Institute of Actuaries of India
ACET APR 2017
Mathematics

1. The value of $\cos 135^{\circ}$ is

   A. $\frac{1}{\sqrt{2}}$

   B. $\frac{1}{2}$

   C. $-\frac{1}{\sqrt{2}}$

   D. 1. 1 mark

2. The values of x that satisfy the inequality $x^2 - 3x - 18 > 0$ lie in the set.

   A. $(-\infty, -6) \cup (3, \infty)$

   B. $(-\infty, -3) \cup (6, \infty)$

   C. $(-\infty, -3] \cup [6, \infty)$

   D. $(-\infty, -6] \cup [3, \infty)$. 2 marks

3. If $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$ then

   A. $\vec{a}$ is perpendicular to $\vec{b}$

   B. $\vec{a}$ is parallel to $\vec{b}$

   C. $\vec{a}$ is equal to $\vec{b}$

   D. $\vec{a}$ and $\vec{b}$ are unit vectors. 2 marks

4. If $ax^2 + bx + c = 0, a \neq 0$, has equal roots then c is equal to is

   A. $-\frac{b^2}{4a}$

   B. $\frac{b^2}{4a}$

   C. $\frac{c}{a}$

   D. $\sqrt{\frac{b^2}{4a}}$. 1 mark

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5. A partial fractions expansion of $\frac{1}{(x-1)(x-2)^2}$ is

   A. $\frac{1}{(x-1)} - \frac{1}{(x-2)^2}$

   B. $\frac{1}{(x-1)} + \frac{1}{(x-2)} + \frac{1}{(x-2)^2}$

   C. $\frac{1}{(x-1)} + \frac{1}{(x-2)^2}$

   D. $\frac{1}{(x-1)} - \frac{1}{(x-2)} + \frac{1}{(x-2)^2}$. 2 marks

6. The value of $\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^{n+6}$ is

   A. 0

   B. 1

   C. e^6

   D. e. 1 mark

7. If $y = \frac{\log x^2}{e^x}$, then $\frac{dy}{dx}$ is

   A. $2e^{-x}\left(\frac{1}{x} + \log x\right)$

   B. $2e^{-x}\left(\frac{1}{x} - \log x\right)$

   C. $2e^{x}\left(\frac{1}{x} - \log x\right)$

   D. $e^{-x}\left(\frac{1}{x} - \log x\right)$. 1 mark

8. If $y = \tan^{-1}(\log x)$, then $\frac{dy}{dx}$ is

   A. $\frac{1}{1+(\log x)^2}$

   B. $\frac{x}{1+(\log x)^2}$

   C. $\frac{1}{x(1+(\log x)^2)}$

   D. $\frac{1}{\left(1+\frac{(\log x)^2}{x}\right)}$. 2 marks

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9. The real function $f(x) = 1 - x - x^2$ is increasing in x over the interval

A. $\left(-\infty, -\frac{1}{2}\right)$
B. $\left(-\infty, \frac{1}{2}\right]$
C. $\left[-\frac{1}{2}, \infty\right)$
D. $\left(-\frac{1}{2}, \infty\right)$. 1 mark

10. The value of $\int x \cos x \ dx$ is

A. $x \sin x + \cos x + c$
B. $x \cos x + \sin x + c$
C. $x \sin x - \cos x + c$
D. $x \cos x - \sin x + c$. 1 mark

11. The value of the integral $\int_0^\infty x^7 e^{-\frac{x}{2}} dx$ is

A. $7!\, 2^8$
B. $8!\, 2^8$
C. $7!\, 2^7$
D. $8!\, 2^7$. 2 marks

12. The value of the integral $\int_{-1}^{1} \sin x \cos^4 x \, dx$ is

A. 1
B. $\frac{1}{2}$
C. 0
D. 4. 2 marks

13. If $P = \begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is such that $P^2 = I$, then the correct statement among the following is

A. $1 - \alpha^2 + \beta\gamma = 0$
B. $1 + \alpha^2 + \beta\gamma = 0$
C. $1 + \alpha^2 - \beta\gamma = 0$
D. $1 - \alpha^2 - \beta\gamma = 0$. 1 mark

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14. If $P = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ then the rank of PP^T (where P^T denotes the transpose of P) is

A. 0
B. 1
C. 2
D. 3. 1 mark

15. The inverse of the matrix $P = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ is

A. $\frac{1}{5}\begin{bmatrix} 4 & -1 & -1 \\ -2 & 3 & -2 \\ -1 & -1 & 4 \end{bmatrix}$

B. $\begin{bmatrix} 4 & -2 & -1 \\ -1 & 3 & -1 \\ -1 & -2 & 4 \end{bmatrix}$

C. $\begin{bmatrix} 4 & -1 & -1 \\ -2 & 3 & -2 \\ -1 & -1 & 4 \end{bmatrix}$

D. $\frac{1}{5}\begin{bmatrix} 4 & -2 & -1 \\ -1 & 3 & -1 \\ -1 & -2 & 4 \end{bmatrix}$. 3 marks

16. It is given that $\log_e 1.5 = 0.405$. Then the value of $\log_e 1.3$, obtained by linear interpolation and by utilizing the known value of $\log_e 1$, is

A. 0.243
B. 0.158
C. 0.329
D. 0.389. 1 mark

17. The value of 0.99^4, up to four decimal places, is

A. 0.0394
B. 1.0406
C. 0.8606
D. 0.9606. 1 mark

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Statistics

18. Five students are to be selected from a group of 10 students to form a team such that two particular students are always included in the team. The number of ways the team can be formed is

    A. 112
    B. 252
    C. 56
    D. 120. 1 mark

19. Box B_1 contains 3 white and 5 red balls, and box B_2 contains 6 white and 4 red balls. A box is selected based on the outcome of tossing a coin with $P(\text{Head}) = \frac{2}{3}$. The box B_1 is selected if head appears and B_2 otherwise. A ball is then drawn at random from the selected box. The probability that it is a red ball is

    A. $\frac{41}{60}$
    B. $\frac{49}{60}$
    C. $\frac{9}{18}$
    D. None of the above. 1 mark

20. Suppose E and F are two events with $P(E) = \frac{1}{5}$ and $P(F) = \frac{1}{3}$. Which of the following statements is correct?

    A. If E and F are independent, then the probability that at least one of them occurs is $\frac{8}{15}$
    B. If E and F are mutually exclusive, then the probability that at least one of them occurs is $\frac{7}{15}$
    C. If E and F are independent, then the probability that E occurs but F does not occur is $\frac{2}{15}$
    D. If E and F are independent, then the probability that neither event occurs is $\frac{12}{15}$.

    2 marks

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21. The mean of the following distribution is 6, where p is unknown.

Value	3	4	5	6	7	8	9
Frequency	1	4	7	6	p	3	1

The distribution has

A. median 6 and mode 5
B. median 6 and mode 7
C. median 5 and mode 5
D. median 7 and mode 7. 3 marks

22. The incomes of 100 families in a certain region are stored in a computer file. The income ranges from Rs. 10,000.00 per year to Rs. 42,500.00 per year. By mistake, the highest income in the data set is recorded as Rs. 4,25,000.00. Which of the following statements regarding the effect of the mistake is true?

A. The average income is overestimated by Rs. 4250.00
B. The median income is correctly estimated
C. The median income is overestimated
D. The interquartile range is overestimated. 2 marks

23. A random variable X takes only two values, 0 and 1, with $P(X = 0) = 0.3$. Then the value of $E(X^{11})$ is

A. 0.3
B. 0.3^{11}
C. 3.3
D. 0.7. 1 mark

24. A random variable X has binomial distribution with mean 4 and variance 2.4. The probability that X is positive

A. is 0.6^6
B. is $1 - 0.4^{10}$
C. is $1 - 0.6^{10}$
D. cannot be determined. 1 mark

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25. A random variable X has Poisson distribution with mean 2. Then the value of $E[X(X-1)(X-2)(X-3)]$ is

A. 4

B. 8

C. 10

D. 16 1 mark

26. The random variable X has the cumulative distribution function

$$F(x) = \frac{x}{12}, \ 0 \leq x \leq 12.$$

The coefficient of variation of X is

A. $\sqrt{3}$

B. $\frac{1}{\sqrt{3}}$

C. 2

D. $2\sqrt{3}$. 2 marks

27. The random variable X has the probability density function.

$$f(x) = 3e^{-3x}, \quad x > 0.$$

The value a for which $E(X-a)^2$ is minimum is

A. 3

B. $\frac{1}{3}$

C. 6

D. 9. 1 mark

28. Suppose X follows the normal distribution with mean μ and variance σ^2, and

$$P(x) = \int_0^x \frac{1}{\sqrt{2\pi}} e^{-\frac{u^2}{2}} du.$$

Then $P(\mu - 2\sigma \leq X \leq \mu + 2\sigma)$ is equal to

A. $2P(2)$

B. $2P(2) - 0.5$

C. $P(2)$

D. $P(2) + 0.5$. 1 mark

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29. The random variable X takes the values -1 and 1, each with probability $\frac{1}{2}$. The covariance between X and X^2 is

A. 2
B. 0
C. -1
D. 1. 1 mark

30. A simple linear regression line of y on x is fitted by the least squares method based on the bivariate data given in the following table.

x	1	8	10	10	14	17
y	1	4	6	12	12	7

The regression coefficient of y on x is found to be $b_{yx} = 0.533$. If z is a new variable defined as $z = 3x$, which of the following statements is true?

A. The intercept of the regression line of y on z with the y-axis is $1.67/3$.
B. The intercept of the regression line of y on z with the y-axis is 1.67×3.
C. The slope of the regression line of y on z is $0.533/3$.
D. The slope of the regression line of y on z is 0.533×3. 3 marks

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Data Interpretation

The following frequency distribution represents the marks of 100 students in a class. Answer Questions 31 – 35 based on this frequency distribution.

Marks	Number of students
10-19	3
20-29	6
30-39	8
40-49	20
50-59	35
60-69	12
70-79	8
80-89	5
90-99	3

31. The number of students scoring less than 50 is

    A. 37
    B. 38
    C. 39
    D. 40. 1 mark

32. The number of students scoring less than 80 but not less than 50 is

    A. 80
    B. 60
    C. 55
    D. 75. 1 mark

33. Suppose it is known that exactly three students have scored 60 each. Then the number of students who have scored more than 60 is

    A. 28
    B. 25
    C. 16
    D. 22. 1 mark

34. The number of students scoring less than 45 is

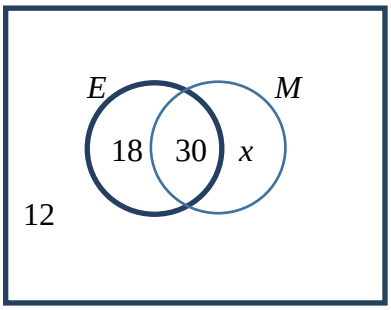
    A. less than 17
    B. between 17 and 37
    C. between 37 and 40
    D. between 40 and 45. 1 mark

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35. The 75^{th} percentile of the marks lies in between

A. 50-59
B. 80-89
C. 70-79
D. 60-69. 2 marks

36. Suppose 80 candidates appeared for a combined test in English and Mathematics. Let E and M denote the set of candidates passed in English and Mathematics, respectively, and is shown in the following Venn-diagram. The numbers 12, 18, 30 and x in different parts of the diagram indicate the number of students in those parts.

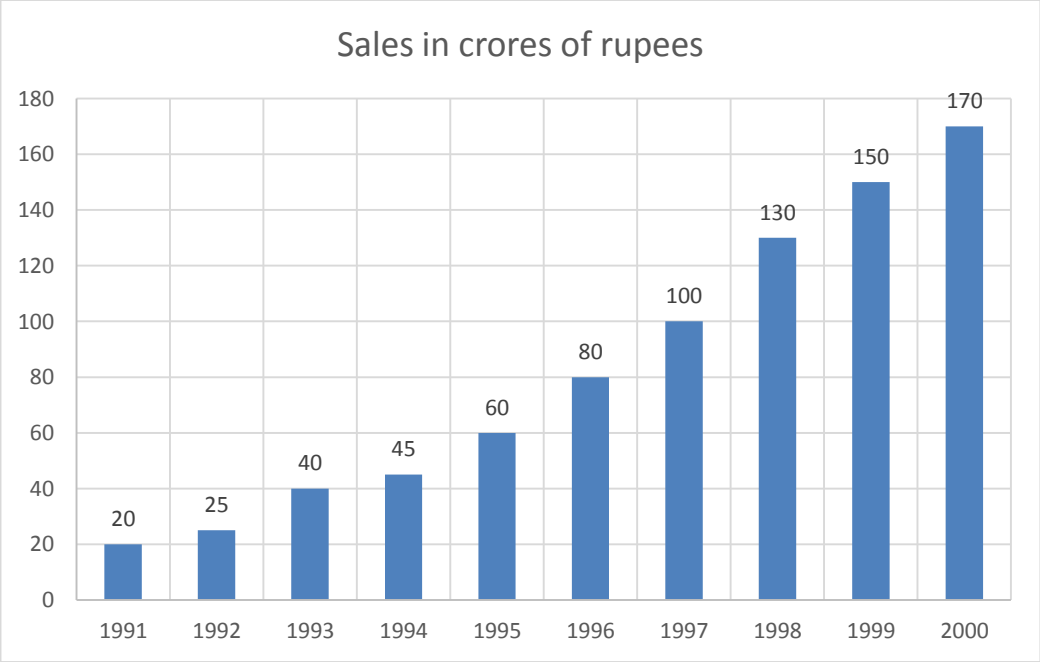


The number of candidates passed in Mathematics is

A. 32
B. 20
C. 50
D. 38. 1 mark

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The sales (in crores of rupees) of a company in ten consecutive years are shown in the bar chart. Use this information to answer Questions 37-38.



37. The percentage rise in sale is maximum during

A. 1998-99
B. 1994-95
C. 1992-93
D. 1996-97. 2 marks

38. The overall change in sales value during 1991-2000 is

A. 750%
B. 850%
C. 88.24%
D. 170%. 1 mark

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English

39. Choose the word that can be used as a synonym of "Satisfied".

A. Quenched
B. Honoured
C. Adjusted
D. Corrected 1 mark

40. Choose the word that can be used as a synonym of "Significant".

A. Substantial
B. Proper
C. Essential
D. Obscure 1 mark

41. Choose the phrase that can be used as an antonym of "To mend".

A. To repair
B. To build
C. To break
D. To prepare 1 mark

42. Choose the word that can be used as an antonym of "Serious".

A. Sober
B. Grievous
C. Genuine
D. Ridiculous 1 mark

43. One who is indifferent to pains and pleasure of life is called

A. Impregnable
B. Stoic
C. Unassailable
D. Inviolable 1 mark

44. One who has good taste for food is called

A. Taster
B. Gourmet
C. Greedy
D. Chef 1 mark

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45. Identify the alternative which will replace '?'

Appreciation : Reward :: Disapproval : ?

A. Crime
B. Guilt
C. Allegation
D. Penalty 1 mark

46. Identify the alternative which will replace '?'

Heat : Warm :: ? : Pretty

A. Beauty
B. Attractive
C. Pleasure
D. Likeable 1 mark

47. Choose the word/phrase that cannot be used as a meaning of "Up to the mark"

A. Good enough
B. Of required standard
C. Excellent
D. Sufficient 1 mark

48. Choose the word/phrase that cannot be used as a meaning of "Ins and outs"

A. Nuts and bolts
B. Full particulars
C. Full details
D. Hammer and nail 1 mark

49. Rearrange the following parts (1, 2, 3 and 4) in proper sequence to obtain a correct sentence.

(1) your chickens
(2) have hatched
(3) don't count
(4) before the eggs

A. 1, 2, 3, 4
B. 3, 1, 4, 2
C. 4, 3, 1, 2
D. 1, 3, 4, 2 1 mark

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50. Rearrange the following parts (1, 2, 3 and 4) in proper sequence to obtain a correct sentence.

(1) you do it right
(2) you only live
(3) once is enough
(4) once but if

A. 1, 2, 4, 3
B. 2, 4, 3, 1
C. 1, 3, 4, 2
D. 2, 4, 1, 3 1 mark

51. Fill the blank in the following sentence.

We _____ the point where the movie was shot.

A. went in
B. went across
C. went about
D. went over 1 mark

52. Fill the blank in the following sentence.

He _____ the railway station in time.

A. reached
B. reached at
C. reached to
D. reached for 1 mark

53. Fill the blank in the following sentence.

He is shy, _____ he danced at the party.

A. nonetheless
B. rather
C. instead
D. even 1 mark

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54. Choose the correct replacement for the underlined part of the following sentence.

He has written extensively on not only major figures in Indian politics like Mahatma Gandhi, but also on the poetry of Kabeer.

A. on not only major figures in Indian politics like Mahatma Gandhi, and also on
B. not only on major figures in Indian politics like Mahatma Gandhi, but also on
C. on major figures in Indian politics like Mahatma Gandhi, as well as
D. on major figures in Indian politics like Mahatma Gandhi, but also on

2 marks

55. Choose the correct replacement for the underlined part of the following sentence.

An analysis of objects found in the cities of Indus valley civilization show that even some people owned gold and silver ornaments.

A. show that some people owned gold and silver ornaments
B. show that some people owned even gold and silver ornaments
C. shows that even some people owned gold and silver ornaments
D. shows that some people owned even gold and silver ornaments 2 marks

56. Choose the correct replacement for the underlined part of the following sentence.

While deciding the new policies for rural development, the Government takes into account life expectancy, education, as well as income per person.

A. life expectancy, education, as well as income per person in its account
B. into account life expectancy and education, as well as income per person
C. into account life expectancy, and education, and income per person
D. life expectancy, education, and income per person in its account 2 marks

57. Select the most logical order of sentences from among the given choices to construct a coherent paragraph.

P: When I came back from the United States, I wanted to tell my family of my great triumph.

Q: I was trying hard to give up smoking for long.

R: I really gave it up.

S: And so when I went to the United States for one year training I said to myself: I really must give it up.

The proper sequence should be

A. PSRQ
B. SPQR
C. QSRP
D. QRSP. 2 marks

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58. Select the most logical order of sentences from among the given choices to construct a coherent paragraph.

P: They were excited, fascinated by the sight of fresh snow on the roads.
Q: Even so, it looked beautiful to tourists of various categories.
R: But some visitors came away with the unforgettable sight of young and scantily clad labours.
S: The locality is almost a slum and stinks most of the time.

The proper sequence should be

A. QSRP
B. SQRP
C. SRPQ
D. SQPR 2 marks

59. Read the following two paragraphs.

Music is capable of a number of health benefits including lowering stress levels, raising states of consciousness, changing moods, accessing different states of mind, developing the brain and is useful in meditation. There isn't a single human culture that has lived without music. For example, native Africans and Americans both used music in the form of chanting for their rituals and healing ceremonies. In Greece, music was used to ease stress, soothe pain and help with sleeping patterns. Many have said music heals the soul, and it appears that they were right.

Research has shown that listening to music in old age can help keep the brain healthy. Since listening to music is like exercising the brain, one can expect the benefits of better memory and mental sharpness as they age. Even people who have some form of brain damage can regain partial or full access to memories by listening to.

Choose the sentence which summarizes above paragraph best:

A. Listening to music has been traditionally used for its healing effects.
B. Listening to music is beneficial for general well-being and health of the brain.
C. Listening to music is beneficial in old age.
D. Listening to music lowers stress. 2 marks

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60. Read the following paragraph:

The new forms of social media are electronic and let people communicate with one another using technology such as computers, smart phones and the internet. Social media can be used to socialise and communicate and help you in various things, for example, get a message to many people at once, or find a job. When it was created, the intention was that people would share thoughts and ideas with likeminded people and keep in touch with distant family. However, you may not have thought about some of the problems it may cause for you. When we post on the internet we think we are safe and secure in our own living rooms or offices. But perhaps, we are not in a safe and private place. We are actually in a very crowded room surrounded by hundreds if not thousands of people on all sides. Someone, who is not in our circle, may be listening to our conversation and may misuse some of our personal information.

Choose the sentence which summarizes above paragraph best:

A. We should be careful while interacting with a stranger on social media.
B. Social media helps us interacting with people.
C. We should not use social media as it may be dangerous.
D. We should be careful while sharing some information on social media.

2 marks

Read the passage below and answer Question 61:

Solar products are being increasingly used to meet rural needs. By the end of 2015, a cumulative total of just under 1 million solar lanterns have been sold in the country, reducing the need for expensive kerosene. In addition, a cumulative total of 30,256 solar powered pumps had been installed for irrigation and drinking water. During 2015 alone, 118,700 solar home lighting systems were installed, and 46,655 solar street lighting installations were provided under a national program.

In January 2016, India and France laid the foundation stone for the headquarters of the International Solar Alliance (ISA) in Gurgaon. The ISA will focus on promoting and developing solar energy and solar products for countries lying wholly or partially between the Tropic of Cancer and the Tropic of Capricorn. The alliance of over 120 countries was announced at the Paris COP21 climate summit.

With about 300 clear, sunny days in a year, the theoretically calculated solar energy incidence on India's land area is about 5000 trillion kilowatt-hours (kWh) per year (or 5 EWh/yr). The solar energy available in a year exceeds the possible energy output of all fossil fuel energy reserves in India. Grid connected solar electricity generation has reached 1% of the total utility electricity generation. Presently, solar generation is serving to meet the peak load during the day time in non-monsoon months when the electricity spot prices are fetching above the daily average price.

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I. In India, Solar power is being used

i. for lights and pumps
ii. as direct fuel for cooking
iii. both i and ii
iv. neither of i and ii.

II. International Solar Alliance will focus on

i. developing solar energy and solar products for India and France
ii. promoting solar energy in India along with some other countries
iii. both i and ii
iv. neither of i and ii.

III. If all the possibilities of deployment of solar energy plants are exhausted in the country,

i. solar energy can exceed the possible energy output of fossil fuel energy reserves in India
ii. price of electricity can come down
iii. both i and ii
iv. neither of i and ii.

61. The correct answers to I, II and III are:

A. iii, iii and iv, respectively
B. iii, i and ii, respectively
C. i, ii and i, respectively
D. iii, iii and ii, respectively. 3 marks

Read the passage below and answer Question 62:

The period of 400 AD to 1600 AD is considered as classical period of Indian Mathematics, though it emerged in the Indian subcontinent from 1200 BC. The decimal number system and the concept of zero as a number was first recorded in Indian mathematics. Indian mathematicians made early contributions to the study of arithmetic, algebra, and trigonometry. In addition, the modern definitions of sine and cosine were developed here. Ancient and medieval Indian mathematical works, all composed in Sanskrit, usually consisted of a section of sutras in which a set of rules or problems were stated with great economy in verse in order to aid memorization by a student. This was followed by a second section consisting of a prose commentary (sometimes multiple commentaries by different scholars) that explained the problem in more detail and provided justification for the solution. In the prose section, the form was not considered as important as the ideas involved.

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Excavations at Harappa, Mohenjo-daro and other sites of the Indus Valley Civilisation have uncovered evidence of the use of practical mathematics. They used a standardised system of weights based on the ratios: 1/20, 1/10, 1/5, 1/2, 1, 2, 5, 10, 20, 50, 100, 200, and 500, with the unit weight equalling approximately 28 grams, approximately equal to the English ounce or Greek uncia. They mass-produced weights in regular geometrical shapes, which included hexahedra, barrels, cones, and cylinders, thereby demonstrating knowledge of basic geometry. The inhabitants of Indus civilisation also tried to standardise measurement of length to a high degree of accuracy. They designed a ruler called as the Mohenjo-daro ruler, whose unit of length (approximately 1.32 inches or 3.4 centimetres) was divided into ten equal parts. Bricks manufactured in ancient Mohenjo-daro often had dimensions that were integral multiples of this unit of length.

I. The decimal number system was first used by the mathematicians based in

i. Greece
ii. Indian subcontinent
iii. England
iv. elsewhere.

II. In ancient and medieval Indian mathematics,

i. a formula was written in the form of Sanskrit verses
ii. a formula was explained as prose
iii. both i and ii
iv. neither of i and ii.

III. People of Indus Valley Civilisation

i. were good at using basic geometry
ii. developed the system of units for measuring mass and length
iii. both i and ii
iv. neither of i and ii.

62. The correct answers to I, II and III are:

A. ii, iv and iv, respectively
B. iv, i and ii, respectively
C. i, ii and iii, respectively
D. ii, iii and iii, respectively. 3 marks

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Logical Reasoning

63. Given below are two statements followed by two conclusions:

Statement I: Some doctors are fools.
Statement II: Some fools are rich.

Conclusion I: Some doctors are rich.
Conclusion II: Some rich are doctors.

Which of the conclusions follow from the two statements?

A. Only conclusion I follows.
B. Only conclusion II follows.
C. Both the conclusions follow.
D. Neither conclusion follows. 1 mark

64. Re-entry occurs when a person leaves his or her social system for a period of time and then returns. Which of the situations described below best describes re-entry?

A. When he is offered a better paying position, Ram leaves the restaurant he manages to manage a new restaurant on the other side of the town.
B. Sheela is spending her first year of college studying abroad in London.
C. Mohan is readjusting to civilian life after five years of service in Indian Army as an officer.
D. After several miserable months, Neeta decides that she can no longer share an apartment with her room-mate Mita. 1 mark

65. A shepherd had 17 sheep. All but 9 have died. How many sheep does he have now?

A. 17
B. 9
C. 8
D. None of the above. 1 mark

66. At a repair workshop, 50 cars were inspected, of which 23 needed new brakes, 34 needed new exhaust systems, and 6 needed neither. How many cars needed new brakes, but not a new exhaust system?

A. 10
B. 21
C. 13
D. 23. 1 mark

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67. Introducing a boy, a girl said, "He is the son of the daughter of the father of my uncle." How is the boy related to the girl? (Assume no marriage between close relatives.)

    A. Son-in-law
    B. Nephew
    C. Uncle
    D. None of the above. 1 mark

68. Given that 27th February 2003 was a Thursday, what was the day on 27th February 1603?

    A. Monday
    B. Thursday
    C. Sunday
    D. Tuesday. 2 marks

69. A clock loses 1% time during the first week and then gains 2% time during the next one week. If the clock was set right at 12 noon on a Sunday, what will be the time that the clock will show exactly 14 days from the time it was set right?

    A. 1:36:48
    B. 1:40:48
    C. 1:41:24
    D. 10:19:12. 1 mark

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

    - D is not neighbour of C or E.
    - A is neighbour of B and C.
    - G is second to the left of D.
    - G is the neighbour of E and F.

    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. 2 marks

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