S1. Ans. (a)
V.C = MSD – VSD

Given: (N+1) VSD = N MSD

$VSD = \left(\frac{N}{N+1}\right)$ MSD

From (1) and (2)

$\text{V.C} = (\text{MSD}) - \frac{\text{N}}{\text{N+1}}(\text{MSD})$

$= \text{MSD}\left(1 - \frac{\text{N}}{\text{N+1}}\right) = \frac{\text{MSD}}{\text{N+1}}$

$= \frac{0.01}{N+1} = \frac{1}{100(N+1)}$.

S2. Ans. (d)
Solid angle $d\Omega = \frac{dA}{r^2}$ has dimensions $[M^0L^0T^0]$

Strain $= \frac{\Delta l}{l}$ has dimensions $[M^0L^0T^0]$

Angle measured in radians is also dimensionless $[M^0L^0T^0]$

$\theta = \frac{l}{r}$.

S3. Ans. (a)
From principle of homogeneity

$[F] = [\alpha t^2] = [\beta t]$

$[\alpha] = \frac{[F]}{[t^2]}$ and $[\beta] = \frac{[F]}{[t]}$

$\therefore [\alpha][t] = [\beta]$

$\frac{\alpha t}{\beta}$ = dimensionless.

S4. Ans. (a)
As the factors controlling temperature and voltage supply are beyond prediction and control so the error occurred due to unpredictable fluctuations of temperature and voltage would be random errors.

S5. Ans. (d)
$m = \rho\pi r^2 l$

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

$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + \frac{2\Delta r}{r} + \frac{\Delta l}{l}$

$\frac{\Delta\rho}{\rho} \times 100 = \frac{0.002}{0.4} \times 100 + \frac{2 \times 0.001}{0.3} \times 100 + \frac{0.02}{5} \times 100$

$= \frac{0.2}{0.4} + \frac{0.2}{0.3} + \frac{2}{5}$

$= 0.5 + 0.67 + 0.4$

$= 1.57$

$= 1.6\%$

S6. Ans. (d)
Given, that, length $(l) = 55.3\ m$
Breadth $(b) = 25\ m$
The area of rectangular field is, $A = l \times b = 55.3 \times 25$
$= 1382.5\ m^2 = 1.3825 \times 10^3 m^2 = 1.4 \times 10^3 = 14 \times 10^2$.

S7. Ans. (c)
Dimensions of magnetic flux
$= [ML^2T^{-2}A^{-1}]$
Dimensions of self-inductance
$= [ML^2T^{-2}A^{-2}]$
Dimensions of magnetic permeability
$= [MLT^{-2}A^{-2}]$
Dimensions of electrical permittivity
$= [M^{-1}L^{-3}T^4A^2]$
So, the correct option is (c)

S8. Ans. (a)
Plane angle and solid angle have supplementary units. Radian (rad) is the unit of plane angle and steradian (sr) is the unit of solid angle Plane angle and solid angle are dimensionless quantities.

S9. Ans. (d)
Hint: E = Energy = $[\text{ML}^2\text{T}^{-2}]$
G = Gravitational constant
$= [\text{M}^{-1}\text{L}^3\text{T}^{-2}]$
So, $\frac{\text{E}}{\text{G}} = \frac{[\text{E}]}{[\text{G}]} = \frac{\text{ML}^2\text{T}^{-2}}{\text{M}^{-1}\text{L}^3\text{T}^{-2}} = [\text{M}^2\text{L}^{-1}\text{T}^0]$

S10. Ans. (c)
Hint: L.C. $= \frac{\text{Pitch}}{\text{CSD}}$
$= \frac{1\text{mm}}{100} = 0.01$ m $= 0.001$ cm
Radius = M.S. + n(L.C.)
= 0 + 52 (0.001)
= 0.052 cm

S11. Ans. (a)

Hint: $E \propto F^a A^b T^c$

$[M^1L^2T^{-2}] \propto [M^1L^{-2}]^a [LT^{-2}]^b [T^c]$

$a = 1$

$a + b = 2 \Rightarrow b = 1$

$-2a - 2b + c = -2$

$\Rightarrow c = 2$

$a = 1\ b = 1\ c = 2$

$E \propto [F]\ [A]\ [T^{+2}]$

S12. Ans. (b)

Hint: Least count

$= \frac{\text{Pitch}}{\text{Number of divisions on circular scale}}$

$\Rightarrow 0.01 \text{ mm} = \frac{\text{Pitch}}{50}$

$\Rightarrow$ pitch $= 0.5$ mm

S13. Ans. (a)

Hint:

In subtraction the number of decimal places in the result should be equal to the number of decimal places of that term in the operation which contain lesser number of decimal places.

S14. Ans. (c)

Hint:

$\text{Stress} = \frac{\text{Force}}{\text{Area}}$

$= \frac{M^1L^1T^{-2}}{L^2}$

$\text{Stress} = M^1L^{-1}T^{-2}$

S15. Ans. (c)

Hint: Mean of given observations

$= \frac{1.25 + 1.24 + 1.27 + 1.21 + 1.28}{5} = 1.25$ sec

Mean of errors

$= \frac{0+0.01+0.02+0.04+0.03}{5}$

$= \frac{0.1}{5}$

% error $= \frac{0.1 \times 100}{5 \times 1.25} = 1.6\%$

S16. Ans. (d)

Hint: 1 minute of arc$= 1' = \left(\frac{1}{60}\right)^0 = \frac{1}{60} \times \frac{\pi}{180}$ radian

$= 2.91 \times 10^{-4}$ radian.

S17. Ans. (b)

Hint: $X = \frac{A^2 B^{\frac{1}{2}}}{C^{\frac{1}{3}} D^3}$

% error, $\frac{\Delta X}{X} \times 100$

$= 2\frac{\Delta A}{A} \times 100 + \frac{1}{2}\frac{\Delta B}{B} \times 100 + \frac{1}{3}\frac{\Delta C}{C} \times 100 + 3\frac{\Delta D}{D} \times 100$

$= 2\% + 1\% + 1\% + 12\%$

$= 16\%$

S18. Ans. (d)

Hint: Reading = MSR + (n × LC) + zero error

$= 0.5 + (25 \times 0.001) + 0.004$

$= 0.529$ cm

S19. Ans. (d)

Hint: $[c]^a [G]^b \left[\frac{e^2}{4\pi\varepsilon_0}\right]^c$

$= [LT^{-1}]^a [M^{-1}L^3T^{-2}]^b [ML^3T^{-2}]^c$

$= L^{a+3b+3c}\ T^{-a-2b-2c}\ M^{-b+c}$

$a + 3b + 3c = 1;\ -a - 2b - 2c$

$= 0;\ -b + c = 0$

$b = \frac{1}{2} \qquad c = \frac{1}{2}$

$a = -2$

$L = c^{-2} G^{\frac{1}{2}\left[\frac{e^2}{4\pi\varepsilon_0}\right]^{\frac{1}{2}}}$

$L = \frac{1}{c^2}\left[G\left[\frac{e^2}{4\pi\varepsilon_0}\right]^{\frac{1}{2}}\right]$

S20. Ans. (c)

Hint: Least count = 1MSD – 1VSD

$= 5 \times 10^{-2} - \frac{49}{50} \times 5 \times 10^{-2}$

Thickness $= 7 + 23 \times 10^{-3} = 7.023$ cm

S21. Ans. (c)

Hint: $\ell \propto h^x G^y c^z$

$M^0L^1T^0 = (ML^2T^{-1})^x (M^{-1}L^3T^{-2})^y (LT^{-1})^z$

$M^{x-y} L^{2x+3y+z} T^{-x-2y-z}$

Equating:

$\left.\begin{aligned} x - y &= 0 \\ 2x + 3y + z &= 1 \\ -x - 2y - z &= 0 \end{aligned}\right\}$

$\Rightarrow x = \frac{1}{2}; y = \frac{1}{2}; z = -\frac{3}{2}$

$\Rightarrow \ell \propto \sqrt{\frac{hG}{c^3}}$

S22. Ans. (b)

Hint: $S.T = [E]^a\ [V]^b\ [T]^c$

$\propto [ML^{-2}T^{-2}]^a [LT^{-1}]^b [T]^c$

$MT^{-2} \propto M^a L^{2a+b}\ T^{-2a+b+c}$

On comparing both sides.

$2a + b = 0, -2a - b + c = -2$

$a = 1, b = -2, c = -2$

we get

$ST = EV^{-2}\ T^{-2}$

S23. Ans. (b)

Hint: $v_c \propto [\eta^x \rho^y r^z]$

$[L^1T^{-1}] \propto [M^1L^{-1}T^{-1}]^x[M^1L^{-3}]^y[L^1]^z$

$[L^1T^{-1}] \propto [M^{x+y}][L^{-x-3y+z}][T^{-x}]$

Taking comparison on both size

$x + y = 0$, $-x - 3y + z = 1$, $-x = -1$

$x = 1$, $y = -1$, $z = -1$

S24. Ans. (d)

Hint: $[\text{Mass}] = \left[\frac{\text{Force}}{\text{Accleration}}\right] = \left[\frac{\text{Force}}{\text{Velocity/time}}\right]$

$= [FV^{-1}T]$

S25. Ans. (b)

Hint: $P = \frac{a^3b^2}{cd} \Rightarrow \frac{\Delta P}{P}$

$= \pm\left(3\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{\Delta d}{d}\right)$

$= \pm(3 \times 1 + 2 \times 2 + 3 + 4) \Rightarrow \pm 14\%$