General Instructions

- Candidates must show their Admit Cards on demand.
- Candidates are not allowed to carry mobile phones and/or digital watches inside the examination hall.
- Only Scientific Non-programming Calculators can be used for the purpose of calculation.
- This question paper booklet contains 50 questions and candidates are required to answer all questions.
- All questions carry equal marks.
- All questions are of objective type having four answer options for each.
- There is only one correct option for every multiple choice question (MCQ). Marks will not be awarded for answering more than one option.
- A right answer will carry **01** mark and **0.25** mark will be deducted for a wrong answer.
- Questions must be answered on the OMR sheet by darkening the appropriate bubble marked A, B, C or D.
- Use only **black ballpoint pen** to mark the answer by completely filling the respective bubble.
- Write question booklet number and your roll number carefully in the specified locations of the OMR answer sheet.
- To write in your Roll No. in the OMR sheet, darken the circle of only the last five digits of the roll number.
- Rough work must be done on the question paper itself. Additional blank pages are given at the end in the question paper booklet for rough work.
- Handover the OMR answer sheet to the invigilator before leaving the examination hall.
- This paper contains questions in English only.
- The OMR answer sheet is liable to become invalid if there is any mistake in filling the correct bubbles for question booklet number / roll number or if there is any discrepancy in the name/signature of the candidate. The OMR answer sheet may also become invalid due to folding or putting stray marks on it or any damage to it. The candidate is solely responsible for such invalidation due to incorrect marking or careless handling of the OMR sheet.
- No candidate shall be allowed to leave the Hall till one hour of commencement of the Examination.
- Candidate found taking an unfair means is liable to be expelled from the examination and all the papers in which (s)he has already appeared are liable to be rejected.

1. Given $f(a)=2$, $f'(a)=1$, $g(a)=-1$, $g'(a)=2$. What is the value of $\lim\limits_{x\to a}\dfrac{g(x)f(a)-g(a)f(x)}{x-a}$?

   A) 5

   B) 0

   C) 1

   D) 0.5

2. The fuel cost of an engine is directly proportional to the square of its velocity. When the velocity is 16 km/hour the fuel cost is Rs. 48 per hour. If the other operational costs of the engine are Rs. 300 per hour, what velocity minimizes the (per hour) fuel cost of running the engine?

   A) 36 km/hour

   B) 40 km/hour

   C) 18 km/hour

   D) 60 km/hour

3. A particle moving with constant acceleration along a straight line traverses 21 ft, 43 ft and 91 ft in 2 seconds, 4 seconds and 7 seconds, respectively. What will be the velocity of the particle after 3 seconds?

   A) 8 ft/sec

   B) 11 ft/sec

   C) 15 ft/sec

   D) 30 ft/sec

4. Evaluate $\int_{-\pi/2}^{\pi/2}\dfrac{dx}{1+\tan^4 x}$.

   A) $\pi/2$

   B) 1

   C) 0

   D) infinity

5. What is the length of the chord generated via interception of the straight line $2x + y = 7$ by the circle $x^2 + y^2 - 6x - 2y + 5 = 0$?

A) $3\sqrt{2}$

B) 5

C) $5\sqrt{2}$

D) $2\sqrt{5}$

6. If the graph of the equation $y = ax^3 + bx^2 + cx + d$ has horizontal tangent at the points $(-2, 6)$ and $(2, 0)$ then

A) $a = \dfrac{3}{16}, b = 0, c = -\dfrac{9}{4}, d = 3$.

B) $a = \dfrac{3}{16}, b = 3, c = -\dfrac{9}{4}, d = 0$.

C) $a = 3, b = 0, c = -\dfrac{9}{4}, d = \dfrac{3}{16}$.

D) $a = 0, b = 3, c = -\dfrac{9}{4}, d = \dfrac{3}{16}$.

7. The equation of the common tangent of the parabolas $y = x^2$ and $y = x^2 - 2x + 2$ is

A) $y = x$

B) $y = x - 0.5$

C) $y = x + 0.25$

D) $y = x - 0.25$

8. If the differentiable function $f(x)$ satisfy the following condition (i) $f(g(x)) = x$; (ii) $f'(x) = 1 + [f(x)]^2$; (iii) $g'(x) = 1/(1 + x^2)$ then

A) $f(x) = \sin x$

B) $f(x) = \sin^{-1} x$

C) $f(x) = \tan x$

D) $f(x) = \tan^{-1} x$

9. If A and B are two 3×3 matrix that satisfy $A+B=2B^T$ and $2A+3B=6I_3$ where B^T is transpose of B and I_3 be the unit matrix of order three then

A) $A=B=\dfrac{4}{5}I_3$

B) $A=B=\dfrac{6}{5}I_3$

C) $A=\dfrac{4}{5}I_3$ and $B=\dfrac{6}{5}I_3$

D) $A=\dfrac{6}{5}I_3$ and $B=\dfrac{4}{5}I_3$

10. Given that $A=\begin{bmatrix}1&2&3\\4&5&6\end{bmatrix}$ and B is a 3×3 matrix whose 2nd column is only know. Specifically $B=\begin{bmatrix}?&4&?\\?&-1&?\\?&2&?\end{bmatrix}$. How much of AB you can determine on the basis of this information?

A) Only 1st row

B) Only 2nd row

C) Only 1st column

D) Only 2nd column

11. The roots of the equation

$$\begin{vmatrix} a^2 & (x-a)^2 & (x-a)^2 \\ (x-b)^2 & b^2 & (x-b)^2 \\ (x-c)^2 & (x-c)^2 & c^2 \end{vmatrix}=0$$

are

A) $x=0,1,ab,ac$

B) $x=0,a,b,c$

C) $x=0,a^2,b^2,c^2$

D) $x=0,a^3,b^3,c^3$

12. If the solution of the initial-value problem $x^2 y' + xy = 1$ with $x > 0$ and $y(1) = C$ is $y = \dfrac{\ln x + 2}{x}$ then

    A) $C = 0$

    B) $C = 1$

    C) $C = 2$

    D) $C = 3$

13. Consider two series are $\{a_n\}_1^\infty$ and $\{b_n\}_1^\infty$ where we have $a_n = a + (n-1)c$ and $b_n = ac^{n-1}$ for some $a > 0$, $0 < c < 1$. The sum $S = \sum_{n=1}^\infty a_n b_n$ is

    A) Increasing in c

    B) Decreasing in c

    C) Non-monotonic in c

    D) Non-monotonic in c depending on the value of a.

14. In a certain city 40% of the people have brown hair, 25% have brown eyes and 15% have brown eyes as well as brown hair. If a person selected at random has brown hair, the probability that he also has brown eyes, is equal to

    A) $\dfrac{1}{4}$

    B) $\dfrac{2}{5}$

    C) $\dfrac{3}{8}$

    D) $\dfrac{3}{4}$

15. If f is a function such that $f(0) = 2$, $f(1) = 3$ and $f(x+2) = 2f(x) - f(x+1)$ for every real x then $f(5)$ is

    A) 7

    B) 13

    C) 1

    D) 5

16. The matrix $\dfrac{1}{3}\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & -1 \end{bmatrix}$ is

    A) Orthogonal

    B) Involutory

    C) Idempotent

    D) Nilopotent

17. In a group of 6 boys and 4 girls, four children are to be selected. In how many different ways can they be selected such that at least one boy should be there?

    A) 159

    B) 194

    C) 205

    D) 209

18. Let x and y be positive numbers and let a and b be real numbers, positive or negative. Suppose that $x^a = y^b$ and $y^a = x^b$. Then we can conclude that

    A) $a = b$ and $x = y$

    B) $a = b$ and x need not to be equal to y

    C) $x = y$ and a need not to be equal to b

    D) $a = b$ or $a = -b$ but x need not to be equal to y

19. The number of solutions of the simultaneous equations $y = 3\log_e x$, $y = \log_e 3x$

    A) 0

    B) 1

    C) 3

    D) infinite

20. The arithmetic mean of two positive numbers is $18\dfrac{3}{4}$ and their geometric mean is 15. The larger of the two numbers is

    A) 24

    B) 25

    C) 20

    D) 30

21. A polygon has 44 diagonals. Find the number of its sides.

    A) 88

    B) 22

    C) 11

    D) 8

22. In an examination, 80% students passed in Mathematics, 72% passed in Science and 13% failed in both the subjects. If 312 students passed in both the subjects, find the total number of students who appeared in the examination.

    A) 380

    B) 580

    C) 480

    D) 460

23. At the end of each year, the value of a certain machine has depreciated by 20% of its value at the beginning of that year. If its initial value was Rs. 1250/-, find the value at the end of 5 years.

    A) 512

    B) 409.60

    C) 0

    D) 250

24. A box contains 5 blue and an unknown number of red balls. Two balls are drawn at random. If the probability of both of the them being blue is (5/14), find the number of red balls.

    A) 12

    B) 3

    C) 36

    D) 14

25. How many of the natural numbers from 1 to 1000 have none of their digits repeated?

    A) 648

    B) 738

    C) 81

    D) 522

Group – B

Directions (Questions 26 to 30)

Read the following information to answer the given questions:

  i)   A, B, C, D, E, F and G are playing cards sitting around a circular table.

 ii)   D is not neighbour of C or E.

iii)   A is neighbour of B and C.

iv)   G, who is second to the left of D, is the neighbour of E and F.

26.   Which of the following is correct?

    A)   B is between A and D.

    B)   D is between F and G.

    C)   E is to the immediate right of G.

    D)   F is to the immediate left of G.

27.   Which of the following are sitting in a pair?

    A)   BF

    B)   GF

    C)   EF

    D)   Both (B) and (C) are correct.

28.   Which of the following will be D's position after E and D interchanging their places?

    A)   Neighbour of G and C.

    B)   To the immediate left of C.

    C)   To the immediate right of F.

    D)   Neighbour of C and A.

29.   Which of the following are sitting in a sequence?

    A)   DGB

    B)   GAE

    C)   BCF

    D)   GFD

30. Which of the following is wrong?

   A) A is to the immediate right of B.

   B) B is to the immediate left of D.

   C) F is between G and D.

   D) E is between G and C.

31. Find the wrong term from given Number series 15, 8, 35, 24, 63, 49, 99

   A) 24

   B) 63

   C) 99

   D) 49

32. Second and fourth Saturdays and every Sunday is a holiday. How many working days will be there in a month of 31 days beginning on a Friday?

   A) 24

   B) 23

   C) 22

   D) 25

33. A watch which gains uniformly is 2 minutes slow at noon on Monday and is 4 minutes 48 seconds fast at 2 p.m on the following Monday, when was it correct?

   A) 2 p.m on Tuesday

   B) 2 p.m on Wednesday

   C) 3 p.m on Thursday

   D) 1 p.m on Friday

34. If SEE is coded as 11 what should be the code number for PLEA?

   A) 6

   B) 7

   C) 8

   D) 9

35. Read the following information carefully to answer the question:

   P × Q means "P is sister of Q"

    P ÷ Q means "P is mother of Q"

    P + Q means "P is brother of Q"

    P – Q means "P is father of Q"

    The expression means "S ÷ T – H × V – N" ?

    A) S is grandmother of N

    B) S is great grandmother of N

    C) S is mother of V

    D) N is grandson of S

36. In the given question, figures 1, 2, 3 and 4 constitute the Problem Set. There is a definite relationship between figures 1 and 2. Establish a similar relationship between figures 3 and 4 by selecting a suitable figure from the options that would replace the question mark (?) in Fig. (4).
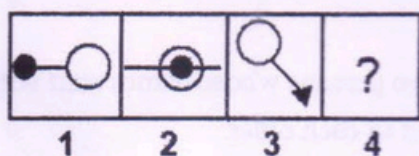
A)

B)

C)

D)

Directions : Read the following sentences for question number 37 to 39.

A, B, C, D and E are 5 friends. All of them are of different heights. The tallest person's position is numbered 1, the next tallest 2, and so on, till the shortest whose position number is 5.

 I. The sum of A's position number and E's position number is equal to the sum of D's position number and C's position number.

 II. C is not the shortest and A is not the tallest.

 III. C is shorter than A, and D is shorter than B.

37. Who is the tallest?

    A) B

    B) A

    C) E

    D) Either B or A

38. If D is shorter than C, then the sum of the position numbers of which of the following combinations is/are a perfect square?

    A) B and A

    B) D and E

    C) C and B

    D) B, C and D, E

39. If D is shorter than C, then which of the following is true?

    A) if made to stand in decreasing order of their heights, no two persons whose names start with consecutive alphabets (as in the alphabetical series) stand adjacent to each other.

    B) The sum of the position numbers of C and A is equal to the position number of E.

    C) The sum of the position numbers of D and E is a prime number.

    D) B is not taller than C.

40. If the positions corresponding to the multiples of 5 in the English alphabet are replaced by symbols and that of multiples of 7 by digits, how many letters will be left?

    A) 15

    B) 17

    C) 18

    D) 21

41. Complete the series 165, 195, 255, 285, 345, ?

    A) 390

    B) 420

    C) 435

    D) 375

42. Here are some words translated from an artificial language.

   relftaga means carefree
   otaga means careful
   fertaga means careless

   Which word could mean "aftercare"?

   A) zentaga

   B) tagafer

   C) tagazen

   D) relffer

43. Choose the pair which is different from the others.

   a) 70 – 80   b) 54 – 62   c) 28 – 32   d) 21 – 24   e) 14 – 16

   A) a

   B) b

   C) c

   D) d

44. Five people were eating apples, A finished before B, but behind C. D finished before E, but behind B. What was the finishing order?

   A) ABDCE

   B) CBDAE

   C) DACEB

   D) CABDE

45. A man has 53 socks in his drawer: 21 identical blue, 15 identical black and 17 identical red. The lights are out and he is completely in the dark. How many socks must he take out to make 100 percent certain he has at least one pair of black socks?

   A) 22

   B) 36

   C) 38

   D) 40

46. A girl meets a lion and unicorn in the forest. The lion lies every Monday, Tuesday and Wednesday and the other days he speaks the truth. The unicorn lies on Thursdays, Fridays and Saturdays, and the other days of the week he speaks the truth. "Yesterday I was lying," the lion told the girl. "So was I," said the unicorn. What day is it?
   A) Sunday
   B) Monday
   C) Thursday
   D) Friday

47. A man is caught on the king's property. He is brought before the king to be punished. The king says, "You must give me a statement. If it is true, you will be killed by lions. If it is false, you will be killed by trampling of wild buffalo. If I can't figure it out, I'll have to let you go." Sure enough, the man was released. What was the man's statement?
   A) "I shall be killed by lions"
   B) "I shall be trampled by wild buffalo"
   C) "You will let me go"
   D) "I am lying".

48. There are three bags, each containing two marbles. Bag A contains two white marbles, Bag B contains two black marbles, and Bag C contains one white marble and one black marble. You pick a random bag and take out one marble, which is white. What is the probability that the remaining marble from the same bag is also white?
   A) 2/3
   B) 1/2
   C) 1/3
   D) 1

49. Suppose Dev left for his college in his car. He drove 15 km towards north and then 10 km towards west. He then turned to the south and covered 5 km. Further, he turned to the east and moved 8 km. Finally, he turned right and drove 10 km. How far and in which direction is he from his starting point?
   A) 2 km West
   B) 5 km East
   C) 3 km North
   D) 6 km South

50. In the following question, select the odd number pair from the given alternatives.
   A) 9 – 90
   B) 6 – 42
   C) 5 – 30
   D) 4 – 36