

# Urban Technical Officer (Mechanical)

Complete Question Paper + Answer Key (Q1–Q100)

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PART 1 — ENGINEERING MECHANICS & STRENGTH OF MATERIALS (Q1–25)

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Q1. Unit of force in SI?

Answer: B (Newton)

Q2. Moment of a couple is:

Answer: A (Same about all points)

Q3. Centroid of a semicircle:

Answer: A ( $4r/3\pi$ )

Q4. Beam 6 m, 30 kN central load → Max bending moment?

Answer: B (45 kNm)

Q5. Weight 250 N on 35° incline → parallel component?

Answer: B (143 N)

Q6. Concurrent forces equilibrium condition?

Answer: C ( $\Sigma F_x=0$  &  $\Sigma F_y=0$ )

Q7. Resultant of two equal forces at 60°?

Answer: C ( $F\sqrt{3}$ )

Q8. Principle of transmissibility?

Answer: C (Force may be shifted along line of action)

Q9. Centripetal acceleration?

Answer: A ( $\omega^2 r$ )

Q10. Resultant of P & Q?

Answer: C ( $\sqrt{P^2 + Q^2 + 2PQ\cos\theta}$ )

Q11.  $\mu = \tan \phi$  →  $\phi$  is:

Answer: A (Angle of friction)

Q12. Reaction of ladder depends on:

Answer: C (Angle)

Q13. Zero force member when:

Answer: A (Two non-collinear members at unloaded joint)

Q14. Poisson's ratio:

Answer: A (Lateral/Longitudinal strain)

Q15. Beam 4 m, UDL 6 kN/m → Max M?

Answer: A (12 kNm)

Q16. Bending stress varies:

Answer: C (Linearly)

Q17. Shaft  $T=300$  Nm,  $d=40$  mm →  $\tau$  approx?

Answer: A ( $\approx 9.5$  MPa)

Q18. Failure theory for ductile materials:

Answer: A (Maximum shear theory — Tresca)

Q19. Bar 20 mm,  $P=40$  kN → Stress?

Answer: A ( $\approx 127$  MPa)

Q20. Thin cylinder  $p=1.2$ MPa,  $d=0.8$ m,  $t=8$ mm  $\rightarrow$  Hoop stress?

Answer: C (75 MPa)

Q21. Relation  $E = 2G(1+\mu)$  true?

Answer: A (True)

Q22. Strain energy for gradually applied load:  $\frac{1}{2}P\delta$

Answer: A (True)

Q23. Cantilever  $L=2$ m,  $W=500$ N  $\rightarrow$  Deflection

Answer: A (0.53 mm)

Q24. Euler load for pinned column  $L=2.5$ m:

Answer: A ( $1.32 \times 10^5$  N)

Q25. Mild steel has:

Answer: B (Yield point)

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PART 2 — THEORY OF MACHINES & FLUID MECHANICS (Q26–50)

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Q26. Torque–power relation:

Answer: B ( $T = 9550P/N$ )

Q27. Function of flywheel:

Answer: D (All of these)

Q28. In SHM, acceleration is:

Answer: A (Proportional to displacement)

Q29. Follower velocity depends on:

Answer: A (Lift & cam speed)

Q30. Belt tension ratio:

Answer: A ( $e^{(\mu\theta)}$ )

Q31. Centrifugal tension:

Answer: B ( $mv^2$ )

Q32. Porter governor equilibrium depends on:

Answer: C (Ball + central load)

Q33. Slider-crank converts:

Answer: C (Both ways)

Q34. Simple gear train ratio:

Answer: A (Inverse of tooth ratio)

Q35. Line of action in involute gears:

Answer: A (Tangent to base circles)

Q36. Balancing reduces:

Answer: C (Vibration)

Q37. Gyroscopic couple:

Answer: A ( $I \omega \Omega$ )

Q38. Density of water:

Answer: A ( $1000 \text{ kg/m}^3$ )

Q39. Pressure due to liquid column:

Answer: B ( $\rho gh$ )

Q40. Centre of pressure lies:

Answer: A (Below centroid)

Q41. Continuity equation  $A_1V_1=A_2V_2$  valid for:

Answer: A (Incompressible flow)

Q42. Bernoulli equation shows:

Answer: B (Energy conservation)

Q43. Venturimeter measures:

Answer: B (Flow rate)

Q44. Laminar pipe flow profile:

Answer: C (Parabolic)

Q45. Reynolds number indicates:

Answer: B (Flow regime)

Q46. Rectangular notch equation:

Answer: A

Q47. Specific gravity:

Answer: A (Density ratio)

Q48. Turbulent head loss:

Answer: B ( $\propto V^2$ )

Q49. Buoyant force:

Answer: A (Weight of displaced fluid)

Q50. Cavitation occurs when  $p <$  vapour pressure:

Answer: A

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### PART 3 — THERMODYNAMICS & HEAT TRANSFER (Q51–75)

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Q51. Zeroth law:

Answer: C

Q52. First law:

Answer: B (Energy conservation)

Q53. Ideal gas law  $PV=nRT$ :

Answer: A

Q54. Isothermal expansion work:

Answer: A (Positive)

Q55. Adiabatic law:

Answer: A ( $PV^\gamma = \text{constant}$ )

Q56.  $\gamma$  for air:

Answer: C (1.4)

Q57. Polytropic work:

Answer: A (Correct)

Q58. Carnot efficiency depends on:

Answer: B (Temperatures only)

Q59. Otto cycle used in:

Answer: B (Petrol engines)

Q60. Mean effective pressure:

Answer: A

Q61.  $\Delta U = mC_v\Delta T$ :

Answer: A

Q62. Entropy increases in:

Answer: B (Irreversible)

Q63. COP of refrigerator:

Answer: A

Q64. Modes of heat transfer:

Answer: D (All)

Q65. Fourier's law:

Answer: A

Q66. Thermal conductivity of insulator:

Answer: A (Zero)

Q67. Composite wall:

Answer: A (Series resistance)

Q68. Newton's cooling:

Answer: A ( $\propto \Delta T$ )

Q69. Laminar Nusselt number relation:

Answer: A

Q70. Overall heat transfer coefficient:

Answer: A

Q71. Stefan–Boltzmann law:

Answer: A

Q72. View factor for large plates:

Answer: A (1)

Q73. Heat exchanger effectiveness:

Answer: A

Q74. Condensation direction:

Answer: B (Vapour → liquid)

Q75. Thermal diffusivity:

Answer: A

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PART 4 — RAC, MACHINE DESIGN & MANUFACTURING (Q76–100)

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Q76. 1 TR = ?

Answer: C (210 kJ/min & 3.517 kW)

Q77. Expansion in VCR occurs in:

Answer: C (Throttle valve)

Q78. Domestic refrigerator refrigerant:

Answer: A (R-12)

Q79. COP of reversed Carnot:

Answer: A

Q80. Dew point is:

Answer: A (Saturation temperature)

Q81. Relative humidity:

Answer: A ( $p_v/p_{vs}$ )

Q82. Sensible heat:

Answer: A (Temperature change)

Q83. COP heat pump:

Answer: A ( $COPR + 1$ )

Q84. Comfort AC maintains:

Answer: A (Temperature + humidity)

Q85. Lowest pressure in VCR:

Answer: B (Compressor suction)

Q86. Factor of safety:

Answer: A (Ultimate/working)

Q87. Bending stress formula:

Answer: A ( $M_y/I$ )

Q88. Cotter joint for:

Answer: A (Axial rods)

Q89. Helix angle:

Answer: B (Helix & plane perpendicular)

Q90. Ductile theory:

Answer: A (Maximum shear)

Q91. Efficiency of screw jack:

Answer: A

Q92. Bearing pressure:

Answer: A ( $W/LD$ )

Q93. Keys transmitting torque:

Answer: D (All)

Q94. Thin cylinder stresses:

Answer: A (Hoop & longitudinal)

Q95. Spring index:

Answer: A ( $D/d$ )

Q96. Casting involves:

Answer: D (All)

Q97. Chip thickness ratio:

Answer: B ( $<1$ )

Q98. Tool life equation  $VT^n=C$ :

Answer: A

Q99. Soldering temperature  $<450^\circ\text{C}$ :

Answer: C

Q100. Arc welding heat source:

Answer: B (Electric arc)

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