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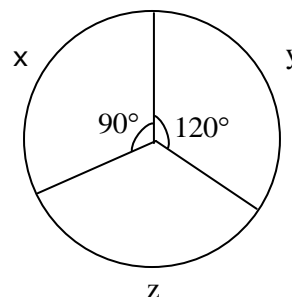
9. What is the 2777th digit in the sequence 1 2 3 4 5 6 7 8 9 10 11 12 13 14…..?
   (A) 9 (B) 3 (C) 7 (D) 6

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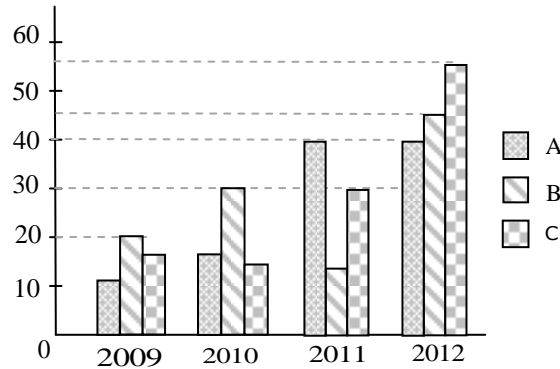
Which of the statement is true ?
   i. Ratio between the production of B in 2011 to C in 2012 is 3 :11
   ii. Average production of A in four years is 20
   iii. Percentage increase in C in 2011 from the previous year is 100%
   (A) i & ii only   (B) ii & iii only
   (C) i & iii only   (D) i, ii & iii

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

INDIAN ENGINEERING OLYMPIAD

Section-II: Technical

1. Degree of freedom for a pure substance having 2 phases is
   (A) 0   (B) 1   (C) 2   (D) 3

2. Brown and sharp indexing plates used in indexing will have the following hole-circles
   Plate 1 : 15,16,17,18,19,20   Plate 2 : 21,23,27,29,31,33
   Plate 3: 35,37,39,41,43,47,49
   The plate(s) which can be used for producing 23 divisions on the job using simple indexing is/are
   (A) Plates (1) & (2)   (B) Plate (1)
   (C) Plate (2)   (D) Plates (1) & (2) & (3)

3. The material of a rubber balloon has a Poisson's ratio of 0.5. If uniform pressure is applied to blow the balloon, then the volumetric strain of the material will be
   (A) 1   (B) 0   (C) 2   (D) 3

4. 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

5. Arrange in increasing order the following machining processes with respect to penetration rate.
   (A) $USM < EDM < LBM < EBM$ (B) $EDM < USM < EBM < LBM$
   (C) $EDM < EBM < USM < LBM$ (D) $EDM < USM < LBM < EBM$

6. For an incompressible flow $\Psi = 2x^2 - 3y^2$, the total acceleration vector is
   (A) $4xi + 4yj$ (B) $10xi + 12yj$ (C) $24xi + 24yj$ (D) $24xi + 12yj$

7. Match the following

Section – A	Section - B
A. Belt and rope drive with slip	1. Face
B. Belt and rope drive without slip	2. Face width
C. Length of parallel to gear axis	3. Higher pair
D. Watts indicator mechanism	4. Lower pair
	5. Double crank mechanism
	6. Double lever mechanism

   (A) A-4,B-2,C-3,D-6   (B) A-3,B-4,C-2,D-6
   (C) A-4,B-3,C-2,D-5   (D) A-3,B-4,C-1,D-5

8. When a cast iron shaft is applied with torque, it
    (A) Fails along a plane perpendicular to longitudinal axis.
    (B) Fails along a plane 45° to longitudinal axis.
    (C) Fails along plane of maximum principal stress.
    (D) Fails along a plane of minimum tension.

9. If $f = x^n + y^n + z^n$, then $\nabla f \cdot r =$
    (A) nf   (B) f   (C) n   (D) 0

10. Consider the following statements.
    In a unit dimensional stress system on the principal plane
    (1) Shear Stress is Zero   (2) Normal Stress is Zero
    (3) Shear Stress is Maximum   (4) Normal Stress is Maximum
    (A) 1 & 2 Correct   (B) 2 & 3 Correct
    (C) 1 & 4 Correct   (D) 3 & 4 Correct

11. For a simply supported beam loaded at midpoint of span, match the following for its cross section.

List - I		List – II
(P)	Moment of area function	1.
(Q)	Shear stress distribution	2.
(R)	Normal stress distribution	3.

    (A) P – 1, Q – 2, R – 3   (B) P – 2, Q – 3, R – 1
    (C) P – 3, Q – 2, R – 1   (D) P – 2, Q – 1, R – 3

12. For two fluids x, y; viscosity dependence on temperature is given below
    $(t - kelvin)(\mu = viscosity)$

    Fluid 'x' $\rightarrow \mu(t) = \exp(t^4 + t^2 + 8)$

    Fluid 'y' $\rightarrow \mu(t) = \exp(-t^6 - t^8 - 23)$

    Which of the following is correct?
    (A) $x - liquid, y - liquid$ (B) $x - liquid, y - gas$
    (C) $x - gas, y - liquid$ (D) $x - gas, y - gas$
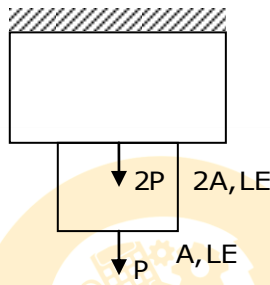
13. Cellular manufacturing is suitable for
    (A) Single product in large volumes
    (B) One – off production of several varieties
    (C) Products with similar features made in batches
    (D) Large variety of products in large volumes

14. $\displaystyle \operatorname*{Lt}_{x \to \infty} \left[\frac{x^2 + 5x + 3}{x^2 + x + 2} \right]^x =$

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

15. The axial movement of bottom surface of a compound bar loaded as shown below is
    ____ $\left(\dfrac{PL}{AE} \right)$.


    (A) 0   (B) 1.5   (C) 2.5   (D) 3.5

16. A fluid undergoes a reversible adiabatic expansion from 0.02m^3 to 0.05m^3 and the initial pressure is 0.5 MPa. Work done during the process is (Take $\gamma = 1.3$)

    (A) 6kJ   (B) 8kJ   (C) 4kJ   (D) 2kJ

17. A nozzle is so shaped that the velocity of flow along centerline changes linearly from 4.5 m/sec to 44.5 m/sec in a distance of 40 cm. The absolute difference in magnitude of convective acceleration at the beginning and end of this distance is _____ m/s^2.
    (A) 5000   (B) 4500   (C) 4000   (B) 3500

18. 'A' is a sphere of mass 1kg and rolls down friction less slope and hits a stationary sphere of same mass and stops. Sphere 'B' moves on rough ground $(\mu = 0.2)$ for a distance of 2m and compresses a spring by 10cm as per layout as shown in figure.
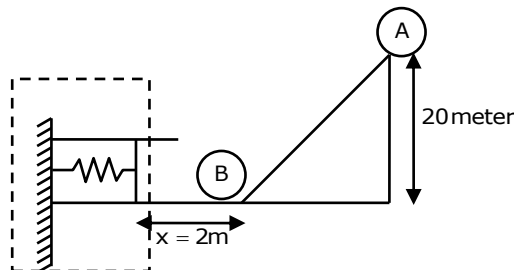
    What is the value of spring stiffness? $\left(g = 10 \text{m/sec}^2 \right)$

   (A) 18.1 N / mm   (B) 27.6 N / mm

    (C) 32.8 N / mm   (D) 39.2 N / mm

19. $\oint_C (xy + y^2)dx + x^2dy =$ _____ 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

20. Match the following:

List – I	List-II
P. Electric discharge machining	1. Vibrating tool
Q. Abrasive jet machining	2. Brittle fracture
R. Electro Chemical machining	3. Faradays Laws
4. Ultrasonic machining	4. Melting and evaporation

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

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

21. In a process, change in enthalpy is 7200 kJ/kg, maximum possible work output is 4800 kJ/kg and change in entropy 8kJ/kg K, the final temperature (in kelvin) is _____.

(A) 400   (B) 300   (C) 200   (D) 100

22. The mobility of the following linkage system is

← Rolling with slip
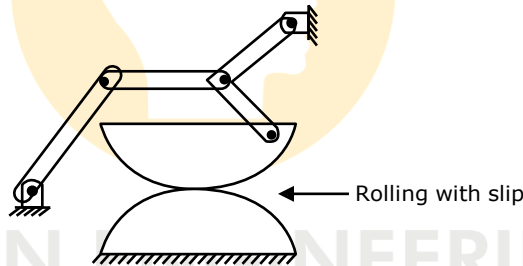
(A) 3   (B) 0   (C) 1   (D) 5

23. A cubical block of 20cm edge and weight 196.2N is allowed to slide down a plane inclined at 20° to the horizontal on which there is thin film of oil of viscosity 2.158 x 10^{-3} N-s/m^2. If the film thickness is estimated to be 0.025mm, then the terminal velocity attained by the block is _____m/s

(A) 19   (B) 14   (C) 23   (D) 16

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

(A) 2πi   (B) πi   (C) 0   (D) 5πi

25. If a material is subjected to two incremental true strains, namely, ε_1 and ε_2. The total true strain is

(A) $\varepsilon_1 - \varepsilon_2$ (B) $\varepsilon_1 \times \varepsilon_2$ (C) $\varepsilon_1 / \varepsilon_2$ (D) $\varepsilon_1 + \varepsilon_2$

26. A canon fires a bomb which aims at hitting a person at 500m distance at angle of 15° to horizontal (Canon inclination). But person observed that a bomb is fired towards him (sound emitted from canon) and moves away from it at 10 m/sec, stops when he hears bomb hitting ground. (Person moves away instantaneously when canon is fired). Canon control estimated new range and fired a bomb at 30° to horizontal (silent-no sound) with a reduced velocity. What is the velocity of bomb fired from canon for second time?

$\left(g = 10 \text{ m}/\sec^2\right)$

(A) $60 \text{m}/\sec$ (B) $70 \text{m}/\sec$ (C) $80 \text{m}/\sec$ (D) $90 \text{m}/\sec$

27. In a horizontal gas engine, force due to pressure of gas when the crank has rotated 30° from inner dead centre is 6000 N, the mass of reciprocating parts is 3 kg. Also, the length of crank and connecting rod are 60 mm and 300 mm respectively. The speed of crank at which the load on gudgeon pin is reversed in direction is _____ rad/s.

(A) 186   (B) 156   (C) 178   (D) 198

28. Identify DOF of the mechanism shown in the figure below where ABEF form a parallelogram, CDGF and JIFH also forms parallelogram.

(A) -1

(B) 0

(C) 1

(D) 3
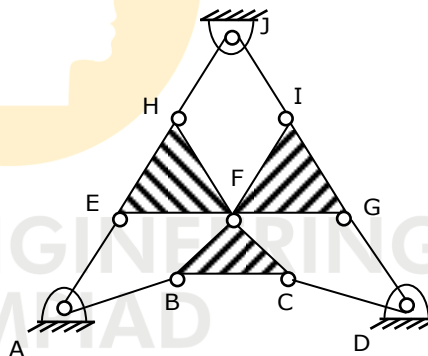
29. 4 kg of air is contained within a piston-cylinder arrangement. It undergoes a process for which the pressure volume relationship $PV^{1.5}=C$. The initial pressure is 3 bar, the initial volume is 0.1 m^3 ,and the final volume is 0.2 m^3 .The change in specific internal energy of air in the process is $u_2-u_1= -4.6$ kJ/kg. Determine the net heat transfer for the process

(A) -0.6 kJ   (B) -0.7 kJ   (C) -0.8 kJ   (D) -0.9 kJ

30. The velocity field in the neighborhood of a stagnation point is given by $u = \dfrac{U_0 x}{L}$, $v = \dfrac{-U_0 y}{L}$, $w = 0$. Show that the acceleration vector is purely radial.

(A) $\left(\dfrac{U_0}{L}\right) r$ (B) $\left(\dfrac{U_0^{\,2}}{L}\right) r$ (C) $\left(\dfrac{U_0^{\,2}}{L^2}\right) r$ (D) $\dfrac{U_0^{\,2}}{L^2}$