2009-ME-27-39

AI24BTECH11002 - K. Akshay Teja

27) One of the eigenvectors of the matrix $A = \begin{bmatrix} 2 & 2 \\ 1 & 3 \end{bmatrix}$ is:

a) $\begin{Bmatrix} 2 \\ -1 \end{Bmatrix}$ b) $\begin{Bmatrix} 2 \\ 1 \end{Bmatrix}$ c) $\begin{Bmatrix} 4 \\ 1 \end{Bmatrix}$ d) $\begin{Bmatrix} 1 \\ -1 \end{Bmatrix}$

28) The velocity vector of a flow field is given as $\mathbf{V} = 2xy\,\hat{i} - x^2\,\hat{j}$. The vorticity vector at $(1, 1, 1)$ is:

a) $4\,\hat{i} - \hat{j}$ b) $4\,\hat{i} - \hat{k}$ c) $\hat{i} - 4\,\hat{j}$ d) $\hat{i} - 4\,\hat{k}$

29) The Laplace transform of a function $f(t)$ is $\frac{1}{s^2(s+1)}$. The function $f(t)$ is:

a) $t - 1 + e^{-t}$ b) $t + 1 + e^{-t}$ c) $-1 + e^{-t}$ d) $2t + e^{t}$

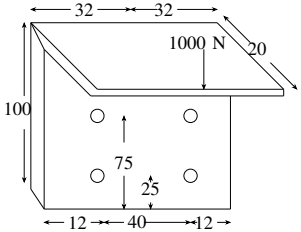
30) A box contains 2 washers, 3 nuts, and 4 bolts. Items are drawn from the box at random one at a time without replacement. The probability of drawing 2 washers first, followed by 3 nuts, and subsequently the 4 bolts is:

a) $\frac{2}{315}$ b) $\frac{1}{630}$ c) $\frac{1}{1260}$ d) $\frac{1}{2520}$

31) A band brake having a band width of 80 mm, drum diameter of 250 mm, coefficient of friction of 0.25, and angle of wrap of 270 degrees is required to exert a friction torque of 1000 Nm. The maximum tension (in kN) developed in the band is:

a) 1.88 b) 3.56 c) 6.12 d) 11.56

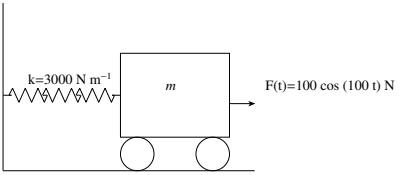
32) A bracket (shown in the figure) is rigidly mounted on a wall using four rivets. Each rivet is 6 mm in diameter and has an effective length of 12 mm.



Direct stresss (in MPa) in the most heavily loaded rivet is

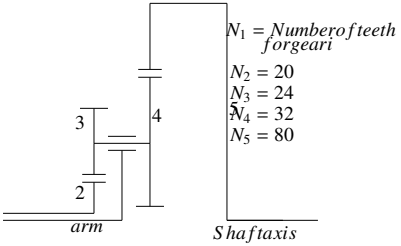
a) 4.4 b) 8.8 c) 17.6 d) 35.2

33) A mass m attached to a spring is subjected to a harmonic force as shown in the figure. The amplitude of the forced motion is observed to be 50 mm. The value of m (in kg) is:



a) 0.1 b) 1.0 c) 0.3 d) 0.5

34) For the epicyclic gear arrangement shown in the figure, ω_2 = 100 rad/s clockwise (CW) and $\omega_{\Delta rms}$ = 80 rad/s counterclockwise (CCW). The angular velocity ω_{arm} (in rad/s) is

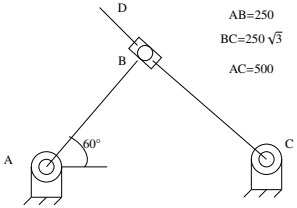


a) 0 b) 70 CW c) 140 CCW d) 140 CW

35) A lightly loaded full journal bearing has a journal diameter of 50 mm, bush bore of 50.05 mm, and bush length of 20 mm. If the rotational speed of the journal is 1200 rpm and the average viscosity of the liquid lubricant is 0.03 Pa s, the power loss (in W) will be:

a) 37 b) 74 c) 118 d) 237

36) For the configuration shown, the angular velocity of link AB is 10 rad/s counterclockwise. The magnitude of the relative sliding velocity (in m s^{-1}) of slider B with respect to rigid link CD is



a) 0 b) 0.86 c) 1.25 d) 250

37) A smooth pipe of diameter 200 mm carries water. The pressure in the pipe at section S_1 (elevation: 10 m) is 50 kPa. At section S_2 (elevation: 12 m), the pressure is 20 kPa and the velocity is 2 m/s. The density of water is 1000 kg/m^3 and the acceleration due to gravity is 9.8 m/s^2. Which of the following is TRUE:

a) flow is from S_1 to S_2 and head loss is 0.53 m
b) flow is from S_2 to S_1 and head loss is 0.53 m
c) flow is from S_1 to S_2 and head loss is 1.06 m
d) flow is from S_2 to S_1 and head loss is 1.06 m

38) Match the following: Which of the following matches is correct?

P: Compressible flow	U: Reynolds number
Q: Free surface flow	V: Nusselt number
R: Boundary layer flow	W: Weber number
S: Pipe flow	X: Froude number
T: Heat convection	Y: Mach number
	Z: Skin friction coefficient

a) P-U; Q-X; R-V; S-Z; T-W
b) P-W; Q-X; R-Z; S-U; T-V
c) P-Y; Q-W; R-Z; S-U; T-X
d) P-Y; Q-W; R-Z; S-U; T-V

39) A monoatomic ideal gas (γ = 1.67, molecular weight = 40) is compressed adiabatically from 0.1 MPa, 300 K to 0.2 MPa. The universal gas constant is 8.314 kJkmol^{-1} K^{-1}. The work of compression of the gas (in kJkg^{-1}) is:

a) 29.7 b) 19.9 c) 13.3 d) 0