2.0m} = 1.414m$

$\sqrt{AB} = 1.4m$

$\frac{\Delta\sqrt{AB}}{\sqrt{AB}} = \frac{1}{2}(\frac{\Delta A}{A}+\frac{\Delta B}{B}) = \frac{0.3}{2}$

$\Delta\sqrt{AB} = \frac{0.3}{2}x\sqrt{AB}$

27. $\ell = 16.2\pm0.1cm = 16.2cm\pm0.6\%$

$b = 10.1\pm0.1cm = 10.1cm\pm1\%$

$A = lxb$

$163.62\pm2.6cm^2$

$A = 164\pm3cm^2$

28. $n_2 = n_1(\frac{m_1}{m_2})^a(\frac{L_1}{L_2})^b(\frac{T_1}{T_2})^C$

29. $\left[\frac{E\ell^2}{m^5G^2}\right] = \frac{(ML^2T^{-2})(M^2L^4T^{-2})}{(M^5)(M^{-2}L^6T^{-4})} = M^0L^0T^0$

30. $V = \frac{S}{t}$

$\frac{\Delta V}{V} = \frac{\Delta S}{S}+\frac{\Delta t}{t}$

$\Delta V = Vx0.0895 = 3.45x0.0895$

$= 0.3087$

$V = (3.5 + 0.3)m/s$