Physicsaholics

DPP – 5 (Unit & Dimension)

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Q 1. The initial and final temperatures of water as recorded by an observer are (40.6 ± 0.2)°C and (78.3 ± 0.3)°C. Calculate the rise in temperature.
(a) (37.7 ± 0.5)°C (b) (37.7 ± 0.1)°C
(c) 37 °C (d) (37.7 ± 0.6)°C

Q 2. If the length of rod A is 3.25 ± 0.01 cm and that of B is 4.19 ± 0.01 cm then the rod B is longer than rod A by:
(a) 0.94 ± 0.00 cm (b) 0.94 ± 0.01 cm
(c) 0.94 ± 0.02 cm (d) 0.94 ± 0.005 cm

Q 3. Acceleration due to gravity is given by $g = \frac{GM}{R^2}$ what is the equation of the fractional error $\frac{\Delta g}{g}$ in measurement of gravity g [G & M constant]:
(a) $-\frac{\Delta R}{R}$ (b) $2\frac{\Delta R}{R}$ (c) $\left(\frac{\Delta R}{R}\right)^2$ (d) $\frac{1}{2}\frac{\Delta R}{R}$

Q 4. If error in measuring diameter of a circle is 4%, the error in the radius of the circle would be:
(a) 2% (b) 8% (c) 4% (d) 1%

Q 5. A physical quantity is given by $X = M^a L^b T^c$. The percentage error in measurement of M, L and T are α, β and γ respectively. Then maximum percentage error in the quantity X is
(a) $a\alpha + b\beta + c\gamma$ (b) $a\alpha + b\beta - c\gamma$
(c) $\frac{a}{\alpha} + \frac{b}{\beta} + \frac{c}{\gamma}$ (d) None of these

Q 6. The resistance R $= \frac{V}{I}$ where V = 100 ± 5 volts and I = 10 ± 0.2 amperes. What is the total error in R ?
(a) 5% (b) 7% (c) 5.2% (d) $\frac{5}{2}$ %

Q 7. According to Joule's law of heating, heat produced $H = I^2Rt$, where I is current, R is resistance and t is time. If the errors in the measurements of I, R and t are 3%, 4% and 6% respectively then error in the measurement of H is
(a) ± 17% (b) ± 16%
(c) ± 19% (d) ± 25%

Q 8. Error in the measurement of radius of a sphere is 1%. The error in the calculated value of its volume is
(a) 1% (b) 3%
(c) 5% (d) 7%

Q 9. A body travels uniformly a distance (13.8 ± 0.2) m in a time (4.0 ± 0.3) s. Calculate its velocity with error limits. What is the percentage error in velocity ?
(a) 6.6% (b) 2.6%
(c) 8.9% (d) 4.8%

Q 10. A physical quantity A is related to a, b, c and d as follows $A = \frac{a^2 b^3}{c\sqrt{d}}$, the percentage errors of measurement in a, b, c and d are 1%, 3%, 2% and 2% respectively. What is the percentage error in the quantity A
(a) 12% (b) 7%
(c) 5% (d) 14%

Q 11. The length, breadth and thickness of a strip are (10.0 ± 0.1)cm, (1.00 ± 0.01) cm and (0.100 ± 0.001) cm respectively. The error in its volume will be
(a) ± 0.03 cm^3 (b) ± 0.111 cm^3 (c) ± 0.012 cm^3 (d) none of these

Q 12. The period of oscillation of a simple pendulum in the experiment is recorded as 2.63s, 2.56s, 2.42s, 2.71s and 2.80s respectively. The average absolute error is
(a) 0.1s (b) 0.11s (c) 0.01s (d) 1.0s

Q 13. The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimate of kinetic energy obtained by measuring mass and speed ?
(a) 11% (b) 8% (c) 5% (d) 1%

Q 14. A cylindrical wire has a mass 0.3 ± 0.003g, radius 0.5 ± 0.005 mm and length 6 ± 0.06 cm. The maximum percentage error in the measurement of its density is:
(a) 1% (b) 2%
(c) 3% (d) 4%

Q 15. For resistances R_1 and R_2, connected in parallel, Find the relative error in their equivalent resistance, if $R_1 = (50 \pm 2) ohm$ and $R_2 = (100 \pm 3) ohm$?
(a) 0.0366 (b) 0.0633
(c) 0.6363 (d) 0.0363

Q 16. Given the numbers : 161cm, 0.161cm, 0.0161 cm. The number of significant figures for the three numbers are
(a) 3, 4 and 5 respectively (b) 3, 3 and 3 respectively
(c) 3, 3 and 4 respectively (d) 3, 4 and 4 respectively

Q 17. The number of significant figures in 0.00210 is
(a) 2 (b) 3
(c) 4 (d) 5

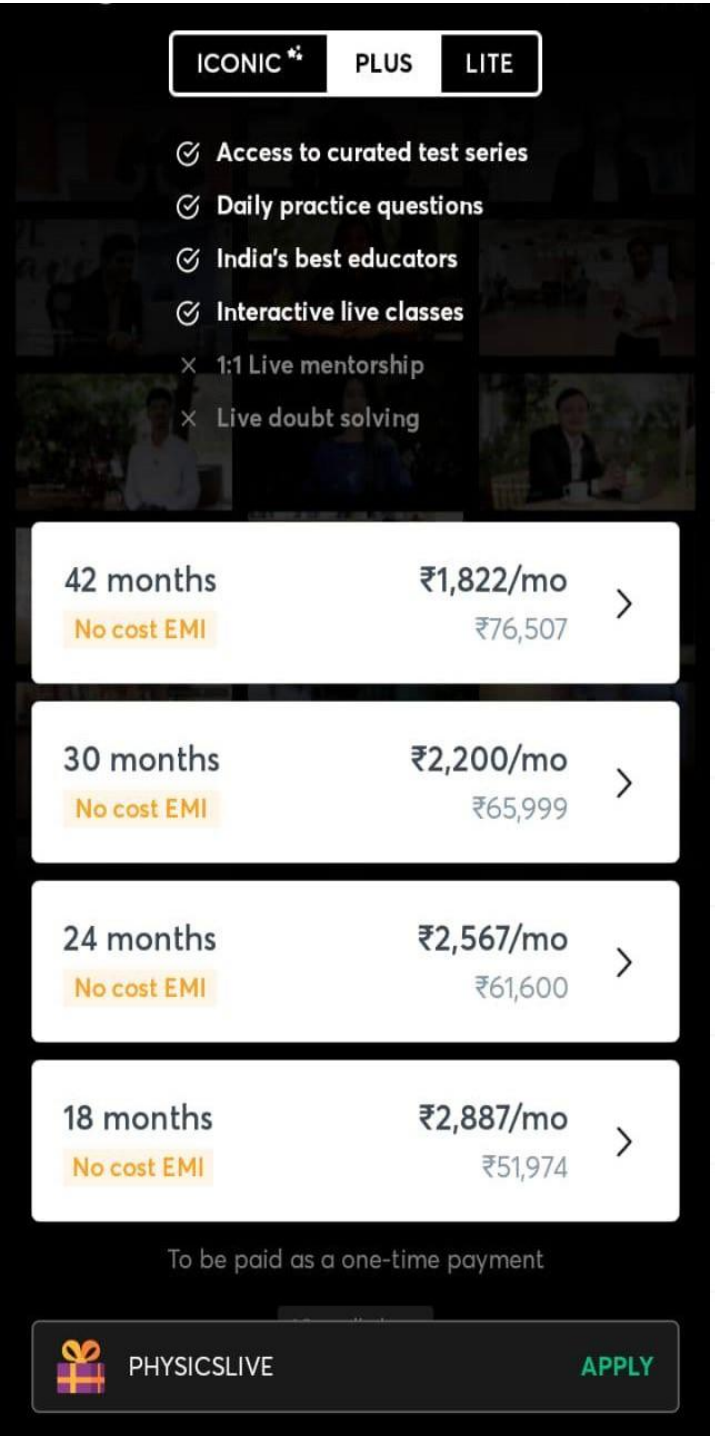
Q 18. If L=2.331cm, B=2.1cm, then L+B=
(a) 4.431 cm (b) 4.43 cm
(c) 4.4 cm (d) 4.2 cm

Q 19. 81.4 g sample of ethyl alcohol contains 0.002 g of water. The amount of pure ethyl alcohol to the proper number of significant figures is
(a) 81.398 g (b) 71.40 g
(c) 81.4 g (d) 81 g

Q 20. In the final answer of the expression $\frac{(29.2-20.2)(1.79\times10^5)}{1.37}$. The number of significant figures is
(a) 1 (b) 2
(c) 3 (d) 4

Answer Key

Q.1 a	**Q.2 c**	**Q.3 b**	**Q.4 c**	**Q.5 a**
Q.6 b	**Q.7 b**	**Q.8 b**	**Q.9 c**	**Q.10 d**
Q.11 a	**Q.12 b**	**Q.13 b**	**Q.14 d**	**Q.15 a**
Q.16 b	**Q.17 b**	**Q.18 c**	**Q.19 c**	**Q.20 b**



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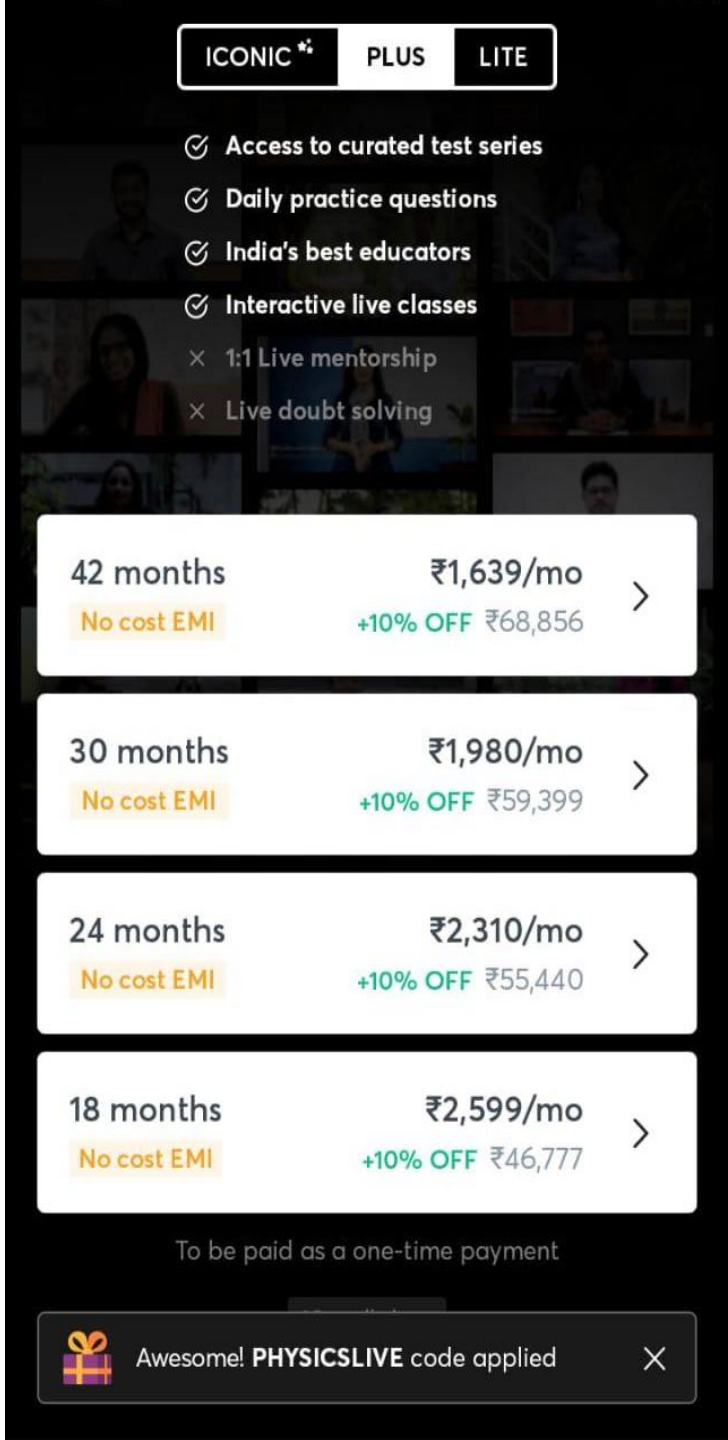

Written Solution

DPP-5 Errors and Significant figures

By Physicsaholics Team

Solution: 1

$T_i = 40.6 \pm 0.2\ ^\circ C$

$T_f = 78.3 \pm 0.3\ ^\circ C$

Rise in temperature:

$\Delta T = T_f - T_i$

$= 78.3 - 40.6 = 37.7\ ^\circ C$

$\Delta T = 0.2 + 0.3 = 0.5\ ^\circ C$

Temperature change $= T \pm \Delta T$

$= 37.7 \pm 0.5\ ^\circ C$

Ans. a

Solution: 2

$l_A = 3.25 \pm 0.01$ cm.

$l_B = 4.19 \pm 0.01$ cm.

$d = l_B - l_A = 4.19 - 3.25$

$= 0.94$

$\Delta d = \Delta l_A + \Delta l_B = 0.01 + 0.01$

$= 0.02$ cm.

$d_f = d \pm \Delta d$

$=$

$d_f = 0.94 \pm 0.02$ cm.

Ans. c

Solution: 3

$$g = \frac{GM}{R^2}$$

if G & M = constant.

then $\frac{\Delta g}{g} = 2\frac{\Delta R}{R}$

Ans. b

Solution: 4

diameter of circle = d

radius of circle = $r = \frac{d}{2}$

given

% error in diameter = $\frac{\Delta d}{d} \times 100 = 4\%$

$\because r = \frac{d}{2} \Rightarrow \frac{\Delta r}{r} = \frac{\Delta d}{d}$

$\therefore$ % error in radius = 4%

Ans. c

Solution: 5

$$X = M^a L^b T^c$$

% error in $M = \alpha = \frac{\Delta M}{M} \times 100$

" " " $L = \beta = \frac{\Delta L}{L} \times 100$

" " " $T = \gamma = \frac{\Delta T}{T} \times 100$

$$\frac{\Delta X}{X} \times 100 = a \frac{\Delta M}{M} \times 100 + b \frac{\Delta L}{L} \times 100 + c \frac{\Delta T}{T} \times 100$$

% error in $X = a\alpha + b\beta + c\gamma$

Ans. a

Solution: 6

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

$V = 100 \pm 5\,V, \quad I = 10 \pm 0.2\,Amp.$

$$\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$$

$$R = \frac{V}{I} = \frac{100}{10} = 10\,\Omega$$

$$\frac{\Delta R}{R} = \frac{5}{100} + \frac{0.2}{100}$$

$$\frac{\Delta R}{R} = 0.07$$

$$\Delta R = 0.07 \times R = 0.07 \times 10$$

$$\Delta R = 0.7\,\Omega$$

$$\Delta R = \pm 0.7\,\Omega,$$

$$\%\,error = \frac{\Delta R}{R} \times 100 = \frac{0.7}{10} \times 100$$

$$= 7\,\%.$$

Ans. b

Solution: 7

$$H = I^2 R t$$

$$\frac{\Delta I}{I} \times 100 = 3\%, \quad \frac{\Delta R}{R} \times 100 = 4\%$$

$$\frac{\Delta t}{t} \times 100 = 6\%$$

$$\frac{\Delta H}{H} \times 100 = \frac{2\Delta I}{I} \times 100 + \frac{\Delta R}{R} \times 100 + \frac{\Delta t}{t} \times 100$$

$$\% \text{ error in } H = 2(3) + (4) + (6)$$

$$= 16\%$$

$$\% \text{ error in } H = 16\%$$

Ans. b

Solution: 8

$$\frac{\Delta r}{r} \times 100 = 1\% = \%\ \text{error in } r$$

$$\text{Volume} = V = \frac{4}{3}\pi r^3$$

$$\frac{\Delta V}{V} \times 100 = 3\frac{\Delta r}{r} \times 100$$

$$\%\ \text{error in } V = 3(\times 1)$$

$$= 3\%$$

Ans. b

Solution: 9

$v = \frac{d}{t}$

$v = \frac{13.8}{4}$

$d = 13.8 \pm 0.2$ m

$t = 4.0 \pm 0.3$ sec

$v = \frac{d}{t}$

$\frac{\Delta v}{v} \times = \left(\frac{\Delta d}{d} \times 100\right) + \left(\frac{\Delta t}{t} \times 100\right)$

$= \left(\frac{0.2}{13.8} \times 100\right) + \left(\frac{0.3}{4} \times 100\right)$

$= \frac{20}{13.8} + \frac{30}{4}$

$= 1.4 + 7.5$

$\boxed{\frac{\Delta v}{v} = 8.9\%}$

Ans. c

Solution: 10

$$A = \frac{a^2 b^3}{c\sqrt{d}}$$

$$\frac{\Delta A}{A} = 2\frac{\Delta a}{a} + 3\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{1}{2}\frac{\Delta d}{d}$$

$$\frac{\Delta A}{A} \times 100 = 2\frac{\Delta a}{a} \times 100 + 3\frac{\Delta b}{b} \times 100 + \frac{\Delta c}{c} \times 100 + \frac{1}{2}\frac{\Delta d}{d} \times 100$$

% error in $A = 2\left(\frac{\Delta a}{a} \times 100\right) + 3\left(\frac{\Delta b}{b} \times 100\right) + \frac{\Delta c}{c} \times 100 + \frac{1}{2}\frac{\Delta d}{d} \times 100$

$= 2(1\%) + 3(3\%) + (2\%) + \frac{1}{2}(2\%)$

% error in $A = 14\%$

Ans. d

Solution: 11

$l = 10 \pm 0.1$ cm, $b = 1 \pm 0.01$ cm,

$w = 0.1 \pm 0.0.01$ cm

Volume, $V = lbw$

$= (10 \times 1 \times 0.1)\ cm^3$

$= 1\ cm^3$

$$\frac{\Delta V}{V} = \frac{\Delta l}{l} + \frac{\Delta b}{b} + \frac{\Delta w}{w} = \frac{0.1}{10} + \frac{0.01}{1} + \frac{0.001}{0.1}$$

$$\Delta V = (0.01 + 0.01 + 0.01) \times V = 0.03 \times 1$$

$$\Delta V = 0.03\ cm^3$$

$$\Delta V = \pm 0.03\ cm^3$$

Ans. a

Solution: 12

$T_1 = 2.63$ Sec, $T_2 = 2.56$ Sec, $T_3 = 2.42$ Sec,
$T_4 = 2.71$ Sec, $T_5 = 2.80$ Sec.

Mean Time period.

$$T_m = \frac{T_1 + T_2 + T_3 + T_4 + T_5}{5}$$

$$= \frac{2.63 + 2.56 + 2.42 + 2.71 + 2.80}{5}$$

$$T_m = 2.62 \text{ Sec.}$$

Absolute errors:

$\Delta T_1 = T_m - T_1 = 2.62 - 2.63 = -0.01$
$\Delta T_2 = T_m - T_2 = 2.62 - 2.56 = 0.06$
$\Delta T_3 = T_m - T_3 = 2.62 - 2.42 = 0.20$
$\Delta T_4 = T_m - T_4 = 2.62 - 2.71 = -0.09$
$\Delta T_5 = T_m - T_5 = 2.62 - 2.80 = -0.18$

Mean Absolute error $= \overline{\Delta T}$
or
~~Average~~

$$\overline{\Delta T} = \frac{|\Delta T_1| + |\Delta T_2| + |\Delta T_3| + |\Delta T_4| + |\Delta T_5|}{5}$$

$$= \frac{0.01 + 0.06 + 0.20 + 0.09 + 0.18}{5}$$

$$= \frac{0.54}{5}$$

$$\overline{\Delta T} = 0.108 \text{ sec}$$

$\simeq 0.11$ sec

Ans. b

Solution: 13

% error in $m = \frac{\Delta m}{m} \times 100 = 2\%$

" " " $v = \frac{\Delta v}{v} \times 100 = 3\%$

$$K.E. = \frac{1}{2} m v^2$$

$\frac{\Delta KE}{KE} \times 100$ = % error in K.E

$$\frac{\Delta KE}{KE} \times 100 = \left(\frac{\Delta m}{m} \times 100\right) + 2\left(\frac{\Delta v}{v} \times 100\right)$$

$$= 2\% + 2(3\%)$$

$$= 8\%$$

Ans. b

Solution: 14

$m = 0.3 \pm 0.003$ gm.

$r = 0.5 \pm 0.005$ mm.

$l = 6 \pm 0.06$ cm.

$$\rho = \frac{m}{V} = \frac{\rho}{\pi r^2 l}$$

% error in density $\Rightarrow$ % of ρ

% of ρ = % mass + % of m

so, or.

so; $\%.\rho = \%.m + 2\%.r + \%.l$

$$\%.\rho = \left(\frac{0.003}{0.3} \times 100\right) + 2 \times \left(\frac{0.005}{0.5}\right) \times 100 + \frac{0.06}{6} \times 100$$

$$\%.\rho = 1 + 2(1) + (1)$$

$$\%.\rho = 4\%$$

Ans. d

Solution: 15

equivalent Resistance in parallel connection :-

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{50 \times 100}{50 + 100} = \frac{5000}{150}$$

$$\boxed{R = \frac{100}{3}\ \Omega}$$

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

$$\frac{\Delta R}{R^2} = \left(\frac{2}{150}\right)^2 + \left(\frac{3}{100}\right)^2$$

$$\frac{\Delta R}{R \times R} = \frac{2}{150 \times 150} + \frac{3}{100 \times 100}$$

$$\frac{\Delta R}{R} = \left(\frac{2}{2500} + \frac{3}{(100)^2}\right) R = \left(\frac{2}{2500} + \frac{3}{(100)^2}\right) \times \frac{100}{3} =$$

$$\frac{\Delta R}{R} = \frac{2}{75} + \frac{1}{100} = 0.0266 + 0.01$$

$$\boxed{\frac{\Delta R}{R} = 0.0366} \quad \text{Ans}$$

Ans. a

Solution: 16

number	no. of significant figures.	
161 cm	3	(all three digits are significant)
0.161 cm	3	(leading zeros are not significant. so; digit 161 are significant)
0.0161 cm	3	(leading zeros are not significant. so; digit 161 are significant)

Ans. b

Solution: 17

in 0.00210 ; 3 Digits are significant.
(2 1 0)

Because leading zeros are not significant but trailing zeros are significant.

Ans. b

Solution: 18

$$L + B = 2.331 + 2.1$$

B has only one digit after decimal (minimum)
so; final Answer will also have only one digit after decimal.

$$L + B = 2.3 + 2.1 = 4.4$$

$$\boxed{L + B = 4.4 \text{ cm}}$$

Ans. c

Solution: 19

Pure Ethyl = sample − water

= 81.4 − 0.002

as; 81.4 has only one digit after decimal and 0.002 has three digits after decimal. Answer will have one digit after decimal:

so; Pure Ethyl = 81.4 gm − 0.0 gm

so; **Pure Ethyle = 81.4 gm** Ans

Ans. c

Solution: 20

$$K = \frac{(29.2 - 20.2)(1.79 \times 10^{5})}{1.37}$$

So, $29.2 - 20.2 = 09.0 = 9.0$

(s.f. = 2) (s.f. = 3)

$$K = \frac{(9.0) \times (1.79 \times 10^{5})}{1.37}$$

(1.37: s.f. = 3)

So, In final answer, no. of s.f. will be minimum.

So, s.f. in final Answer = 2 Ans

Ans. b

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