CE
2012

EE24BTECH11063 - Y.Harsha Vardhan Reddy

Q.10 to Q.22 carry 2 marks each

1) A uniform flow with a velocity of 2 m/s in the x-direction approaches a line source placed on the x-axis at a distance of 0.1 m from the origin. If the origin is the stagnation point in the resulting flow, the strength of the source (in m^2/s, rounded off to 2 decimal places) is _____.

2) In a steady incompressible flow of a fluid past a smooth stationary sphere, the drag force F depends on the flow velocity U, diameter D, and the dynamic viscosity μ and density ρ of the fluid. Experiments are conducted on the same sphere at the same flow velocity using two different fluids. The density of the second fluid is two times that of the first fluid. The dynamic viscosity of the second fluid is n times that of the first fluid. If the non-dimensional force $F/(\rho U^2 D^2)$ remains the same in both the experiments, the value of n is _____.

3) An incompressible fluid flows past a flat plate as shown in the figure below3.1 with a uniform inlet velocity profile $u = U$ and a parabolic exit velocity profile $u = U(2\eta - \eta^2)$, where u is the component of velocity parallel to the wall, y is the normal distance from the plate, and $\eta = y/\delta$. If the volume flow rate across the top surface of the control volume (CV) is $Q = pU\delta$ per unit width (perpendicular to the x-y plane) of the plate, the value of p (rounded off to 2 decimal places) is _____.

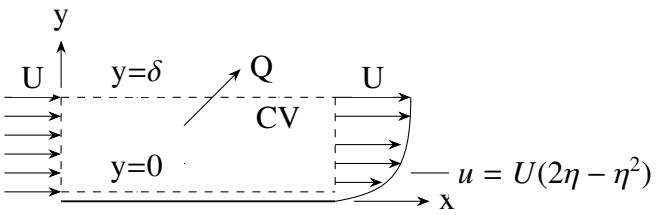

Fig. 3.1

4) A jet engine is to be tested on a thrust stand as shown in the figure below4.1. The conditions prevailing in typical test are as follows: Axial intake air velocity=100 m/s; axial exhaust gas velocity=250m/s; intake cross-sectional area =1 m^2; intake static

pressure=-22 kPa(gauge); exhaust static pressure = 0 kPa(gauge); mass flow rate throgh the engine = 100kg/s. The anchoring force (in kN) in axial direction on the thrust stand is _____

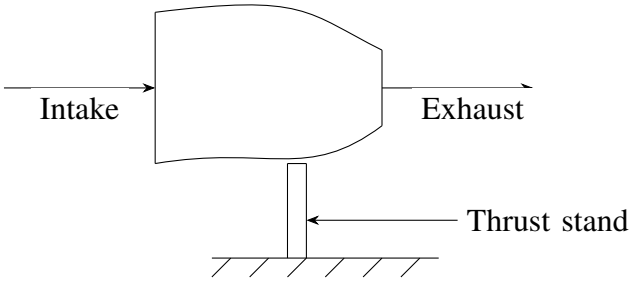

Fig. 4.1

Q.1 TO Q.9 CARRY 1 MARK EACH

1) On decreasing the objective aperture size in an optical microscope
   a) the spherical aberration increases
   b) the depth of field increases
   c) the diffraction-limited resolution increases
   d) the astigmatism increases

2) Pilling-Bedworth ratios for oxides of some metals are given in the table.

Metal	Pilling-Bedworth Ratio
Li	0.57
Ce	1.16
Ta	2.33
W	3.40

Based on the criterion of Pilling-Bedworth ratio alone, which one of the following metals will be most protected from high temperature oxidation?

a) Li b) Ce c) Ta d) W

3) In NaCl, the substitution of a Na^+ ion by a Ca^{2+} ion would most probably lead to
   a) the formation of a Na^+ vacancy
   b) the creation of a Cl^- interstitial
   c) the formation of a Cl^- vacancy
   d) the formation of a Na^+ and Cl^- vacancy pair

4) Which one of the following is time-independent?

a) Elastic deformation
b) Anelastic deformation
c) Viscoelastic deformation
d) Creep deformation

5) Copper is diffused into aluminium at 400 °C for 100 hours to obtain a certain concentration at a given depth. In another experiment conducted at 500 °C, to achieve the same concentration of copper at the same depth, the time required in hours is
(Given: Diffusion coefficients of copper in aluminium at 400 °C and 500 °C are 5 $\times 10^{-14}$ m^2 s^{-1} and 6 $\times 10^{-13}$ m^2 s^{-1}, respectively)

a) 7.33 b) 8.33 c) 9.33 d) 10.33

6) If carbon (C) in iron (Fe) is 6 percent by weight, then its atomic percent is approximately
(Given: atomic weight C = 12, Fe = 56)

a) 13 b) 23 c) 30 d) 50

7) GaAs has advantage over silicon when used in integrated circuits at low power because it has
a) larger band gap
b) more than one element
c) higher electron mobility
d) higher hole mobility

8) Glass transition temperature of a polymer can be determined by
a) Thermo-gravimetric analysis
b) Raman spectroscopy
c) NMR spectroscopy
d) Differential scanning calorimetry

9) The maximum wavelength of radiation to which Germanium (Ge) is opaque will be
(Given: energy gap of Ge = 0.67 eV, Planck's constant $h = 6.63 \times 10^{-34}$ J·s, velocity of light $c = 3 \times 10^8$ m s^{-1}, and 1 eV = 1.6×10^{-19} J)

a) 0.8 μm b) 1.8 μm c) 2.8 μm d) 4.8 μm