Indian Institute of Technology Kanpur

INDUSTRIAL AND MANAGEMENT ENGINEERING DEPARTMENT

PhD Sample Questions for the Written Test

Quantitative Aptitude

1. The area of the triangle whose vertices are (a,a), (a+1, a+1), (a+2, a) is:
   (a) a^2 (b) 1 (c) 2a (d) $\sqrt{2}$

2. A milkman mixes 20 litres of water with 80 litres of milk. After selling one-fourth of this mixture, he adds water to replenish the quantity that he has sold. What is the current proportion of water to milk?
   (a) 2:3 (b) 1:2 (c) 1:3 (d) 3:4

3. If the sum of the first 11 terms of an arithmetic progression equals that of the first 19 terms, then what is the sum of the first 30 terms?
   (a) 0 (b) -1 (c) 1 (d) Not unique

4. If a man cycles at 10 km/hr, then he arrives at a certain place at 1 p.m. If he cycles at 15 km/hr, he will arrive at the same place at 11 a.m. At what speed must he cycle to get there at noon?
   (a) 11 km/hr (b) 12 km/hr (c) 13 km/hr (d) 14 km/hr

5. If $f: \mathbb{R} \to \mathbb{R}$ be given by $f(x) = (3 - x^3)^{\frac{1}{3}}$, then $fof(x)$ is
   (a) $x^{\frac{1}{3}}$ (b) x^3 (c) x (d) $(3 - x^3)$

6. The total revenue in Rupees received from the sale of x units of a product is given by $R(x) = 3x^2 + 36x + 5$. Find the marginal revenue when $x = 15$, where by marginal revenue we mean the rate of change of total revenue with respect to the number of items sold at an instant.
   (a) 116 (b) 96 (c) 90 (d) 126

7. The interval in which $y = x^2e^{-x}$ is increasing is
   (a) $(-\infty, \infty)$ (b) $(-2,0)$ (c) $(2, \infty)$ (d) $(0,2)$

8. The area bounded by the curve $y = x|x|$, x-axis and the ordinates $x = -1$ and $x = 1$ is given by
   (a) 0 (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) $\frac{4}{3}$

9. Probability that A speaks truth is $\frac{4}{5}$. A coin is tossed. A reports that a head appears. The probability that actually there was head is
   (a) $\frac{4}{5}$ (b) $\frac{1}{2}$ (c) $\frac{1}{5}$ (d) $\frac{2}{5}$

Verbal Ability

To answer question no. 10-13, please read the following paragraph carefully.

Venus likely had oceans in its early years, most experts agree, for a few hundred million to a couple of billion years, back when the sun was 30 percent less hot. In other words, even the water enthusiasts should agree that Venus was once a good candidate for life. "If you want to think about the best place, 4 billion years ago, to start life in this solar system, it would probably be Venus," University of Washington palaeontologist Peter Ward told more than 800 colleagues at a panel at the American Museum of Natural History. As the sun grew more intense, carbon dioxide and water vapour trapped the heat, conditions spun out of control, the seas boiled off. Venus can be understood as a greenhouse-effect morality tale.

Don't look for evidence of ancient Venusian life on the ground, though, because 700 million years ago a cataclysm occurred: Fissures opened all across the planet's crust, and lava covered everything: a "global resurfacing event," in the language of another researcher Schulze Makuch. Paleobiologists looking for fossils on Venus after that catastrophe would be like a forensics team hunting for skid marks on road that's been long paved over. To this day, lava flows regularly scorch the planet's surface.

In the 19th century, astronomers saw Venus as a bright orb, and imagined it to be a warm swamp world, much like a younger Earth. But by the early 20th century, improved instruments and new knowledge of the long Venusian night caused scientists to doubt life could thrive there, despite superficial similarities to Earth in mass, gravity and size.

Probes were launched, beginning with Mariner 2 in 1962, and sent back information that didn't, all the time, give hope to anyone looking for signs of life. Mariner's flyby glimpse was enough to reveal Venus' stifling carbon dioxide atmosphere. Regular volleys of flybys, orbiters, probes and landers followed, notably 1978's Pioneer mission and 16 different Soviet Venera missions, many of which were predictably destroyed by either the planet's crushing pressure or infernal temperatures, or some combination of the two. Each mission made the planet appear more foreboding than the last: The Pioneer mission confirmed a dense layer of corrosive sulphuric acid clouds 50 kilometers up, while Magellan in 1994 uncovered lava flows frying the planet's surface. Yet buried within the glum reports are anomalies in the data that, some now claim, may be the first hidden glimpses of life on and above the planet.

10. Which of the following is true?

(a) Planet Venus is an exact replica of Planet Earth.

(b) There is only a vague physical resemblance between Venus and Earth.

(c) No two physical features of Venus and Earth are same.

(d) Venus is another Earth in all aspects.

11. Regarding the planet Venus.

(A) its atmosphere is saturated with carbon dioxide.

(B) it might have supported life in the past.

(C) the atmospheric pressure and temperature seem to be too high for anything to survive.

(D) there is evidence of lava flows regularly.

(a) Only A and B are true.

(b) A, B and D only are true.

(c) B, C and D only are true.

(d) all the above four statements hold good.

12. Tag the correct partners:

(1) Mariner 2	(A) the surface of Venus	
(2) Magellan	(B) the clouds above Venus	
(3) Pioneer	(C) the atmosphere of Venus.	

(a)	(b)	(c)	(d)
1 – B	1 – C	1 – C	1 – A
2 – A	2 – B	2 – A	2 – B
3 – C	3 – A	3 – B	3 – C

13. Paleobiologists may have to look for evidence of life on Venus,

(a) on its surface.

(b) buried underneath its surface.

(c) through probes, arbiters etc.

(d) only after establishing the fact that water once existed on its surface.

Logical Reasoning and Data Interpretation

The table shows trends in external transactions of Indian corporate sector during the period 1993-94 to 1997-98. In addition, the following definitions hold good:

Year	1997-98	1996-97	1995-96	1994-95	1993-94
Export Intensity*	9.2	8.2	7.9	7.5	7.3
Import Intensity*	14.2	16.2	15.5	13.8	12.4
Imported raw material/Total cost of raw material	20.2	19.2	17.6	16.3	16
Imported capital goods/Gross fixed assets	17.6	9.8	11.8	16.3	19.5
*Ratio of Exports (or Imports) to Sales					

$Sales_i$, $Imports_i$, and $Exports_i$, respectively denote the sales, imports and exports in year i.

Deficit in year i, $Deficit_i = Imports_i - Exports_i$

Deficit Intensity in year i, $DI_i = Deficit_i / Sales_i$

Growth rate of Deficit Intensity in year i, $GDI_i = (DI_i - DI_{i-1})/DI_{i-1}$

Further, note that all imports are classified as either raw material or capital goods.

Trends in External Transactions of Indian Corporate Sector (All figures in %)

14. The highest growth rate in deficit intensity was recorded in
    (a) 1994-95 (b) 1995-96 (c) 1996-97 (d) 1997-1998
15. The value of the highest growth rate in deficit intensity is approximately
    (a) 8.45% (b) 2.15% (c) 33.3% (d) 23.5%
16. Which of the following statements can be inferred to be true from the given data?
    (a) During the five-year period between 1993-94 and 1997-98, exports have increased every year.
    (b) During the five-year period between 1993--94 and 1997-98, imports have decreased every year.
    (c) Deficit in 1997-98 was lower than that of 1993-94.
    (d) Deficit intensity has increased every year between 1993-94 and 1996-97.

Elle is three times older than Yogesh, Zaheer is half the age of Wahida. Yogesh is older than Zaheer.

17. Which of the following information will be sufficient to estimate Elle's age?
    (a) Zaheer is 10 years old.
    (b) Both Yogesh and Wahida are older than Zaheer by the same number of years
    (c) Both (a) and (b) above

(d) None of the above.

18. Which of the following can be inferred?

(a) Yogesh is older than Wahida

(b) Elle is older than Wahida

(c) Elle may be younger than Wahida

(d) None of the above