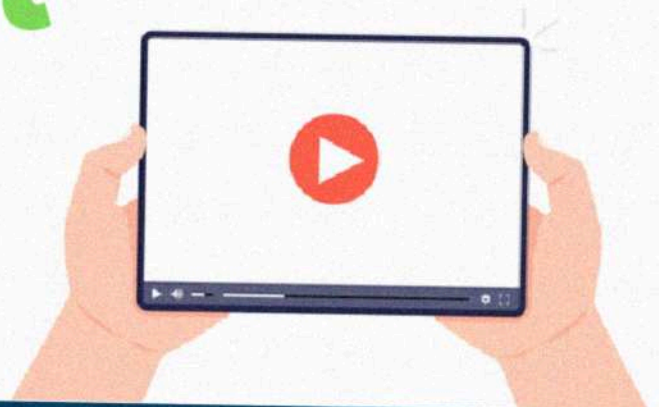


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M.Sc. Entrance Examination
Department of Economic Sciences
Indian Institute of Technology, Kanpur
June 15, 2023

Instructions:

This question paper has a total of 50 questions. Each question is followed by 4 choices. You must select the most appropriate choice. Please indicate the most appropriate choice clearly on the answer booklet provided. Each correct answer will earn you 2 points. For each wrong answer, you will lose 0.50 points. For each question you leave unanswered, you earn 0 points.

You have 2 hours to complete the examination. You are required to answer the questions on your own with no external assistance or equipment other than a pen. You may not communicate with anyone inside or outside the examination hall while the examination is in progress, except the exam invigilators. Furthermore, you are not allowed to use mobile phones, calculators or AI-based tools. Attempting to access the internet in any manner is strictly prohibited. Any violation will lead to cancellation of your candidacy in this round and permanent disqualification from appearing on future iterations of this examination.

Questions:

1. Let A be an invertible matrix given by $A = \begin{pmatrix} 1 & x \\ 0 & 1 \end{pmatrix}$. If $A^{-1} = \begin{pmatrix} 1 & y \\ 0 & 1 \end{pmatrix}$, then the value of $x + y$ is
- 1
 - 0
 - 1
 - 2

Answer: b

2. If the equations $-x + y - 2z = 0$, $x - y + z = 0$ and $ax - by + z = 0$ have a non-trivial solution, then
- $a = b + 1$
 - $a + b = 0$
 - $a = b$
 - $a + 1 = b$

Answer: c

3. The value of the determinant $\begin{vmatrix} \alpha & \alpha + 2 & \alpha + 4 \\ \alpha + 2 & \alpha + 4 & \alpha + 6 \\ \alpha + 4 & \alpha + 6 & \alpha + 9 \end{vmatrix}$ is
- α
 - $\alpha + 4$
 - 4
 - 4

Answer: d

4. If 25, x_1 , x_2 , 16 are 4 consecutive terms of an arithmetic progression, then
- $x_1 = 20, x_2 = 17$
 - $x_1 = 22, x_2 = 19$
 - $x_1 = 23, x_2 = 18$
 - $x_1 = 21, x_2 = 17$

Answer: b

5. The first three terms of a geometric progression are such that their sum is $\frac{21}{4}$ and their product is 1. Which of the following is not a term of the geometric progression?
- 4
 - 1
 - $\frac{1}{8}$
 - $\frac{1}{4}$

Answer: c

6. How many two-digit numbers can be formed using the numbers 0, 1 and 2 considering that the digits may be repeated?
- 8
 - 4
 - 9
 - 6

Answer: d

7. From a class of 4 boys and 3 girls, four students are to be selected to form a mathematics olympiad team so that at least 2 girls are there in the team. In how many ways can this be done?
- 22
 - 23
 - 24
 - 18

Answer: a

8. For any positive integer $n \geq 2$, $2^{2n} - 3n - 1$ is always divisible by
- 20
 - 6
 - 9
 - 15

Answer: c

9. In the binomial expansion of $(1 - x)^n$ where n is a positive integer, if the coefficients of x and x^3 are equal then the value of n is
- 3
 - 4
 - 5
 - 6

Answer: b

10. Which of the following functions is differentiable at $x = 0$?

- a. $\max(0, x)$
- b. $\max(0, x) + \min(0, x)$
- c. $\min(0, x)$
- d. $\max(0, x) - \min(0, x)$

Answer: b

11. $\lim_{n \rightarrow \infty} \left(\frac{(1+n^2)^{\frac{1}{2}}}{(1+n^3)^{\frac{1}{3}}} \right)$ is

- a. 1
- b. 0
- c. ∞
- d. does not exist.

Answer: a

12. The integral $\int \frac{dx}{x^2-x}$ is

- a. $\log_e \left(\left| 1 - \frac{1}{x} \right| \right) + C$
- b. $\log_e \left(\left| \frac{x}{x-1} \right| \right) + C$
- c. $\frac{1}{\left(\frac{x^3}{3} - \frac{x^2}{2} \right)} + C$
- d. none of the above

Answer: a

13. The integral $\int_0^{\infty} x e^{-\frac{1}{2}(1+a^2)x} dx$ is

- a. $\frac{1}{2(1+a^2)}$
- b. $\frac{2}{(1+a^2)}$
- c. $\frac{1}{4(1+a^2)^2}$
- d. none of the above

Answer: d

14. Let $f(x) = \frac{1-|x|}{1+|x|}$. Which of the following is true regarding the function f ?

- a. Both minimum and maximum exist
- b. Maximum exists but minimum does not
- c. Minimum exists but maximum does not
- d. Neither maximum nor minimum exist

Answer: b

15. Consider the function $f(x) = \sum_{i=1}^{10} (x-i)^2$. The minimum of f is attained at

- a. $x = 5$
- b. $x = 4.5$
- c. $x = 5.5$
- d. none of the above

Answer: c

16. Consider the values of (x, y) that satisfy $x^2 + y^2 \leq 1$. Under this constraint, the maximum of $(7x - 5y)$ is

- a. $\sqrt{7+5}$
- b. $\sqrt{7-5}$
- c. $\sqrt{7^2+5^2}$
- d. $\sqrt{7^2-5^2}$

Answer: c

17. Let I denote the identity matrix. If A is a non-singular matrix that satisfies $AA^T = A^T A$ and $B = A^{-1}A^T$, then BB^T is

- a. B^{-1}
- b. B^T
- c. $B+I$
- d. I

Answer: d

18. Consider a 4×4 matrix A with its entries A_{ij} given by $A_{ij} = \begin{cases} 2, & i \geq j, \\ 0, & i < j. \end{cases}$

Then the determinant of the matrix A is

- a. 2
- b. -2
- c. 16
- d. -16

Answer: c

19. A vaccine has 90% probability of being effective in preventing a certain disease. The probability of getting the disease if a person is not vaccinated is 50%. In a certain geographic region, 25% of the people get vaccinated. A person is selected from that region at random. Then the probability that he or she will contract the disease is

- a. 0.25
- b. 0.75
- c. 0.40
- d. 0.60

Answer: c

20. A speed post company sends 60% of its order by a parcel service that delivers late 2% of the time. It sends the other 40% of its order by a local transportation service that delivers late by 7% of the time. Then the probability that an order delivered late was sent by the parcel service is

- a. 0.04
- b. 0.30
- c. 0.35
- d. 0.09

Answer: b

21. The mode of a random variable X , that follows Binomial $(6, \frac{1}{3})$ distribution, is

- a. 3
- b. 5
- c. 2
- d. 4

Answer: c

22. The maximum value of the variance of a random variable X , that follows Binomial (n,p) distribution, is

- a. $n^2/4$
- b. $n^2/2$
- c. $n/2$
- d. $n/4$

Answer: d

23. There are 500 misprints in a book of 500 pages. Assume that the number of misprints in a page follow Poisson distribution. Then the probability that a given page will contain at least 3 misprints is

- a. $1 - \frac{5}{2e}$
- b. $1 - \frac{2}{e}$
- c. $\frac{5}{2e}$
- d. $\frac{2}{e}$

Answer: a

24. The weekly wage of workers of a factory follows a normal distribution with a mean of Rs. 400 and a standard deviation of Rs. 50. If the wages of 80 workers are less than Rs. 350, then the approximate total number of workers in the factory is

(Given $\int_0^1 \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} dt = 0.34$)

- a. 400 workers
- b. 450 workers
- c. 500 workers
- d. 550 workers

Answer: c

25. If a random variable X follows a normal distribution having mean, $\mu = 18$, and variance $\sigma^2 = 625$, then $P(X < 67 | X > 18)$ is

(Given $\int_0^{1.96} \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} dt = 0.475$)

- a. 0.950
- b. 0.475
- c. 0.500
- d. 0.525

Answer: a

26. Consider a seller who sells a product that has unit elastic demand (i.e., the elasticity of demand for the product is 1). If the price of the good increases by 10%, what happens to the total revenue of the seller?

- a. It increases by 10%
- b. It increases by 20%
- c. It decreases by 10%
- d. It remains unchanged

Answer: d

27. Consider a consumer who consumes only goods A and B (both of which are normal goods). Suppose that the price of good A decreases while the price of good B stays constant. Which of the following is correct:
- Both the income effect and the substitution effect lead to an increase in the consumption of good A.
 - Both the income effect and the substitution effect lead to a decrease in the consumption of good A.
 - The income effect leads to an increase in the consumption of good A and a decrease in the consumption of good B.
 - The income effect leads to a decrease in the consumption of good A while the substitution effect leads to an increase in the consumption of good B.

Answer: a

28. Consider a perfectly competitive market for a vaccine. Initially, supply of the vaccine is given by $P=1000+10Q$ and demand is given by $P=1600-5Q$. Then, due to the release of a study finding adverse side effects of the vaccine, the demand decreases. Which of the following can *possibly* be the new equilibrium price and quantity?
- $P=1300, Q=30$
 - $P=1300, Q=50$
 - $P=1500, Q=30$
 - $P=1500, Q=50$

Answer: a

29. A consumer consumes only goods A and B. Suppose that deflation causes the price of both goods, as well as the consumer's income, to decrease by 5%. How would her budget constraint (with quantity of good A on the horizontal axis) be affected?
- It would shift inward but remain parallel to the original one
 - It would shift outward but remain parallel to the original one
 - It would pivot (rotate) at the vertical axis, so that it becomes flatter
 - It would remain unchanged

Answer: d

30. The law of diminishing marginal product implies that the marginal product curve eventually (i.e., for high enough quantities of the input):
- decreases
 - increases
 - increases at a decreasing rate
 - None of the above; the law of diminishing marginal product has nothing to do with the marginal product curve

Answer: a

31. Gross Domestic Product is the sum of which of the following.
- the value of all intermediate and final goods and services produced
 - the value of final goods and services produced in a country
 - the sum of net factor income received in a year
 - all the above

Answer: b

32. If an Indian citizen is employed by an Indian company in Germany, the income the Indian citizen earns, and remits is:
- part of German GNP and Indian GDP.
 - part of German GNP and Indian GNP.
 - part of German GDP and Indian GNP.
 - part of German GDP and Indian GDP.

Answer: c

33. Suppose that gross national product at market price is \$4300.5 billion, depreciation is \$550.1 billion, and indirect taxes are \$399.3 billion. Then, which of the following appropriately shows the net national product at factor cost?
- \$3351.1 billion.
 - \$4549.8 billion.
 - \$3851.2 billion.
 - \$3750.4 billion.

Answer: a

Solution Hints: Answer is 3351.1 (Net National Product at factor cost = GDP at factor cost - depreciation, where GDP at factor cost = GDP at market price - indirect tax, thus, Net National Product at factor cost = \$4300.5 billion - \$399.3 billion - \$550.1 billion)

34. Assume that an economy in a particular year has exports = 300, imports = 400, tax revenues = 1,100, government purchases = 1,400, gross domestic savings = 900. Then the level of gross domestic investment is:

- 600
- 700
- 900
- 1100

Answer: b

Solution Hints: $C+S+T = C+I+G + (X-Z)$

$$= S+T = I + G + (X-Z)$$

$$900+1100 = I + 1400 + (300-400)$$

$$I=700$$

35. Assume that a country produces only two types of commodities: Wheat and Sugar. The country imports Rice. The table below shows the price and the total quantity of Wheat and Sugar produced and Rice imported, in year 2020 and 2021.

Product	Year 2020		Year 2021	
	Quantity (KG)	Price (INR)	Quantity (KG)	Price (INR)
Wheat	500	10	700	20
Sugar	150	20	250	40
Rice	100	30	300	40

From the given table, what is the real GDP in 2021 at 2020 prices?

- a. 21000
- b. 24000
- c. 8000
- d. None of these

Answer: d

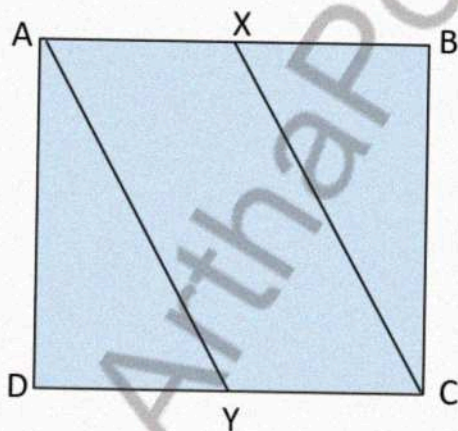
Solution Hints: Correct answer is 12,000. Real GDP in 2021 at 2020 prices is $(700 \times 10 + 250 \times 20 = 12000)$. Here, Rice is not part of GDP

36. When you reverse the digits of the number 14, the number increases by 27. How many other two-digit numbers increase by 27 when their digits are reversed?
- a. 4
 - b. 5
 - c. 6
 - d. 7

Answer: b

37. If the value of $-2k + (8 - 30k)^{0.5}$ is positive, which of the following ranges represents the value of k ?
- a. $-4 < k < (8/30)$
 - b. $k < 0.25$
 - c. $0 < k < (8/30)$
 - d. $-2 < k < (8/30)$

Answer: b



38. Consider the above figure. ABCD is a square having sides equal to 4 units, and X and Y are the midpoints of AB and CD, respectively. What is the perimeter, in units, of AXCY?
- a. 4
 - b. $2+2(3)^{0.5}$
 - c. $4+4(5)^{0.5}$
 - d. $8(5)^{0.5}$

Answer: c

39. Let X be a positive, two-digit integer. Consider the following two statements:

(I) The remainder when X is divided by 9 is 8

(II) The remainder when X is divided by 8 is 7

In order to pin down the value of X,

- a. Statement (I) ALONE is sufficient, but statement (II) ALONE is not sufficient.
- b. Statement (II) ALONE is sufficient, but statement (I) ALONE is not sufficient.
- c. BOTH statements TOGETHER are sufficient, but NEITHER statement ALONE is sufficient.
- d. EACH statement ALONE is sufficient."

Answer: c

40. Yesterday you were unexpectedly given a free ticket to a Sonu Nigam concert scheduled for September 1. The market price of this ticket is INR 750, but the most you could sell it for is only INR 500. Today you discover that Indian Ocean will be giving a concert that same evening. Tickets for the Indian Ocean concert are still available at INR 750. Had you known before receiving your Sonu Nigam ticket yesterday that Indian Ocean would be coming, you definitely would have bought a ticket to see them, not Sonu Nigam. Based on what you are told of your liking, it follows that you should attend the Indian Ocean and not Sonu Nigam.

- a. True
- b. False
- c. More information is needed
- d. None of the above

Answer: c

41. Arrange the following sentences in a proper sequence:

- (A) At least **two major shocks** have hit the global economy since 2020. It all started with the pandemic-induced contraction of the global output, followed by the Russian-Ukraine conflict leading to a worldwide surge in inflation.
- (B) In general, global economic shocks in the past were severe but spaced out in time.
- (C) Then, the central banks across economies led by the Federal Reserve responded with synchronized policy rate hikes to curb inflation.

(D) This changed in the third decade of this millennium.

- a. ABDC
- b. BDAC
- c. ADCB
- d. BACD

Answer: b

42. Arrange the following sentences in a proper sequence:

- (A) I was about to examine the hull which formed on deck a kind of horizon platform.
- (B) Daybreak appeared.
- (C) Suddenly, I felt it gradually sinking.
- (D) The morning mists surrounded us, but they soon cleared off.

- a. CABD
- b. ABDC
- c. DBAC
- d. BDAC

Answer: d

43. Select the word that is an antonym of PLAUSIBLE

- a. Inpalusible
- b. Unplausible
- c. Implausible
- d. Displausible

Answer: c

44. Select the correct sentence:

- a. Although domestic consumption rebounded in many economies, the rebound in India was impressive for its scale.
- b. Although domestic consumption rebounded in many economies, the bounce in India was impressive for its scale.
- c. Although domestic consumption rebounded in many economies, the rebound in India was impressioned for its scale.
- d. Although domestic consumption bounced in many economies, the rebound in India was impressive for its scale.

Answer: a

45. RBI has projected headline inflation at 6.8 per cent in FY23, which is outside its target range. At the same time, it is not high enough to deter private consumption and also not so low as to weaken the inducement to invest. Moderately high inflation has further ensured the anchoring of inflationary expectations preventing prices from weakening demand and growth in India. Additionally, with inflation on the declining path, the interest cost of domestic credit will likely decline, inducing a further increase in demand for credit by corporates and retail borrowers.

Which one of the following is the CORRECT logical inference based on the information given in the above passage?

- a. Inflation rate in India is alarmingly high and requires brisk intervention of the RBI.
- b. Economic growth in India has slowed down due to rising inflationary pressure.
- c. Inflationary pressure will ease out in the near future and spur investment.
- d. RBI is worried that inflation is outside their target range.

Answer: c

46. Given below are three statements and four conclusions drawn based on the statements.

Statement 1: Some doctors are writers.

Statement 2: No writer is an actor.

Statement 3: All actors are doctors.

Conclusion I: Some writers are doctors.

Conclusion II: All doctors are actors.

Conclusion III: No actor is a writer.

Conclusion IV: Some actors are writers.

Which one of the following options can be logically inferred?

- a. Only conclusion I is correct
- b. Only conclusion II and conclusion III are correct
- c. Only conclusion I and conclusion III are correct
- d. Either conclusion III or conclusion IV is correct

Answer: c

47. Choose the correct words in sequence to fill up the blanks:

Even as India's outlook remains bright, global economic _____ for the next year have been _____ down by the combination of a unique set of challenges expected to impart a few downside risks.

- a. Prospectus; weighted
- b. Prospectus; weighed
- c. Prospects; weighted
- d. Prospects; weighed

Answer: d

48. The flight will leave at 9:30 PM, we **have been** ready by 7:30 PM, so that we can reach the airport on time.

To make the above sentence grammatically correct, the phrase marked in bold is to be replaced by:

- a. were
- b. are
- c. must be
- d. should have been

Answer: c

49. Generally, poverty is primarily measured in terms of lack of monetary means for a decent living. However, by definition, 'poverty' has wider implications and leads to multiple disadvantages at the same time – such as poor health or malnutrition, lack of sanitation, clean drinking water or electricity, poor quality of education etc. Focusing on one factor alone, such as income, is not enough to capture the reality of poverty.

Which one of the following is the **MOST APPROPRIATE** logical inference based on the information given in the above passage?

- a. Deprivation is a unidimensional concept.
- b. A multi-dimensional measure of poverty gives a comprehensive picture.
- c. Poverty is due to lack of adequate income.
- d. Health, sanitation etc. should be improved to eradicate poverty.

Answer: b

50. Based on the given statements, choose the most appropriate option about the conclusions.

Statements: In a one day cricket match, the total runs made by a team were 200. Out of these 160 runs were made by spinners.

Conclusions:

- I. 80% of the team consists of spinners.
- II. The opening batsmen were spinners.

- a. Only conclusion I follows
- b. Only conclusion II follows
- c. Both I and II follows
- d. Neither I nor II follows

Answer: d

*******The End*******