# 2015-ME-14-26

AI24BTECH11002 - K. Akshay Teja

1) The value of $\lim_{x\to 0} \frac{1-\cos(x^2)}{2x^4}$ is

a) 0 b) $\frac{1}{2}$ c) $\frac{1}{4}$ d) undefined

2) Given two complex numbers $z_1 = 5 + \left(5\sqrt{3}\right)i$ and $z_2 = \frac{2}{\sqrt{3}} + 2i$, the argument of $\frac{z_1}{z_2}$ in degrees is 60°.

a) 0 b) 30 c) 60 d) 90

3) Consider fully developed flow in a circular pipe with negligible entrance length effects. Assuming the mass flow rate, density and friction factor to be constant, if the length of the pipe is doubled and the diameter is halved, the head loss due to friction will increase by a factor of

a) 4 b) 16 c) 32 d) 64

4) The Blasius equation related to boundary layer theory is a
   a) third-order linear partial differential equation
   b) third-order nonlinear partial differential equation
   c) second-order nonlinear ordinary differential equation
   d) third-order nonlinear ordinary differential equation

5) For flow of viscous fluid over a flat plate, if the fluid temperature is the same as the plate temperature, the thermal boundary layer is
   a) thinner than the velocity boundary layer
   b) thicker than the velocity boundary layer
   c) of the same thickness as the velocity boundary layer
   d) not formed at all

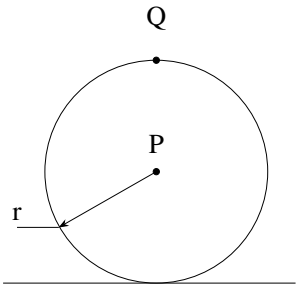
6) For an ideal gas with constant values of specific heats, for calculation of the specific enthalpy:
   a) it is sufficient to know only the temperature
   b) both temperature and pressure are required to be known
   c) both temperature and volume are required to be known
   d) both temperature and mass are required to be known

7) A Carnot engine (CE-1) works between two temperature reservoirs A and B, where $T_A$ = 900 K and $T_B$ = 500 K. A second Carnot engine (CE-2) works between temperature reservoirs B and C, where $T_C$ = 300 K. In each cycle of CE-1 and CE-2, all the heat rejected by CE-1 to reservoir B is used by CE-2. For one cycle of operation, if the net heat $Q$ absorbed by CE-1 from reservoir A is 150 MJ, the net heat rejected to reservoir C by CE-2 (in MJ) is

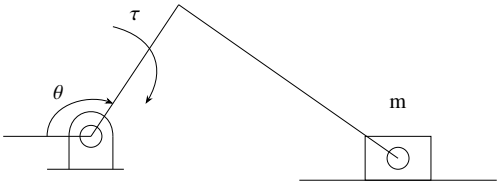
8) Air enters a diesel engine with a density of 1.0 kg/m$^3$. The compression ratio is 21. At steady state, the air intake is $30\times10^3$ kg/s and the net work output is 15 kW. The mean effective pressure (in kPa) is

9) A stream of moist air (mass flow rate = 10.1 kg/s) with humidity ratio of 0.01 $\frac{kg}{kg\,s\,dry\,air}$ mixes with a second stream of superheated water vapour flowing at 0.1 kg/s. Assuming proper and uniform mixing with no condensation, the humidity ratio of the final stream (in $\frac{kg}{kg\,s\,dry\,air}$) is

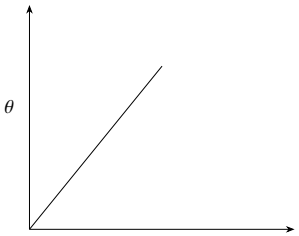
10) A wheel of radius $r$ rolls without slipping on a horizontal surface as shown below. If the velocity of point $P$ is 10 m/s in the horizontal direction, the magnitude of velocity of point $Q$ (in m/s) is



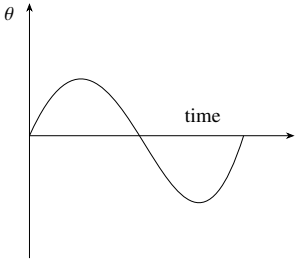

11) Consider a slider crank mechanism with nonzero masses and inertia. A constant torque $T$ is applied on the crank as shown in the figure. Which of the following plots best resembles variation of crank angle $\theta$ versus time?



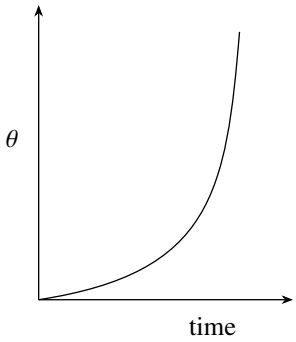

a)



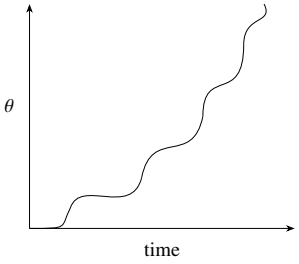

b)



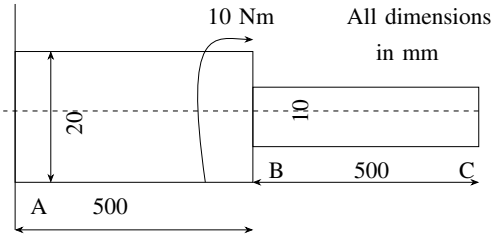

c)




d)




12) Consider a stepped shaft subjected to a twisting moment applied at $B$ as shown in the figure. Assume shear modulus, $G$ = 77 GPa. The angle of twist at $C$ (in degrees) is




13) Two identical trusses support a load of 100 N as shown in the figure. The length of each truss is 1.0 m; cross-sectional area is 200 mm$^2$; Young's modulus $E$ = 200 GPa. The force in the truss $AB$ (in N) is