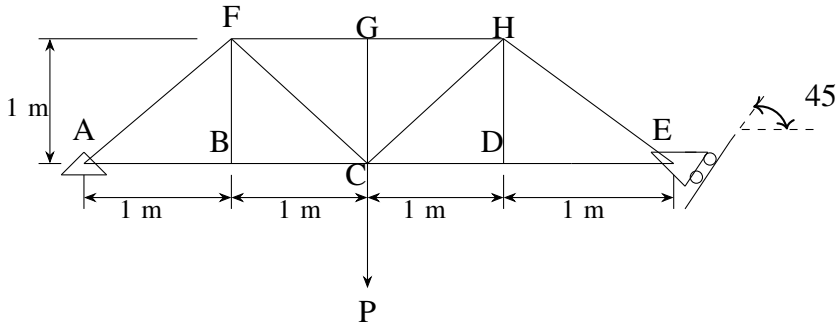
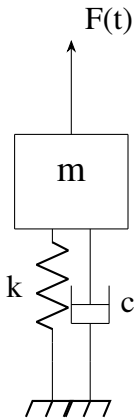


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- 14) The members carrying zero force (*i.e.* zero-force members) in the truss shown in the figure, for any load $P > 0$ with no appreciable deformation of the truss (*i.e.* with no appreciable change in angles between the members), are



- BF and DH only
 - BF, DH and GC only
 - BF, DH, GC, CD and DE only
 - BF, DH, GC, FG and GH only
- 15) Which of the following function $f(z)$, of the complex variable z , is NOT analytic at all points on the complex plane?
- $f(z) = z^2$
 - $f(z) = e^z$
 - $f(z) = \sin z$
 - $f(z) = \log z$
- 16) A single-degree-of-freedom oscillator is subjected to harmonic excitation $F(t) = F_0 \cos(\omega t)$ as shown in the figure.



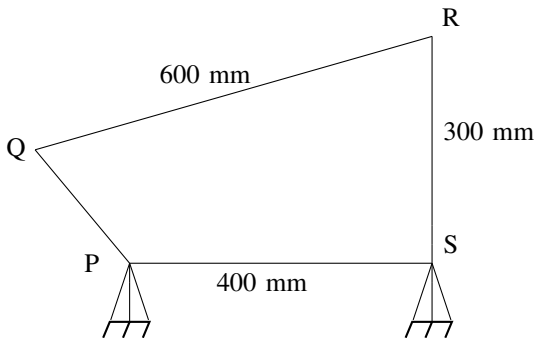
The non-zero value of ω , for which the amplitude of the force transmitted to the ground will be F_0 , is

- a) $\sqrt{\frac{k}{2m}}$
- b) $\sqrt{\frac{k}{m}}$
- c) $\sqrt{\frac{2k}{m}}$
- d) $2\sqrt{\frac{k}{m}}$

17) The stress state at a point in a material under plane stress condition is equi-biaxial tension with a magnitude of 10 MPa . If one unit on the $\sigma - \tau$ plane is 1 MPa , the Mohr's circle representation of the state-of-stress is given by

- a) a circle with a radius equal to principal stress and its center at the origin of the $\sigma - \tau$ plane
- b) a point on the σ axis at a distance of 10 units from the origin
- c) a circle with a radius of 10 units on the $\sigma - \tau$ plane
- d) a point on the τ axis at a distance of 10 units from the origin

18) A four bar mechanism is shown below.



For the mechanism to be a crank-rocker mechanism, the length of the link PQ can be

- a) 80 mm

- b) 200 mm
c) 300 mm
d) 350 mm
- 19) A helical gear with 20 pressure angle and 30 helix angle mounted at the mid-span of a shaft that is supported between two bearings at the ends. The nature of the stresses induced in the shaft is
- a) normal stress due to bending only
b) normal stress due to bending in one plane and axial loading; shear stress due to torsion
c) normal stress due to bending in two planes and axial loading; shear stress due to torsion
d) normal stress due to bending in one plane; shear stress due to torsion
- 20) The crystal structure of γ ion (austenite phase) is
- a) BCC
b) FCC
c) HCP
d) BCT
- 21) Match the following.

Heat treatment process	Effect
<i>P: Tempering</i>	1. <i>Strengthening</i>
<i>Q: Quenching</i>	2. <i>Toughening</i>
<i>R: Annealing</i>	3. <i>Hardening</i>
<i>S: Normalizing</i>	4. <i>Softening</i>

- a) $P - 2, Q - 3, R - 4, S - 1$
b) $P - 1, Q - 1, R - 3, S - 2$
c) $P - 3, Q - 3, R - 1, S - 3$
d) $P - 4, Q - 3, R - 2, S - 1$
- 22) The base of a brass bracket needs rough grinding. For this purpose, the most suitable grinding wheel grade specification is
- a) C30Q12V
b) A50G8V
c) C90J4B
d) A30D12V
- 23) In the critical Path Method (CPM), the cost-time slope of an activity is given by
- a) $\frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Crash Time} - \text{Normal Time}}$
b) $\frac{\text{Crash Time} - \text{Normal Time}}{\text{Crash Cost} - \text{Normal Cost}}$
c) $\frac{\text{Crash Time} - \text{Normal Time}}{\text{Crash Cost} - \text{Normal Cost}}$
d) $\frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Time} - \text{Crash Time}}$
- 24) Froude number is the ratio of
- a) buoyancy forces to viscous forces
b) inertia forces to viscous forces

- c) buoyancy forces to inertia forces
- d) inertia forces to gravity forces

25) Match the following non-dimensional numbers with the corresponding definitions :

Non-dimensional number	Definition
P : Reynolds number	1. $\frac{\text{Inertia force}}{\text{Viscous force}}$
Q : Grashof number	2. $\frac{\text{Buoyancy force}}{\text{Viscous force}}$
R : Nusselt number	3. $\frac{\text{Convective heat transfer}}{\text{Conduction heat transfer}}$
S : Prandtl number	4. $\frac{\text{Momentum diffusivity}}{\text{Thermal diffusivity}}$

- a) $P - 1, Q - 3, R - 2, S - 4$
- b) $P - 3, Q - 1, R - 2, S - 4$
- c) $P - 4, Q - 3, R - 1, S - 2$
- d) $P - 3, Q - 1, R - 4, S - 2$

26) The velocity field of an incompressible flow in a Cartesian system is represented by

$$\vec{V} = 2(x^2 - y^2)\hat{i} + v\hat{j} + 3\hat{k}$$

Which one of the following expressions for v is valid?

- a) $-4xz + 6xy$
- b) $-4xy - 4xz$
- c) $4xz - 6xy$
- d) $4xy + 4xz$