Section-I: General Aptitude

1. $2^{(x-1)} - 2^{(x-4)} = 7(2^{11})$, what is x?
   (A) 9 (B)11 (C)13 (D)15

2. Length of a rectangle increases by 20%, while its breadth reduces by 10%. Find the percentage change in its perimeter.
   (A) 10% increase (B) 8% increase (C) 5% increase (D) Can't say

3. In a group, average weight of the females was 60kgs. The average weight of the entire group was twice as close to the average weight of the men as it was to the average weight of the women. What percentage of the group were women?
   (A) 40 (B) 33.33 (C) 50 (D) 66.67

4. Govind decided to walk down the escalator of a shopping mall. He found that if he walks down 25 steps, he requires 15 seconds to reach the bottom. However, if he steps down 13 steps, he requires 24 seconds to reach the bottom. Find out the height of the stairway in steps.
   (A) 30 (B) 40 (C) 45 (D) 50

5. Taps A and B, operating simultaneously, can fill a certain tank in 72 min; Taps A and C, operating simultaneously, can fill the tank in 90 min; and Taps B and C, operating simultaneously, can fill the tank in 2 hours. How many hours does it take Taps A, B, and C, operating simultaneously, to fill the tank ?
   (A) 1/3 (B) 1 (C) 2/3 (D) 5/6

6. A customer at Paradise hotel calculates his tip by adding a constant amount to another sum that is directly proportional to the total bill for the meal. If the total bill for his meal had been 100/- greater, the customer would've calculated a tip of 60/-. If the total bill for his meal had been 150/- less, the customer would've calculated a tip of 40/-. If his total bill for the meal was 600/- what will be the amount of his tip?
   (A) 48 (B) 56 (C) 52 (D) 50

7. There are five hotels in a line. If 4 men go into a hotel at 11 am, then what will be the probability that each go into a different hotel?
   (A) $\frac{124}{125}$ (B) $\frac{24}{125}$ (C) $\frac{42}{125}$ (D) $\frac{48}{625}$

8. In a class of 40 students, 12 enrolled for both English & German. 22 enrolled for German. If students of class enrolled at least one of the subjects, then how many students enrolled for only English & not German?
   (A) 30 (B) 12 (C) 18 (D) 40

9. Mr. Vikas buys some apples at 8 per rupee from one trader and a similar quantity at 5 per rupee from another trader. He mixes both the varieties and sell the whole at 9 per rupee. What is the profit or loss percentage that he makes?
(A) 31.62 % Profit (B) 31.62 % Loss (C) 46.25 % Profit (D) 46.25 % Loss

10.

Type of program ↓ \ AGE Group →	15-20	21-30	31+
Daily Serials	6	4	17
Comedy	7	5	5
Singing/dancing	6	12	14
Devotional	1	4	11
News	2	3	15
Sports	9	3	4
Quiz	2	2	2
Total	33	33	68

What percentage of respondents aged 21-30 indicated a favourite program other than singing/dancing?
(A) 36 % (B) 46 % (C) 64 % (D) 60 %

11. **Analogy**
AESTHETICS : BEAUTY ::
(A) ethics: etiquette (B) epistemology : knowledge
(C) theology: morals (D) rhetoric : reasoning

12. Choose the appropriate antonym for the word **ABOMINATE**
(A) loathe (B) despise (C) adore (D) abhor

13. Choose the sentence that is grammatically correct:
(A) The serving bowl or the plates go on that shelf
(B) The serving bowls or the plate go on that shelf
(C) The serving bowl or the plate go on that shelf
(D) The serving bowls or the plates goes on that shelf

14. The management of the company had cordially invited its staff for the 25th Anniversary function.
Choose the best conclusion:
(A) The company is going to wind-up the next year
(B) It is mandatory for all the staff to attend the function
(C) The management of the company is spend-thrift
(D) The company is well-established

15. Find out the error part in the given sentence
Ram is junior / than shyam / and Ram is / older than shyam
(A) (B) (C) (D)

16. Find the proper meaning of the words given in bold letters.
After working for years in the same company, Ramu decided to **Jack it all.**
(A) Continue (B) Change (C) Stop (D) Cheat.

17. Urban services have not expanded fast enough to cope up with urban expansion. Low investment allocations have tended to be underspent. Both public and private infrastructure quality has declined. The impact of the environment in which children live and the supporting services available to them when they fall ill, seem clear. The decline in average food availability and the rise in absolute poverty, point in the same unsatisfactory directions.
Choose the weakest statement related to the above passage
(A) Though adequate provisions of funds were made but they were received under spent
(B) Low cost urban housing is on the priority
(C) There is nothing to boast about urban services
(D) Birth rate is higher in urban areas than in rural areas

18. **Sentence completion**
Data concerning the effects on a small population of high concentrations of a potentially hazardous chemical are frequently used to ------- the effects on a large population of lower amounts of the same chemical.
(A) verify (B) redress (C) predict (D) realize

19. **Select the best alternative for the underlined part:**
Currently 93,250,000 billion barrels a year, world consumption of oil is rising at a rate of 3 percent annually.
(A) world consumption of oil is rising at a rate of
(B) the world is consuming oil at an increasing rate of
(C) the world's oil is being consumed at the increasing rate of
(D) the rise in the rate of the world's oil consumption is

20. False currency is being supplied to India through buses that run between India and Pakistan. Find out the course of action to be taken.
(A) The govt. should ban the buses
(B) The govt. should change the currency
(C) The govt. should strengthen the vigilance
(D) Indian govt. should warn the Pakistan govt.

Section-II: Technical

1. If 5 moles of N_2 reacts with 10 moles of O_2 to give 4 moles of NO_2 and 2 moles of NO, then the percentage of O_2 present in the exit stream will be

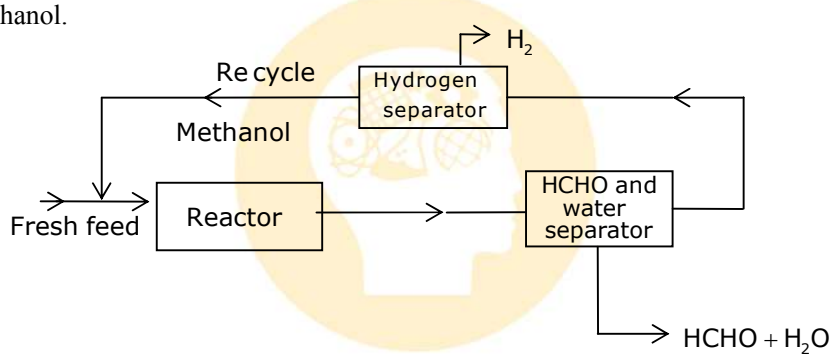
(A) 36 (B) 42 (C) 39 (D) 32

2. Methanol vapour can be converted into formaldehyde by the following reaction scheme:

$CH_3OH + 0.5\,O_2 \longrightarrow HCHO + H_2O$

$CH_3OH \longrightarrow HCHO + H_2$

The fresh feed to the process is 0.5 k mol/hr of O_2 and excess CH_3OH and all of O_2 reacts in the reactor. Formaldehyde and water are removed from the product stream initially and H_2 is removed from recycled methanol. Recycled flow rate of methanol is 1 k mol/hr. The ratio of methanol reacting by decomposition to that by oxidation is 3. Calculate per pass conversion of methanol.



(A) 20% (B) 60% (C) 80% (D) 40%

3. Super heated steam at 1 bar and $250^{\circ}C$ enters a adiabatic nozzle with negligible velocity and leaves as saturated vapour at 0.3 bar. Calculate the exit velocity of steam.

Data: Enthalpy for steam at 1 bar and $250^{\circ}C = 3977.7$ kJ / kg

Enthalpy for saturated at 0.3 bar $= 3183.5$ kJ / kg

(A) 1602.48 m / s (B) 815.41 m / s

(C) 1467.32 m / s (D) 1260.31 m / s

4. In the manufacture of nitric acid by ammonia oxidation process, the concentration of HNO_3 obtained after oxidation and absorption is only 57-60%, because

(A) HNO_3 reaches its solubility limit in water at this concentration range.

(B) Nitric acid forms a constant boiling mixture with water.

(C) Nitric acid in this concentration range can be directly used for commercial purpose, and the higher concentration is not required.

(D) Higher concentration leads to explosion.

5. Match the catalyst used in various chemical processes:

(P) Nickel supported on magnesite	(1) Manufacture of nitric acid by oxidation of ammonia to nitric oxide. (Oswald's process).
(Q) Platinum	(2) Protein catalyst (enzyme) used in digestion of food
(R) Pepsin or ptyalin	(3) Production of sulphur by oxidation-reduction of H_2S
(S) Alumina	(4) Manufacture of ammonia by partial oxidation of hydrocarbons by oxygen enriched air.

(A) P-4, Q-1, R-3, S-2 (B) P-4, Q-1, R-2, S-3
(C) P-3, Q-2, R-4, S-1 (D) P-1, Q-2, R-3, S-4

6. Calculate the operating speed of the ball mill from the given data:
Diameter of ball mill = 500mm; Diameter of ball = 50mm
Operating speed of the ball mill is 35% of critical speed.
(A) 0.56 (B) 0.74 (C) 0.36 (D) 0.64

7. Methane diffuses at steady state through the tube containing helium. At point 1, the partial pressure of methane is 55 KPa and at point 2 it is 15 KPa. The points 1 & 2 are 30mm apart. The total pressure is 101.3 KPa and temperature is 298 K $(25°)$. Calculate the flux of CH_4 at steady state for equimolar counter diffusion. Take the value of diffusivity as $6.75\times10^{-5}\ m^2/s$.

(A) $3.63\times10^{-5}\ K\,mol/(m^2.s)$ (B) $4.83\times10^{-5}\ K\,mol/(m^2.s)$
(C) $9.63\times10^{-5}\ K\,mol/(m^2.s)$ (D) $6.36\times10^{-5}\ K\,mol/(m^2.s)$

8. A copper plate moving with a velocity of 52 cm/s which is situated 0.03mm away from fixed plate requires a force of $1.6\frac{N}{m^2}$ to maintain this velocity. Calculate the viscosity of the fluid between the plates.

(A) 15.29×10^{-3} poise (B) 2.85×10^{-3} poise
(C) 9.23×10^{-4} poise (D) 4.62×10^{-3} poise

9. What would be expectation of number of failures preceding the first success in an infinite series of independent trials with constant probability of success p?

(A) $\frac{1}{p}$ (B) $\frac{1}{q}$ (C) $\frac{q}{p}$ (D) None of these

10. Evaluate $\iint xy(x+y)dxdy$ taken over the area between $y = x^2$ and $y = x$.

(A) 0 (B) 2/56 (C) 1/56 (D) 3/56

11. Calculate the power required to crush 50 ton/h of limestone, if 80% of feed passes a 2.5 in-screen and 80% of product through 0.1 in-screen. Work index for lime stone is 12.74.

(A) 101.1 kW (B) 510 kW (C) 150 kW (D) 75.2 kW

12. Water is discharge from a reservoir. Distance between the centre of opening and the water surface is 1.4 m. The opening can be considered as a small orifice. Calculate the area (m^2) of opening, if discharge through opening is $4.5\ {}^{m^3}\!/_{sec.}$. $(C_d = 0.7)$.

(A) 1.227 (B) 2.458 (C) 4.578 (D) 0.894

13. What are the dryness fraction values for a liquid just starts boiling and for the vapour which is formed after complete vaporization?

(A) 0, 1 (B) 1, 0
(C) Between 0 and 1 (D) Greater than 1

14. Two pipes of same length having diameters 10cm and 20cm respectively are connected in series. If the coefficient of friction is same in both the pipes, then the equivalent diameter in cm of the system will be

(A) 11.4 (B) 16.5 (C) 9.87 (D) 13.54

15. A distillation column is used to separate a binary mixture of A and B. The intercept of operating line of rectifying section is 0.345 and distillate composition is 0.76. Distillate is produced at 120 k mol / hr , if the feed is saturated liquid. Calculate the vapour rate in the stripping section.

(A) 163.19 K mol / hr (B) 264.31 K mol / hr
(C) 71.04 K mol / hr (D) 305.73 K mol / hr

16. Steam at 150ºC is transferred from boiler to turbine in a pipeline whose outer diameter is 200mm and inner diameter is 180mm. The surface temperature of the pipeline is 148.5ºC. The thermal conductivity of the tube material is 45W/mK. Find the rate of heat loss from a length of 1m of the pipeline.

(A) 3847W/m (B) 4023W/m (C) 4526W/m (D) 3500W/m

17. A homogeneous liquid phase reaction, $A \rightarrow B;\ -r_A = KC_A^{\,2}$, take place with 76% conversion in a well mixed reactor operating isothermally. What will be the conversion, if the reactor is replaced by a plug flow type of equal size all else remaining the same?

(A) 80% (B) 75 % (C) 92.3 % (D) 100 %

18. The iterative root of $f(x) = 3x^2 + 2x + 1$ using Newton Raphson method is

(A) $x_{n+1} = \dfrac{3x_n^{\,2} + 1}{6x_n + 2}$ (B) $x_{n+1} = \dfrac{9x_n^{\,2} + 4x_n + 1}{6x_n + 2}$

(C) $x_{n+1} = \dfrac{3x_n^{\,2} - 1}{6x_n + 2}$ (D) $x_{n+1} = \dfrac{9x_n^{\,2} - 4x_n - 1}{6x_n + 2}$

19. $\int_0^{\infty}\int_y^{\infty} xe^{-\frac{x^2}{y}}\,dxdy =$

(A) 0.5 (B) 1 (C) 1.5 (D) 2

20. General solution of $\dfrac{xdy}{dx} = 2 - 4x^3$ is

(A) $y = 2\ln x - \dfrac{4x^3}{3} + c$ (B) $y = \ln x - \dfrac{4x^3}{3} + c$

(C) $y = 2\ln x + \dfrac{4x^3}{3} + c$ (D) $y = x^2 - \dfrac{4\ln x^3}{3} + c$

21. 2 large parallel planes have the same emissivity. The heat transfer between the two is Q. To reduce the heat transfer, 10 radiation shields are introduced between them. What is the percentage reduction in heat transfer?

(A) 90 (B) 88.89 (C) 90.91 (D) 100

22. The half-life period of decomposition of a compound is 50min. If the initial concentration is halved, the half-life is reduced to 25min, then what will be the order?

(A) First order (B) Second order (C) Zero order (D) Third order

23. Water enters a double pipe heat exchanger at $72\,kg/min$. It is to be heated from 30°C to 75°C using oil of specific heat $1.57\,kJ/kg\,K$. The flow is in counter current mode. Oil at $185\,kg/min$ enters at 125°C. Oil flows through the annulus. Overall heat transfer coefficient is $350\,W/m^2K$.

Data: Heat capacity of water is 4.18kJ/kg-K

The average temperature difference (K) between oil and water in the heat exchanger is °C.

(A) 45.8 (B) 56.4 (C) 51.4 (D) 61.2

24. In a batch reactor a reversible first order reaction $A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} R$ takes place. After 10minutes, conversion of A is 42% while equilibrium conversion is 58%. Find the values of K_1 and k_2 if $C_{AO} = 0.40$ mol / lit and $C_{RO} = 0$.

(A) $K_1 = 0.0168\ min^{-1}$, $K_2 = 0.074\,min^{-1}$

(B) $K_1 = 0.074\ min^{-1}$, $K_2 = 0.053\ min^{-1}$

(C) $K_1 = 0.0168\ min^{-1}$, $K_2 = 0.053\,min^{-1}$

(D) $K_1 = 0.074\ min^{-1}$, $K_2 = 0.0168\,min^{-1}$

25. Match the following humidity measuring apparatus in List-I with their functioning in List-II.

List-I		List- II	
P	Direct chemical method	1	Measurement done using the electrical conductivity
Q	Hygrometer method	2	Measurement done using the dry bulb and wet bulb temperatures
R	Sling psychrometer method	3	Measurement based on expansion and contraction of materials like hair, wood, animal membrane and paper
S	Dew point method	4	Measurement done using chemical like H_2SO_4, P_2O_5 etc.

(A) P-2, Q-1, R-4, S-3 (B) P-3, Q-2, R-1, S-4
(C) P-4, Q-3, R-2, S-1 (D) P-1, Q-3, R-2, S-4

26. A fire alarm unit, which is sensitive to the temperature, a unity gain is first order system with a time constant of three minutes. There is sudden $120^{o}C$ rise in temperature because of fire caused by electric shock. If an increase of $60^{o}C$ is required to activate the alarm, then the delay (minutes) in signaling the fire alarm will be
(A) 2.07 (B) 2.89 (C) 1.56 (D) 3.21

27. The cost of blower and index in the year 2000 are Rs. 15000 and Rs. 500 respectively. (Use 27 as 0.41)
If the cost index for the blower in the year 2008 is 1000, then the cost of the blower in the year 2008 with the same capacity will be
(A) 15000 (B) 7500 (C) 3000 (D) 30000

28. A pressure vessel is required to have a capacity of $20\,m^3$. The vessel contains operating pressure of $6\,kg/cm^2$ and the material used for fabrication contain an allowable stress of $1090\,kg/cm^2$. Welded joint efficiency 85%, and corrosion allowable is 2 mm.
Estimate the optimum diameter.
(A) 1.56 m (B) 1.67 m (C) 1.76 m (D) 1.70 m

29. Find the number of degrees of freedom for a system prepared by partially decomposing NH_4Cl into an evacuated space.
(A) 4 (B) 1 (C) 3 (D) 2

30. At $300^{o}C$, water has fugacity 6503kPa and vapour pressure 8673kPa. Under these conditions, one mole of water in liquid phase volume is of 2 and that in vapour phase is 389 cm^3, calculate the fugacity at 9300kPa.
(A) 7238 kPa (B) 8365 kPa (C) 6503 kPa (D) 7820 kPa