

AI24BTECH11002 - K. Akshay Teja

A thin-walled (thickness  $\ll$  radius), hollow shaft of length 1 m and mean radius,  $R = 5\text{ cm}$  has to be designed such that it can transmit a torque,  $T=7\text{ kN-m}$ . A survey of different commercially available materials was made and following data was obtained from the suppliers (  $E$  : Young's modulus,  $\tau_y$  : yield stress in shear,  $\rho$ ; density):

| Material | $E(\text{GPa})$ | $\tau_p(\text{MPa})$ | $\rho(\text{kg/m}^3)$ |
|----------|-----------------|----------------------|-----------------------|
| X        | 200             | 550                  | 7700                  |
| Y        | 70              | 225                  | 2700                  |
| Z        | 110             | 375                  | 4875                  |

1) If you assume a factor of safety of 2, what should be the approximate thickness of such a shaft?

- a) 0.5 mm                      b) 1 mm                      c) 2 mm                      d) 4 mm

Prandtl's lifting line equation for a general wing is given by

$\alpha(y_0) = \frac{\Gamma(y_0)}{\pi U_\infty c(y_0)} + \alpha_{L=0}(y_0) + \frac{1}{4\pi U_\infty} \int_{-\frac{b}{2}}^{\frac{b}{2}} \frac{(\partial\Gamma/\partial y)}{y_0 - y} dy$ , where  $U_\infty$  is the free-stream velocity,  $\alpha$  is the angle of attack,  $y_0$  is the spanwise location,  $\alpha_{L=0}(y_0)$  gives the spanwise variation of zero-lift angle,  $c$  is the chord,  $b$  is the span, and  $\Gamma(y_0)$  gives the spanwise variation of circulation.

2) The rate of change of circulation with angle of attack  $\Gamma_\alpha = \frac{\partial\Gamma}{\partial\alpha}$  is:

- a) inversely proportional to  $\alpha$                       c) a linear function of  $\alpha$   
b) independent of  $\alpha$                       d) a quadratic function of  $\alpha$

3) Given that  $C_L \propto \int_{-\frac{b}{2}}^{\frac{b}{2}} \Gamma(y) dy$ , the corresponding lift curve-slope  $\frac{\partial C_L}{\partial\alpha}$  is

- a) independent of  $\alpha$                       c) a quadratic function of  $\alpha$   
b) a linear function of  $\alpha$                       d) a cubic function of  $\alpha$

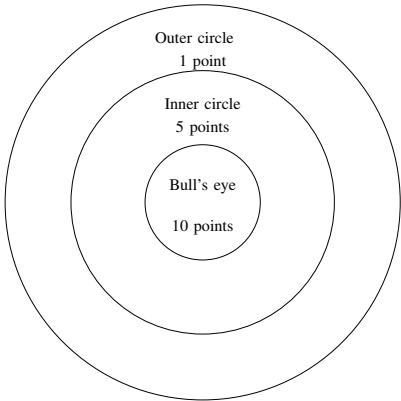
4) Choose the word from the options given below that is most nearly opposite in meaning to the given word: Deference

- a) aversion                      b) resignation                      c) suspicion                      d) contempt

5) Choose the most appropriate word(s) from the options given below to complete the following sentence:

We lost confidence in him because he never \_\_\_\_\_ the grandiose promises he had made.

- a) delivered                      b) delivered on                      c) forgot                      d) reneged on
- 6) Choose the word or phrase that best completes the sentence below:  
\_\_\_\_\_ in the frozen wastes of Arctic takes special equipment.
- a) To survive                      b) Surviving                      c) Survival                      d) That survival
- 7) In how many ways can 3 scholarships be awarded to 4 applicants, when each applicant can receive any number of scholarships?
- a) 4                      b) 12                      c) 64                      d) 81
- 8) Choose the most appropriate word from the options given below to complete the following sentence:  
The \_\_\_\_\_ of evidence was on the side of the plaintiff since all but one witness testified that his story was correct.
- a) paucity                      b) propensity                      c) preponderance                      d) accuracy
- 9) If  $\frac{2y+1}{y+2} < 1$ , then which of the following alternatives gives the CORRECT range of  $y$ ?
- a)  $-2 < y < 2$                       b)  $-2 < y < 1$                       c)  $-3 < y < 1$                       d)  $-4 < y < 1$
- 10) A student attempted to solve a quadratic equation in  $x$  twice. However, in the first attempt, he incorrectly wrote the constant term and ended up with the roots as (4,3). In the second attempt, he incorrectly wrote down the coefficient of  $x$  and got the roots as (3,2). Based on the above information, the roots of the correct quadratic equation are:
- a)  $(-3, 4)$                       b)  $(3, -4)$                       c)  $(6, 1)$                       d)  $(4, 2)$
- 11)  $L$ ,  $M$ , and  $N$  are waiting in a queue meant for children to enter the zoo. There are 5 children between  $L$  and  $M$ , and 8 children between  $M$  and  $N$ . If there are 3 children ahead of  $N$  and 21 children behind  $L$ , then what is the minimum number of children in the queue?
- a) 28                      b) 27                      c) 41                      d) 40
- 12) Four archers  $P$ ,  $Q$ ,  $R$ , and  $S$  try to hit a bull's eye during a tournament consisting of seven rounds. The final scores received by the players during the tournament are listed in the table below.



The final scores received by the players during the tournament are listed in the table below

| Round | <i>P</i> | <i>Q</i> | <i>R</i> | <i>S</i> |
|-------|----------|----------|----------|----------|
| 1     | 1        | 5        | 1        | 10       |
| 2     | 5        | 10       | 10       | 1        |
| 3     | 1        | 1        | 1        | 5        |
| 4     | 10       | 10       | 1        | 1        |
| 5     | 1        | 5        | 5        | 10       |
| 6     | 10       | 5        | 1        | 1        |
| 7     | 5        | 10       | 1        | 1        |

The most accurate and the most consistent players during the tournament are respectively:

- a) P and S                      b) Q and R                      c) Q and Q                      d) R and Q

- 13) It can be inferred from the passage that:
- a) A cumulus cloud on the ground is called fog.
  - b) It is easy to predict the weather by studying clouds.
  - c) Clouds are generally of very different shapes, sizes, and mass.
  - d) There are four basic cloud types: stratus, nimbus, cumulus, and cirrus.