Section-I: General Aptitude

1. The values of x which satisfy $(x-1)(x)(x+1) \leq 0$ is / are

    i. $x \leq 0$;   ii. $x \leq -1$ iii. $0 \leq x \leq 1$

    (A) Only I   (B) Both ii and iii   (C) Both i and ii   (D) Both i and iii

2. A company awarded annual bonuses to its employees. Of the employees at the company, 70% received bonuses of at least 10,000, 40% received bonuses of at least 50,000, and 20% received bonuses of at least 1,00,000. If 60 employees received bonuses of less than 10,000, how many employees received bonuses of at lest 50,000 but less than 1,00,000?

    (A) 80   (B) 50   (C) 48   (D) 40

3. A sum of money compounded annually amounts to thrice itself in 10 years. In how many years, will it become 9 times itself?

    (A) 6   (B) 8   (C) 10   (D) 12

4. Babita was asked to calculate the arithmetic mean of ten positivetwo digit integers. By mistake, she interchanged the two digits, say t and u, in one of these ten integers. As a result, her answer for the arithmetic mean was 1.8 more than what it should have been. Then u - t equals

    (A) 1   (B) 2   (C) 3   (D) 4

5. Operating alone, Tap A takes twice as long as Tap B takes to fill an empty tank. Operating together at their respective constant rates, the taps can fill the tank in 6 hours. How many hours would it take the Tap A to fill the tank operating alone?

    (A) 18   (B) 9   (C) 12   (D) 15

6. A shopkeeper sells two items at the price of Rs.160. If one of them is sold at 10% profit and another sold at 10% loss, then find the profit/loss?

    (A) 3.23   (B) 5.75   (C) 2.5   (D) 6.9

7. The sum of ages of 5 children born at interval of 3 years each is 50 years. What is the age of youngest child?

    (A) 10   (B) 2   (C) 7   (D) 4

8. The cost of the components x, y, z of a machine worth Rs.45,000 in 1996 is given as a pie chart ? In the following year, the cost of the components x, y, z increased by 10%, 30%, and 20% respectively. What is the cost of the machine in 1997?

    (A) 54375

    (B) 52375

    (C) 54475

    (D) 54365
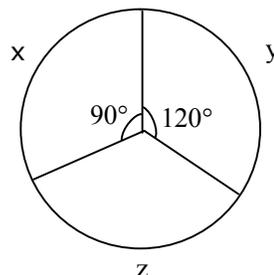
9. What is the 2777th digit in the sequence 1 2 3 4 5 6 7 8 9 10 11 12 13 14.....?
    (A) 9   (B) 3   (C) 7   (D) 6

10. Production of sugar (in thousand tons) by three sugar mills over the year
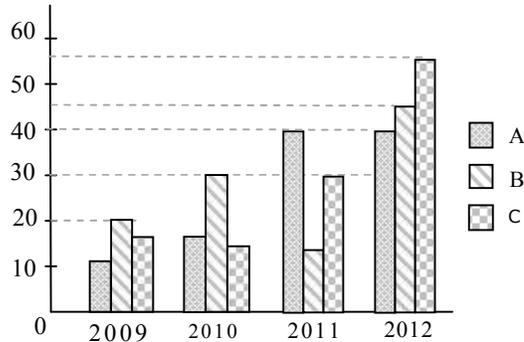
    Which of the statement is true ?
    i.   Ratio between the production of B in 2011 to C in 2012 is 3 :11
    ii. Average production of A in four years is 20
    iii. Percentage increase in C in 2011 from the previous year is 100%
    (A) i & ii only   (B) ii & iii only
    (C) i & iii only   (D) i, ii & iii

11. "Students who hired a hack to write their projects were punished"
    Choose the best assumption for the given statement:
    (A) Students have become mischievous
    (B) Hack's are intelligent
    (C) Hiring a hack is inexpensive
    (D) Students have projects to be done

12. Find out the error part in the given sentence
    Rajesh is/ smarter enough/ to get selected for his post/ without any recommendations
    (A)   (B)   (C)   (D)

13. Arrange the given parts of the sentence in correct order:
    and recognize / all of us must / the machine tool industry / in the Country/
    [1]   [2]   [3]   [4]
    strategic and vital / have a deep introspection / the fact that /
     [5]   [6]   [7]
    has a very special place / from the point / interests of the nation.
     [8]   [9]   [10]
    (A) 2,4,7,8,6,9,1,10,3,5   (B) 2,6,5,8,4,3,1,7,10,9
    (C) 2,3,8,9,6,7,10,4,1,5   (D) 2,6,1,7,3,8,4,9,5,10

14. Choose the appropriate word which gives the meaning of the sentence given:
    A critical situation in which no progress can be made:
    (A) Hullabaloo   (B) Aggression   (C) Histrionic   (D) impasse

15. There was once a newspaper vendor who had a rude customer. Every morning the customer throws the money at the vendor. The vendor would pick up the money, smile politely and say, "Thank you sir". The vendor's assistant asked him "why are you always polite with him when he is so rude to you". The vendor replied "He can't help being rude and I can't help being polite".

   What is vendor's conclusion?

   (A) Strive for excellence   (B) Work is worship

   (C) Rebels do not realize   (D) Keep faith in our own ideas

16. In 1991, produce growers began using a new, inexpensive pesticide, provoking many objections that they would damage both the environment and the produce they were growing. However, the fears have proven unfounded as, though 1996, produce prices had dropped and no ill effects had been reported.

   Which of the following, if true, would be the strongest objection to the argument above?

   (A) Consumption of the produce declined from 1991 to 1993, but rose sharply from 1994 to 1996.

   (B) Several areas in which use of the pesticide was forbidden have also experienced a drop in produce prices.

   (C) The amount of produce grown in 1991 was larger than that of 1996.

   (D) The time since the beginning of the use of the pesticide has been too short to allow
   some of the predicted effects to occur.

17. Choose the appropriate antonym for the bold word **Linger**

   (A) Sojourn   (B) Fiery   (C) Condone   (D) Quilt

18. Find the proper meaning of the word given in bold letters

   APP won the election **fair and square.**

   (A) Honestly   (B) Falsely   (C) Corruptedly   (D) Unexpectedly

19. None but the rich can afford air travel. Some of those who travel by air become sick. Some of those who become sick require treatment.

   Choose the best conclusion:

   (A) All the rich travel by air

   (B) All the persons who travel by air become sick

   (C) All sick persons travel by air

   (D) Only rich can travel by air

20. **Sentence completion**

   According to Maslow's theory of need hierarchy, material is the _____ demand of human beings, in that it provides the founding floor from which the other demands are generated.

   (A) essential   (B) basic   (C) final   (D) emotional

Section-II: Technical

1. A fluid is supplied between two reservoirs with the help of three parallel pipe, their respective diameters being1 x, 2x and 3x respectively. They are all of same length 'L' and have the same friction factors 'F'. If the largest pipe caries 60 litres/sec, and then find discharge through the smallest pipe $(in\ m^3 / s)$.

    (Assuming turbulent flow in all three pipes).
    (A) 3.85   (B) 4.56   (C) 2.95   (D) 3.35

2. The Orsat analysis of a flue gas is
    CO_2 12.0%
    O_2 8.0%
    N_2 80.0%
    If the nitrogen present in the flue gas is contributed by only air, then the percent of excess air used in the combustion will be
    (A) 54.3   (B) 75.1   (C) 60.3   (D) 68.4

3. A hot fluid flows through a well-mixed stirred tank which is provided with a cooling jacket. The fluid in the cooling jacket can also be assumed to be well mixed. Calculate the heat transfer area of the jacket required.
    Assume the following data:

    Hot fluid: Flow rate, $W_h = 80\,kg / s;\ T_{ih} = 25^o C;\ C_{ph} = 4\,kJ / kg^o C$

    Cold fluid: Flow rate, $W_C = 200\,kg / s;\ t_{in} = 25^o C$

    $t_{out} = 50^o C;\ C_{Pc} = 6\,kJ / kg^o C$

    $U = 2.0\ kW / m^2\ {}^o C$

    (A) 288.46   (B) 238.28   (C) 218.18   (D) 210.18

4. An electric wire carrying a current of 208A with an applied voltage of 1.82V is submerged horizontally in water at 8 bar and $208^o C$.
    Data: Diameter of wire = 1.8 mm
    Length of wire = 208 mm length
    Saturation temperature of water at $208^o C$ and 8 bar $= 160^o C$

    The boiling heat transfer coefficient $(in\ W / m^2\ {}^o C)$ will be

    (A) 5280   (B) 6708   (C) 4132   (D) 5594

5. A bag contains 3 green and 2 red balls. A man draws 2 balls at random from the bag. If he is to receive 20paise for every green ball he draws and 10paise for every red one, what is his expectation (in paisa)?
    (A) 32   (B) 42   (C) 52   (D) 65

6. At NTP, calculate the concentration of CO_2 in the flue gases from a boiler $\left(\text{in } kg/m^3\right)$, if the flue gas are assumed perfect and concentration of CO_2 in parts per million by volume at NTP is 13000 ppm ?

    (A) 0.135   (B) 0.251   (C) 0.085   (D) 0.025

7. An air compressor receives air at $27^\circ C$ and delivers it to a receiver at the rate of 0.5 Kg/s. It is driven by an electric motor which absorbs 10kW and the efficiency of the drive is 80%. Water jacket cooling is used at the rate of 6 Kg/min while its temperature rises from $10^\circ C$ to $20^\circ C$.

    Data : $C_{Pw} = 4.186$ and $C_{Pa} = 1.005$ kJ / Kg.K

    The temperature of the air delivered in $^\circ C$ will be

    (A) 43.5   (B) 39.8   (C) 48.7   (D) 52.5

8. Unsaturated air (with dry bulb temperature and dew point being 35ºC and 18ºC respectively) passed through a water spray chamber maintained at 15ºC. Air will be
    (A) Cooled and humidified
    (B) Cooled and dehumidified with increase in wet bulb temperature
    (C) Cooled at the same relative humidity
    (D) Cooled and dehumidified with decrease in wet bulb temperature

9. A continuous rectification column is used to separate a binary mixture of A and B. Distillate is produced at a rate of $100 \dfrac{kmol}{hr}$ and contains 98 mole% A. The mole fractions of A in the liquid and in the vapour respectively from the adjacent ideal plates in the enriching section are as follows:

	x	y
n^{th} Plate	0.65	0.82
$n^{th} +1$ Plate	0.56	0.76

    The latent heat of vaporization is same for all composition. Feed is a saturated liquid. What will be the reflux ratio?

    (A) 1   (B) 4   (C) 3   (D) 2

10. If $f = x^n + y^n + z^n$, then $\nabla f \cdot r =$

    (A) nf   (B) f   (C) n   (D) 0

11. A metal body weighing 28kg at a temperature of $400^\circ C$ is dropped in 130kg of a fluid at $32^\circ C$. Estimate the entropy of the system consisting of fluid and metal body.

    Data: Specific heat of metal $= 0.42$ kJ / kg K

         Specific heat of fluid $= 2.3$ kJ / kg K

    (A) 5.66 kJ/k   (B) 3.84 kJ/k   (C) 4.57 kJ/k   (D) 1.3 kJ/k

12. An experimental determination of a vapor liquid equilibrium state of benzene (1) and toluene (2) binary system have the following data:

$x_1 = 0.4$ $T = 45°C$

$y_1 = 0.35$ $P = 200\, kPa$

The saturation vapor pressure of the pure components at $45°C$ are

$Benzene\,(1) = 142\, kPa;\; Toluene\,(2) = 206\, kPa$

The liquid phase activities coefficients of the system are
(Assume that the vapour phase as ideal).

(A) $1.232\,\&\,1.912$ (B) $1.731\,\&\,1.052$

(C) $1.052\,\&\,1.232$ (D) $1.052\,\&\,1.756$

13. What is the ratio of tangential velocity at blade tips to the blade tip velocity, if the liquid leaves the impeller at an angle of 45°?

(A) 0.5   (B) 2   (C) 3   (D) $\dfrac{1}{3}$

14. Crushing of feed particles is done by crushing rolls of 160cm in diameter by 60cm width of face. Crushing rolls set in such a way their surfaces are 1.30cm apart of the narrowest point. They are to crush a rock having specific gravity of 2.40, angle of nip is 60° and roll speed is 110 rpm. Find the maximum permissible size (in cm) of feed.

(A) 31.2   (B) 26.25   (C) 16.53   (D) 39.64

15. $\displaystyle \underset{x\to\infty}{Lt}\left[\dfrac{x^2 + 5x + 3}{x^2 + x + 2}\right]^x =$

(A) e^4 (B) e^3 (C) e^2 (D) e

16. A single-acting reciprocating pump, running at 50 rpm delivers 0.00736 m^3/s of water. The diameter of the piston is 200 mm and stroke length is 300 mm. Determine the coefficient of discharge.

(A) 0.937   (B) 0.63   (C) 0.456   (D) 0.746

17. An open tank 5m long and 2.0m deep and 3.0m wide contains oil of relative density 0.9 to a depth of 0.9m as shown in the figure below. The tank is accelerated along its length on a horizontal track at a constant value of 3.0m/s^2.

The new position of the oil surface will be at

(A) 1.665m   (B) 2.185m   (C) 0.894m   (D) 1.356m

18. A flat plate is moving in a wind tunnel with a speed of $32\dfrac{m}{sec}$ having dimension 1.8m long and 0.8 wide. The co-efficient of drag and lift are 0.12 and 0.64. If the density of air is $1.15 kg/m^3$. Find power exerted by air on the plate.

    (A) 4.86kW (B) 6.34kW (C) 2.56kW (D) 3.25kW

19. A submarine moves horizontally in a sea and has its axis below the water surface. A Prandtl pitot tube placed in front of the submarine and along its axis is connected to the two limbs of U-tube containing mercury. The difference in mercury level is found to be 170mm. Find the speed of submarine.
    (Specific gravity of sea water is 1.015)

    (A) 1.1 m/s (B) 3.2 m/s (C) 6.4 m/s (D) 8.6 m/s

20. $\oint_c \left(xy + y^2\right)dx + x^2 dy =$ _____ where C is the closed curve of the region bounded by y=x and $y=x^2$

    (A) 1/20 (B) -1/20 (C) 1/40 (D) -1/40

21. The solution for contour integral $\oint_{|z|=1} e^{1/z}\sin\dfrac{1}{z}dz$ is

    (A) $2\pi i$ (B) πi (C) 0 (D) $5\pi i$

22. What is the value of emissivity for two plane parallel grey surfaces, maintaining at 400 K and 300 K, if the radiative heat transfer rate per unit area between them is 812W?

    (A) 0.95 (B) 0.92 (C) 0.90 (D) 0.99

23. Pure water is to be obtained from a feed containing 6 wt% salt using a desalination unit as shown below:
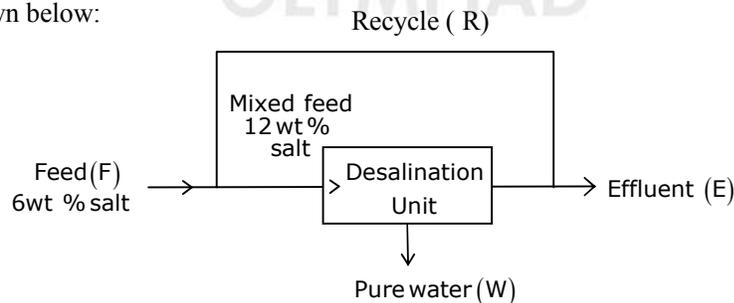
    The overall recovery of pure water (through stream W) is 0.80 kg/kg feed.
    The mass fraction of salt in effluent stream will be

    (A) 0.1 (B) 0.7 (C) 1.1 (D) 0.3

24. A wet stock of $(NH_4)_2SO_4$ containing 25% water on dry basis is sent to a dryer. The material leaving the dryer contains 2.5% moisture on dry basis. Determine the % of water removed in the drying operation?

    (A) 85 (B) 90 (C) 94 (D) 76

25. A fluid process has to be cooled from 32ºC to 12ºC in a shell and tube exchanger using glycol solution which enters at 7ºC and leaves at 17ºC. The temperature parameters used to determine the correction factor are

   (A) 9.1 and 12.4   (B) 2 and 0.4   (C) 0.5 and 2.5   (D) 15 and 5

26. A solution is to be concentrated from 12% to 26% solids in a evaporator with a feed rate of 31000 kg/h. Evaporator is working at reduced pressure such that boiling point is 325 K. New feed is introduced at 300 K. Estimate the steam economy.

   Data: Specific heat of feed = 4.1 KJ/kg.K.

   Latent heat of condensation of steam at 0.20 MPa = 2100 kJ/kg.

   Latent heat of vapourisation of water at 333 K = 2800 kJ/kg

   (A) 0.602mm   (B) 0.902mm   (C) 0.802mm   (D) 0.702 mm

27. If the maximum allowable superficial vapor velocity in packed column is 6.2 m/s and if liquid density is 55 kg/m^3 and empirical constant is 0.40, then the vapor density in packed column (in kg/m^3) will be

   (A) 0.45   (B) 0.36   (C) 0.18   (D) 0.22

28. A mixture of ethyl acetate vapor and air has a relative saturation of 40 percent at 27°C and a total pressure of 200 kN/m^2. If the vapor pressure of ethyl acetate at 27°C is 20 kN/m^2, then the molar saturation at the given conditions is given by

   (A) 8.67%   (B) 4.17%   (C) 5.25%   (D) 8%

29. A Carnot engine is operating between two reservoirs which consists of H_2O. In one reservoir H_2O is in the form of ice and in the other reservoir H_2O is in the form of saturated vapour. If 267 kJ of heat is supplied, then the work delivered by the Carnot engine (in kJ) will be

   (A) 71.56   (B) 48.61   (C) 56.84   (D) 89.50

30. Vapour pressure of benzene at 43°C is 61.37 kPa. Vapour pressure of water at 43°C is 16.42 kPa. Calculate the vapour phase composition of benzene at temperature 316 K under a pressure of 51 kPa at equilibrium. Assume that both liquid and vapour behaves ideally.

   (A) 0.78   (B) 0.92   (C) 0.64   (D) 0.85