IAI

Institute of Actuaries of India

ACET OCT 2016

Mathematics

1. The values of x when the real functions $f(x) = 3x^2 - 1$ and $g(x) = x + 3$ are equal are

   A. $-1,\ -\frac{4}{3}$

   B. $-1,\ \frac{4}{3}$

   C. $1,\ -\frac{4}{3}$

   D. $1,\ \frac{4}{3}$. 2 marks

2. The Maclaurins' series for $\log(1 + x)$ (with $|x| < 1$) is

   A. $x + \frac{x^2}{2} + \frac{x^3}{3} + \cdots$

   B. $1 + x + \frac{x^2}{2} + \frac{x^3}{3} + \cdots$

   C. $x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots$

   D. $1 + x + \frac{x^2}{2} + \frac{x^3}{3} - \cdots$. 1 mark

3. The following table gives, for a given right tail probability $(\alpha = 0.1)$ and for different degrees of freedom n, the values of t.

n	30	40	60
t	1.310	1.303	1.296

   Assuming simple linear relationship between n and t, the interpolated value of t when $n = 35$ is

   A. 1.3065

   B. 1.3060

   C. 1.3135

   D. 1.2995. 1 mark

4. The value of $\left(\sqrt{3} + 1\right)^5 - \left(\sqrt{3} - 1\right)^5$ is

   A. $68\sqrt{3}$

   B. 152

   C. $76 + 34\sqrt{3}$

D. 76. 2 marks

5. The ratio $\frac{3x+7}{x^2-3x+2}$ is resolved into partial fraction as

A. $\frac{13}{x-2}+\frac{10}{x-1}$

B. $\frac{-1}{x+2}-\frac{-4}{x+1}$

C. $\frac{3}{x-2}+\frac{7}{x-1}$

D. $\frac{13}{x-2}-\frac{10}{x-1}$. 2 marks

6. $\lim_{x\to\infty}\frac{x^2}{e^x}$ is

A. 1

B. 2

C. 0

D. ∞. 1 mark

7. If $y=\tan^{-1}x$ then $\frac{dy}{dx}$ is equal to

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

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

C. $1+x^2$

D. $1-x^2$. 1 mark

8. The function $\log(\log x)$ is an increasing function of x in

A. $[1,\infty)$

B. $(1,\infty)$

C. $(-\infty,\infty)$

D. $(-\infty,1)$. 1 mark

9. The value of $\int_0^1\frac{e^x+1}{e^x}\,dx$ is

A. $2-e^{-1}$

B. $-e^{-1}$

C. $1-e^{-1}$

D. ∞. 1 mark

10. If x and y satisfy the equation $x^3 + 8xy + y^3$=64, then $\frac{dy}{dx}$ is

A. $\frac{3x^2+8y}{8x+3y^2}$

B. $-\frac{3x^2+8y}{8x+3y^2}$

C. $\frac{3x^2-8y}{8x+3y^2}$

D. $-\frac{3x^2+8y}{8x-3y^2}$. 3 marks

11. The value of $\int \log x \, dx$, is (assuming k is a constant)

A. $x \log x + x + k$
B. $x \log x - x + k$
C. $-x \log x + x + k$
D. $\frac{1}{x} + k$. 1 mark

12. The value of $\int_0^\infty x^6 \, e^{-\frac{x}{2}} dx$ is equal to

A. $2^6 6!$
B. $2^7 6!$
C. $2^7 7!$
D. $2^6 7!$. 2 marks

13. If $\vec{a} = 2\vec{\imath} + 2j - \vec{k}$ and $\vec{b} = 6\vec{\imath} - 3j + 2\vec{k}$, then $\vec{a}.\vec{b}$ is equal to

A. 20
B. 0
C. 27
D. 4. 1 mark

14. Let $\vec{a} = 3\vec{\imath} + 2\vec{j} + 9\vec{k}$ and $\vec{b} = \vec{\imath} + m\vec{j} + 3\vec{k}$. The value of m when $\vec{a}$ and $\vec{b}$ are parallel is

A. $\frac{2}{3}$

B. 1

C. 2

D. $\frac{3}{2}$. 1 mark

15. If $P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ then $P^4 - 2P^3 + P^2 - 3P$ is equal to

A. P
B. $3P$
C. $9P$
D. the identity matrix. 2 marks

16. If $P = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$, then P^{-1} is (assuming T in superscript denotes transpose)

A. P^T
B. $-P^T$
C. P
D. $-P$. 1 mark

17. If $P = \begin{bmatrix} 4 & x+2 \\ 2x-3 & x+1 \end{bmatrix}$ is such that $P = P^T$ (where T in superscript denotes transpose), then the value of x is

A. 4
B. 3
C. 1
D. 5. 1 mark

18. If $A = \begin{bmatrix} 1 & -1 & 2 \\ 2 & -2 & 4 \\ 4 & -4 & 8 \end{bmatrix}$, then the rank of A is

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

Statistics

19. If $C_r^{15} : C_{r-1}^{15} = 11 : 5$, then r is

    A. 11
    B. 6
    C. 10
    D. 5. 1 mark

20. The following is the line plot of number of books bought by individual customers at a bookstore in one day.

		x				
x		x				x
x	x	x	x			x
x	x	x	x	x		x
1	2	3	4	5	6	7

    The median number of books bought by customers is

    A. 3
    B. 4
    C. 3.5
    D. 4.5. 1 mark

21. The arithmetic mean and geometric mean of two observations are 25 and 15 respectively. The two observations are

    A. $25, 25$
    B. $0, 50$
    C. $45, 5$
    D. $20, 30$. 1 mark

22. If $P(A) = 0.8, P(B) = 0.35$, and $(A \cap B) = 0.25$, then $P(AUB)$ is equal to

    A. 0.9
    B. 0
    C. 1
    D. 0.75. 1 mark

23. The probability that a Poisson random variable X takes a positive value is $1 - e^{-2}$. The mean of X is

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

24. The variance of the first n natural numbers $(1, 2, \dots, n)$ is

A. $\frac{(n+1)(2n+1)}{6}$

B. $\frac{n^2-1}{12}$

C. $\frac{2n\,(2n+3)}{6}$

D. $\frac{(n+1)^2}{12}$. 2 marks

25. A and B are independent events such that $P(A) = \frac{1}{3}$ and $P(B) = \frac{3}{4}$, then $P(A|A \cup B)$ is equal to

A. $\frac{2}{5}$

B. $\frac{4}{9}$

C. $\frac{4}{13}$

D. $\frac{1}{3}$. 2 marks

26. The value of *k* for which the function

$$f(x) = \begin{cases} \min\{x, (k-x)\} & \text{if } 0 < x < 2, \\ 0 & \text{otherwise,} \end{cases}$$

is a probability density function is

A. 1

B. 2

C. 3

D. 4. 2 marks

27. The mean and variance of a normal random variable *X* are 40 and 16 respectively. Then $P(X < 46)$ is

A. 0.4938

B. 0.9332

C. 0.5062

D. 0.0668. 2 marks

28. The correlation coefficient between X and Y is 0.6. If $\sigma_X = 1.5$, $\sigma_Y = 2$, $\bar{X} = 10$, and $\bar{Y} = 20$, then the regression of $Z = 10Y + 5$ on X is

A. $Z - 20 = 0.8\,(X - 10)$

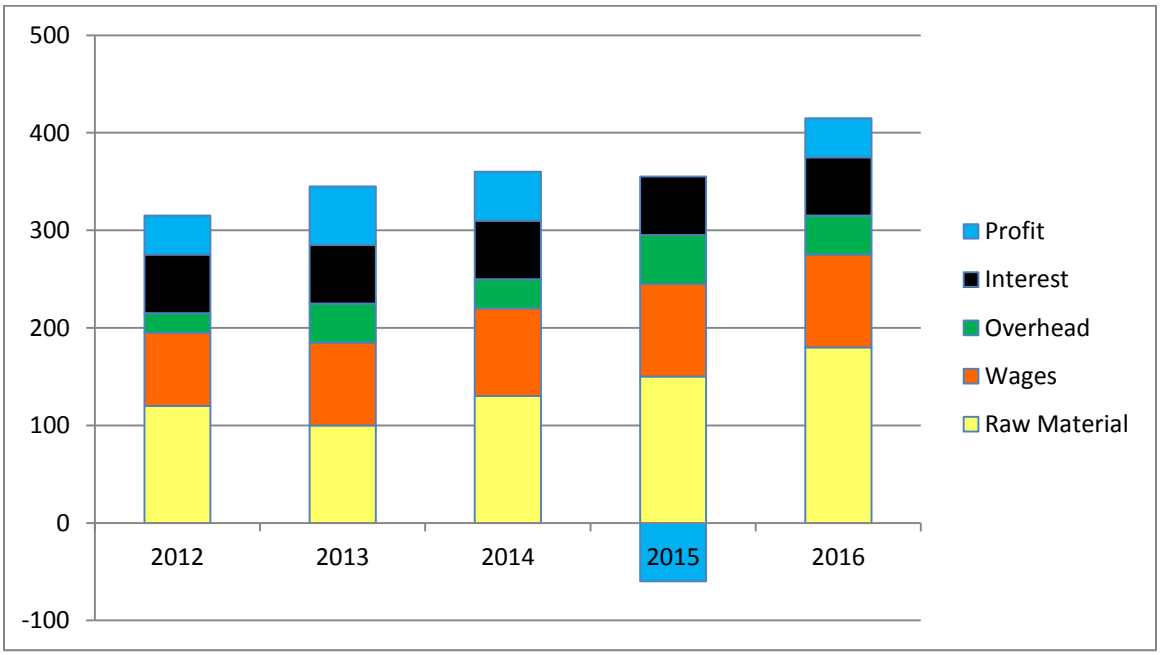
B. $X - 10 = 0.8(Z - 20)$

C. $Z - 205 = 0.45\,(X - 10)$

D. $Z - 205 = 8(X - 10)$. 3 marks

Data Interpretation

Answer the Questions 29-31 based on the composite bar-chart of cost of raw material, wages, overhead costs, interest paid and profit over five successive years, given below.



29. In which of the following years was the biggest change in the profit observed?

    A. Between 2012 and 2013
    B. Between 2013 and 2014
    C. Between 2014 and 2015
    D. Between 2015 and 2016. 1 mark

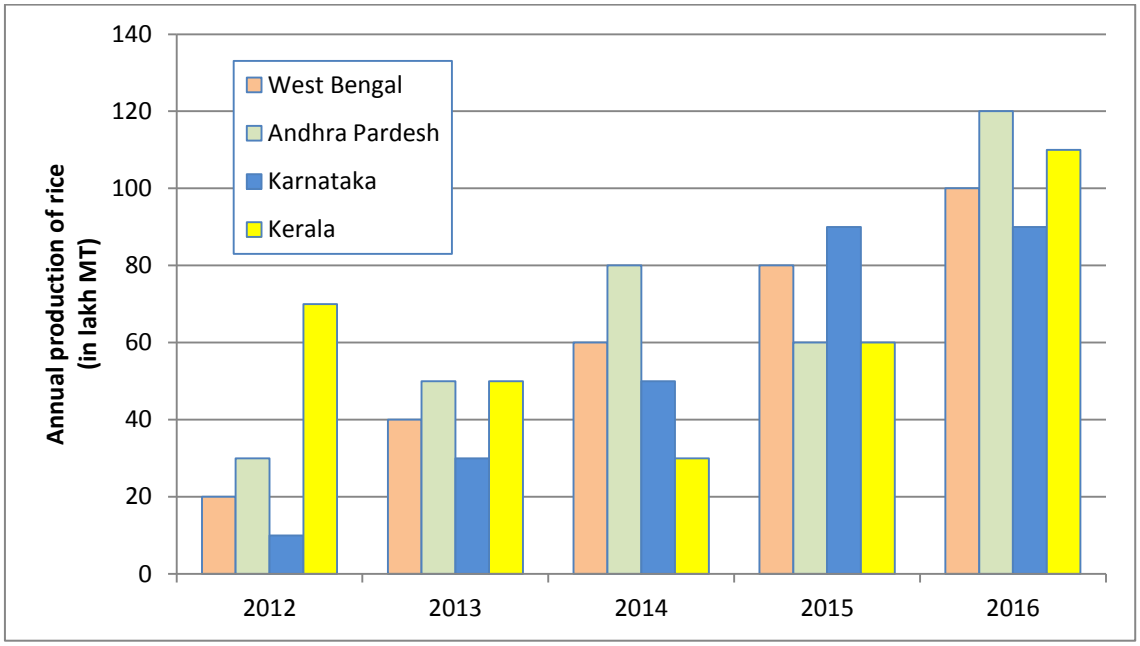
30. Which component of the cost of production has remained more or less constant over the period?

    A. Wages
    B. Interest
    C. Overhead
    D. Raw material. 1 mark

31. Wages, as a percentage of total cost of production, was the largest in the year

    A. 2012
    B. 2013
    C. 2014
    D. 2015. 2 marks

Answer the Questions 32-34 based on the comparative bar chart of the production of rice in four states in five successive years, given below. The data for 2016 are projected.



32. In which of the following states did the production of rice increase every year?

A. West Bengal
B. Andhra Pradesh
C. Karnataka
D. Kerala. 1 mark

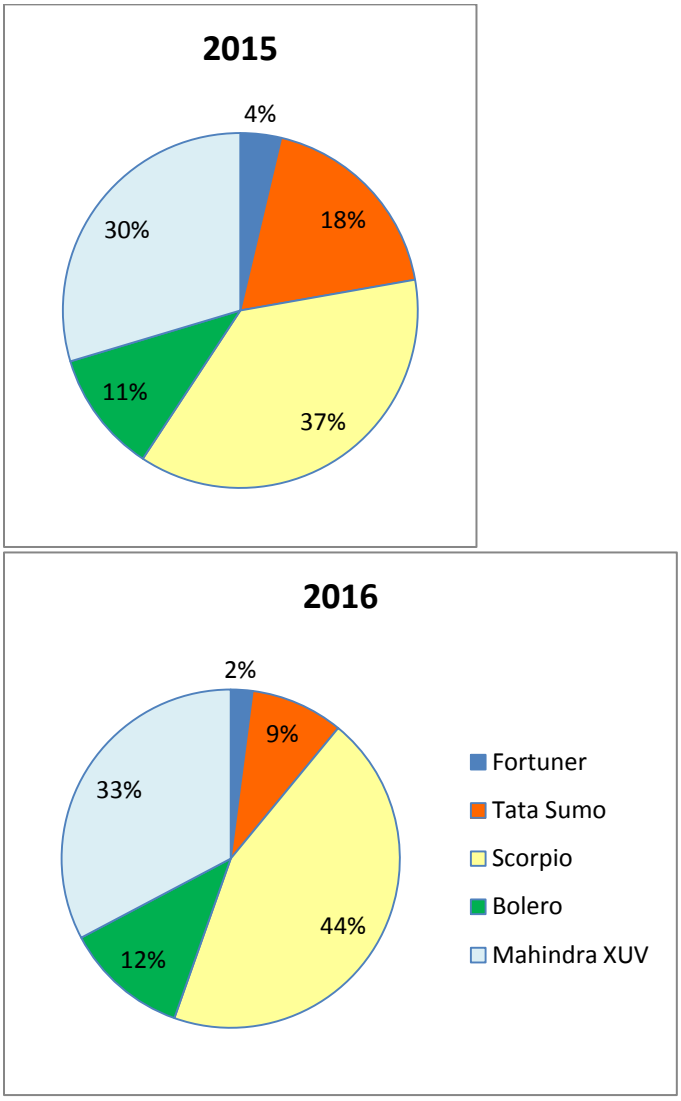
33. By what percentage was the production of rice in Kerala in 2015 less than the production of rice in West Bengal in 2014?

A. 16.67%
B. 0%
C. 20%
D. 40%. 1 mark

34. What is the difference between the average production of rice in the states of Andhra Pradesh and Karnataka over the period?

A. 34 lakh MT
B. 24 lakh MT
C. 14 lakh MT
D. 4 lakh MT. 2 marks

The market shares (in terms of the total number of vehicles sold) of five SUV models in two successive years are shown in the following pie charts. Use the information given in these to answer Questions 35-36.



35. If the 2015 sales for all SUV models is 27,00,000 and these have grown by 25% in 2016, then what is the approximate increase in the number of Scorpio vehicles sold in 2016 over 2015?

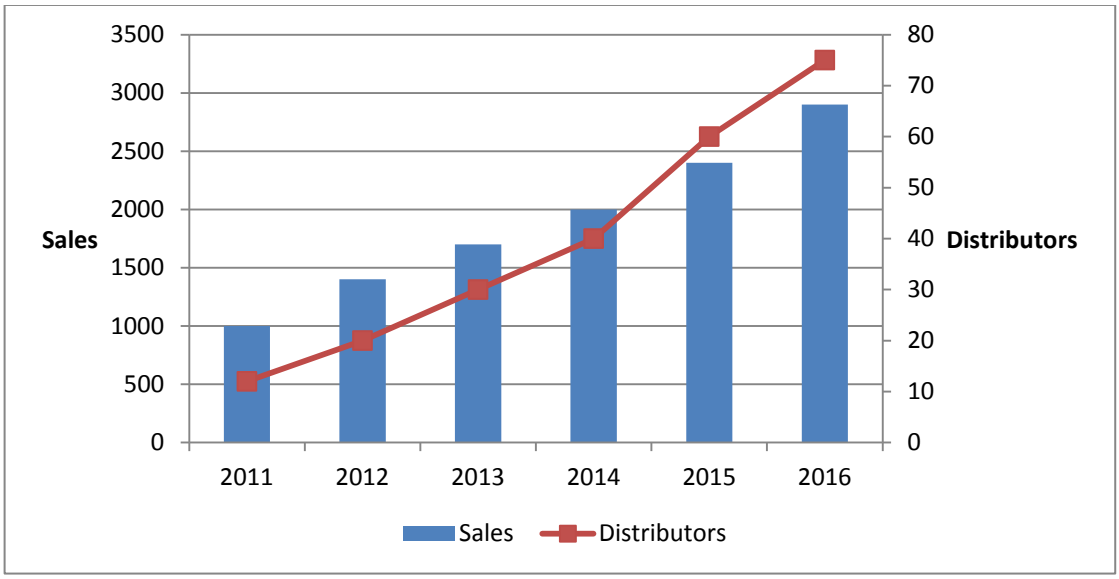
A. 426,000
B. 456,000
C. 486,000
D. 506,000. 1 mark

36. If the 2015 sales for all SUV models is 2,700,000 and these have grown by 25% in 2016, then how many SUV models have grown more than the average growth rate of all the SUV models taken together?

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

3 marks

In the following figure, the number of distributors of a company in six successive years has been shown in a line graph overlaid on a bar chart depicting the sales (in millions of rupees). Use this information to answer Questions 37-38.



37. In which year were the sales per distributor lowest?

A. 2016
B. 2015
C. 2014
D. 2012. 1 mark

38. In which year did the sales increase (from the previous year) by a higher percentage than the number of distributors?

A. 2016
B. 2012
C. 2014
D. None. 1 mark

English

39. Choose the word that cannot be used as a synonym of "Smart".

A. Savvy
B. Astute
C. Shrewd
D. Humdrum. 1 mark

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

A. Piquant
B. Arid
C. Banal
D. Prosaic. 1 mark

41. Choose the word that cannot be used as an antonym of "Vehement".

A. Effete
B. Decrepit
C. Supine
D. Underlying. 1 mark

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

A. Cruddy
B. Snide
C. Putrid
D. Virtuous. 1 mark

43. Find out the alternative which will replace '?'

Lion : Pride :: Fish : ?

A. Swimming
B. Shoal
C. Water
D. Humbleness. 1 mark

44. Find out the alternative which will replace '?'

Pen : Paper :: Brush : ?

A. Painting
B. Colour
C. Canvas
D. Board. 1 mark

45. One word for “Something that strongly attracts attention and admiration” is

A. cynosure
B. showy
C. winsome
D. copacetic. 1 mark

46. Someone who is new to a field or activity is called

A. kook
B. tyro
C. cretin
D. ignorant. 1 mark

47. Meaning of the proverb “A bird in the hand is worth two in the bush” is

A. One should not be jealous of what others have got.
B. One gets the fruits of one’s own actions.
C. A little fortune now will attract bigger fortune in future.
D. It is better to accept the little we have than reject it hoping to get a lot later.
1 mark

48. Meaning of the proverb “All roads lead to Rome” is

A. People with similar interests and tastes tend to group.
B. People can arrive at the same conclusion by different means.
C. Family ties are stronger than other relationships.
D. All evil will be finished in the end. 1 mark

49. Fill the blank in the following sentence:

Great people are indifferent _____ pain and pleasure.

A. to
B. in
C. for
D. about. 1 mark

50. Fill the blank in the following sentence:

Do his office colleagues know _____?

A. where from he comes
B. from where does he come
C. where does he come from
D. where he comes from. 1 mark

51. Fill the blank in the following sentence:

He was a little afraid in the beginning, _____ he visited the haunted fort.

A. despite
B. nonetheless
C. while
D. however. 1 mark

52. Fill the blank in the following sentence:

When you have an unpleasant boss, you simply have to _____ him.

A. put with
B. put up with
C. make up with
D. make with. 1 mark

53. Fill the blank in the following sentence:

During the struggling days of his life, he would have to _____ with a very small house.

A. make up
B. make
C. make do
D. make upon. 1 mark

54. Identify the correct sentence.

A. In recent games, the performance of our players was worse as I had expected.
B. In recent games, the performance of our players was worse than I had expected.
C. In recent games, the performance of our players was worse than expectation.
D. In recent games, the performance of our players was worst than that was expected. 2 marks

55. Identify the correct sentence.

A. He is tired as he is working since 7 O'clock in the morning.
B. All the furniture in his house are made of teak.
C. I, you and my son will go to see the match next Sunday.
D. Factory workers are hell bent upon getting what is due to them. 2 marks

56. Identify the correct sentence.

A. Pay taxes lest you may be caught.
B. It is one and half hours since I took the medicines.
C. As the rainy season approaches, the number of patients in hospitals are increasing by leaps and bounds.
D. The teacher asked why you are late? 2 marks

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

P: The diet of the people having Orthorexia nervosa can actually be unhealthy, with nutritional deficits specific to the diet they have imposed upon themselves.

Q: Orthorexia nervosa is a condition in which the person develops fixation on righteous eating.

R: They also lose the ability to eat intuitively – to know when they are hungry, how much they need, and when they are full.

S: They may be socially isolated, often because they plan their life around food.

The proper sequence should be

A. PQSR
B. QPRS
C. PSRP
D. QPSR. 2 marks

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

P: Hackers may steal your personal information and may commit identity theft.

Q: Identity theft may affect your personal financial circumstances costing you and the banks millions.

R: If your identity is stolen, you may not get loans until the matter is cleared up.

S: This may be done by contacting you and pretending to be from a legitimate organization.

The proper sequence should be

A. PSQR
B. PRSQ
C. PQRS
D. PQSR. 2 marks

Read the passage below and answer Question No 59:

Traffic congestion or traffic jam is one of the biggest problems of urban India. The main cause of traffic congestion is the country's public transport infrastructure, which is failing to keep up with the rapidly growing developments in the cities. There is an estimated one lakh motorized vehicles travelling on Delhi roads per day. All this has not only led to obvious delays and jams, but a high rate of accidents as well as increased air and noise pollution. National Road Safety Council has been trying to formulate road safety policy since 1988. Road safety policies were again attempted in 2003 by the Ministry of Highways and Transport and in 2004 at the Annual Session of Indian Roads Congress, the ministry introduced eleven elements for road safety policies under the title 'Safer Roads for Everyone'. These elements include the overall framework for road safety, safety education and enforcement of the policies. There are a number of initiatives that have already been set up in different parts of the country to relieve the problem of congestion. The Intelligent Transport System is working to provide safe and accessible public transport for commuters in India. Some examples include advanced traffic management systems, wireless traffic signal controllers, CCTV junction surveillance, electronic toll collection systems, advanced vehicle control systems and video incident detection.

I. Main reasons of the traffic congestion in the cities include

i. lack of policies
ii. lack of infrastructure
iii. both i and ii above.

II. Main reasons of road accidents include

i. inadequate public transport infrastructure
ii. rapid urban development
iii. both i and ii above.

III. In order to reduce traffic congestion, the government emphasizes on

i. controlled urban development
ii. use of advanced techniques
iii. both i and ii above.

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

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

Read the passage below and answer Question No 60:

During the early Vedic period, women enjoyed equal status with men in all aspects of life. Rigvedic verses suggest that women were educated, married at a mature age and were free to select their own husbands. Scriptures such as the Rig Veda and Upanishads mention several women sages and seers. In approximately 500 B.C., the status of women began to decline. Although various reform movements allowed women to be admitted to religious orders, by and large women in India faced confinement and restrictions. Indian women's position in society further deteriorated during the medieval period, when child marriages and a ban on remarriage by widows became part of social life in some communities in India. During the British Raj, many reformers fought for the betterment of women. Women in India now participate fully in areas such as education, sports, politics, media, art and culture, service sectors, science and technology, etc. Indira Gandhi, who served as Prime Minister of India for an aggregate period of fifteen years, is the world's longest serving woman Prime Minister. The Constitution of India guarantees to all Indian women equality (Article 14), no discrimination by the State (Article 15(1)), equality of opportunity (Article 16), and equal pay for equal work (Article 39(d)). In addition, it allows special provisions to be made by the State in favor of women and children (Article 15(3)), renounces practices derogatory to the dignity of women (Article 51(A) (e)), and also allows for provisions to be made by the State for securing just and humane conditions of work and for maternity relief.

I. The status of women in Indian society is not equal to that of men because

   i. in many parts of the country, some medieval customs are still practiced
   ii. of the lack of equal women's rights
   iii. both i and ii above.

II. The improved status of women in modern India is reflected by

   i. participation of women in different walks of life
   ii. constitutional safeguards
   iii. both i and ii above.

III. The status of women started deteriorating

   i. before medieval period
   ii. during medieval period
   iii. after medieval period.

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

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

61. Classify each of the statements given below as Fact (F), Inference (I) or Judgment (J).

I. Even a layman can see how closely chimpanzees resemble humans.
II. People love to see chimpanzees playing the drums or riding the bicycles.
III. As per surveys, the population of chimpanzees is decreasing.

A. JJF
B. FFI
C. JJI
D. IIF. 2 marks

62. Classify each of the statements given below as Fact (F), Inference (I) or Judgment (J).

I. After a storm comes a calm.
II. If you drive just after consuming alcohol, you may meet with an accident.
III. People who talk a lot or threaten may not be actually harmful.

A. FIF
B. JFJ
C. JJJ
D. IFI. 2 marks

Logical Reasoning

63. Identify the closest match to FISH : SCHOOL from the following choices.

    A. Wolf : pack
    B. Elephant : jungle
    C. Beagle : clan
    D. Herd : peacock. 1 mark

64. The next two elements of the sequence 17 32 19 29 21 26 23 are

    A. 25 25
    B. 20 22
    C. 23 25
    D. 25 22. 1 mark

65. If 8th December, 2008 was a Monday, which day of the week was it on 8th December, 2007?

    A. Saturday
    B. Tuesday
    C. Sunday
    D. Friday. 1 mark

66. In a certain code, MONKEY is written as XDJMNL. How is TIGER written in that code?

    A. QDFHS
    B. SDFHS
    C. SHFDQ
    D. UJHFS. 1 mark

67. Anil, introducing a woman in a party, said, she is the wife of the grandson of my mother. Which one of the following choices is a possible description of how Anil is related to the woman? (Assume no marriage between close relatives.)

    A. Brother-in-law
    B. Grandfather
    C. Husband
    D. Father-in-law. 1 mark

68. Out of forty students, 14 are taking English Composition and 29 are taking Chemistry. If five students are in both the classes, how many students are in neither class?

A. 2
B. 3
C. 5
D. 7. 1 mark

69. A watch gains time uniformly. It is 2 minutes slow at noon on Sunday, and is 4 minutes 48 seconds fast at 2 pm on the following Sunday. When was it correct?

A. 1:00 pm on Monday
B. 2:00 pm on Tuesday
C. 3:15 pm on Thursday
D. 3:15 pm on Wednesday. 2 marks

70. A, B, C, D, E, F, G and H are sitting in a row.

- A is fourth to the right of E.
- H is fourth to the left of D.
- C and F, neither of whom is sitting in an extreme position, are neighbours of B and E, respectively.
- H is next to the left of A and A is the neighbor of B.

Who are sitting in the extreme ends?

A. E and G
B. E and D
C. H and A
D. H and B. 2 marks

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