APL 104: Quiz 3 (Set A)

Full Marks: 24 Duration: 1 hrs Date: 16^{th} Nov 2016

Problem 1: A solid cylinder is rotated about its own axis in outer space (where no gravity acts) and left alone. What stress components generate in the cylinder?
(a) σ_{zz} (b) $\sigma_{rr}, \sigma_{\theta\theta}$ (c) both (a) and (b) (d) all stress components vanish (2)

Problem 2: A solid cylinder is shrunk fit with a hollow cylinder. In which direction would the composite disk have to be rotated about its own axis so that the contact radial stress at the interface of two disks vanish?
(a) clockwise (b) anti-clockwise (c) both (a) and (b) (d) none of these (2)

Problem 3: For problem 2, at what angular speed will the interface radial stress become tensile? (assume no adhesion between disks)
(a) at a speed higher than in problem 2 (b) can't say (c) never (d) will always be tensile (2)

Problem 4: A straight beam is subjected to a transverse load 'P' at its middle which generates slope θ_p at its tip. In the second case, only a bending moment 'M' is applied at its tip. How much would be the deflection of the beam at the middle then?
(a) $\frac{M\theta_p}{P}$ (b) 0 (c) $\frac{M}{P}$ (d) more information needed (2)

Problem 5: An isotropic hollow cylinder of length 'L' is dropped in the ocean and rests on its bed. Assume the pressure at the ocean bed to be p_0 which acts all along the cylinder's lateral and end cross-sectional surfaces. What would be axial strain generated in the cylinder?
(a) zero (b) $-\frac{p_0}{E}$ (c) $-p_0\frac{1-2\nu}{E}$ (d) none of these (2)

Problem 6: Suppose a solid cylinder of radius 'R' is subjected to pure torsion and it yields at a critical torque T_y. If we want to use maximum principal stress theory for failure, what would be the critical principal stress?
(a) $\frac{2T_y}{\pi R^3}$ (b) $\frac{2T_y}{\pi R^2}$ (c) $\frac{8T_y}{\pi R^3}$ (d) none (2)

Problem 7: A cantilever is subjected to bending moment and a force at its tip (see Fig. 7). The equation for its deflection based on Euler Bernouli theory would be:
(a) $EI\frac{d^2y}{dx^2}+Py = M$ (b) $EI\frac{d^2y}{dx^2}+Py = M+Py(L)$ (c) $EI\frac{d^2y}{dx^2} = M+Py(L)$ (d) none of these (3)

Problem 8: What would be the solution for deflection of beam obtained by solving the correct equation in Problem 7?
(a) $\frac{M}{Pcos(wL)}(1-cos(wx))$ (b) cannot be determined (c) $\frac{Mx^2}{2EI}$ (d) none of these. (3)

Problem 9: A beam is uniformly charged with charge per unit length being q_0. An electric field acts in the negative x direction as shown in figure 9. How would the bending moment vary along the length of the beam? (neglect the interaction of charge on the beam with themselves and only consider their interaction with the external electric field)
(a) M(x) = 0 (b) $M(x) = q_0E\left(\int_x^L y(z)dz - y(x)L\right)$ (c) $M(x) = q_0E\int_x^L y(z)dz$ (d) none of these (3)

Correct answer: $M(x) = q_0 E\left(\int_x^L y(z)dz - y(x)(L-x)\right)$

If you have marked option (b), you will get 2 marks.

Problem 10: A hanging clip is clamped at one end and subjected to forces and moments as shown in figure 10. The displacement of the clip tip in the direction of applied force is measured both in the presence and absence of moment. How much will be the rotation at the point of application of moment if only the force acts at the tip?
(a) $\frac{\delta_1-\delta_2}{M}P$ (b) $\frac{\delta_1}{M}P$ (c) $\frac{\delta_2}{M}P$ (d) none (3)

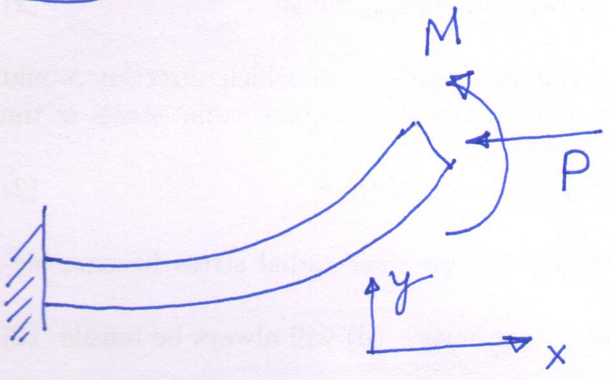


Fig 7

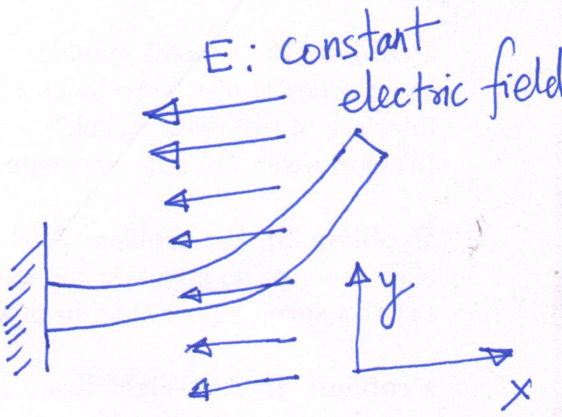
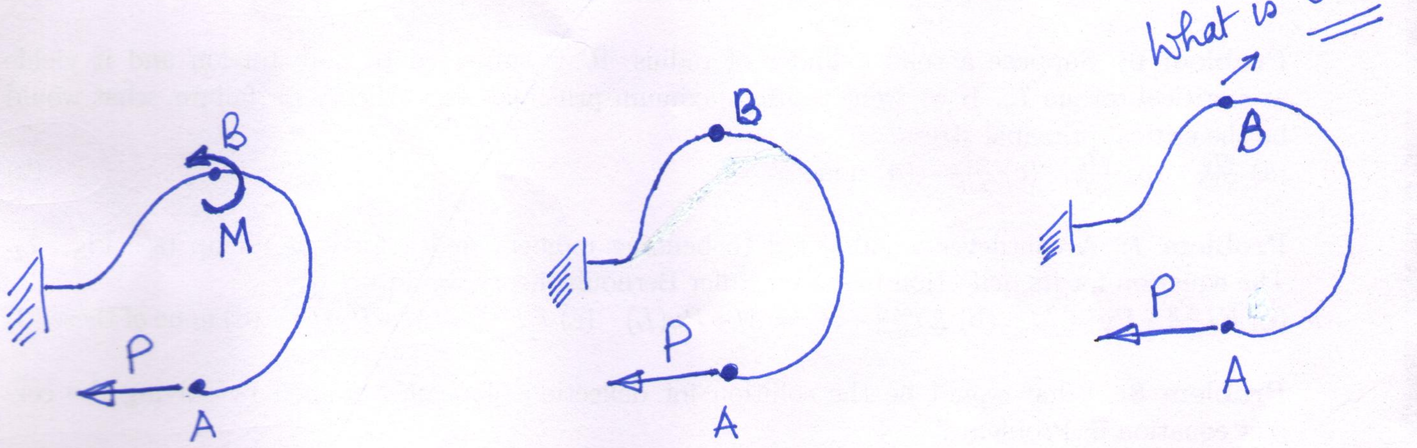


Fig 9



Case 1 Case 2 Case 3

Fig. 10

deflecti of A: δ_1

deflection of A: δ_2

rotation at B = ??
Find out !!