ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2025
EXAMINATION CATEGORY: TECHNICAL

PAPER II: GENERAL SUBJECT KNOWLEDGE PAPER FOR ENGINEERING

Date	:	October 10, 2025
Total Marks	:	100
Examination Time	:	90 minutes (1.5 hours)
Reading Time	:	15 Minutes (prior to examination time)

GENERAL INSTRUCTIONS:

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of the Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO parts: Part I & Part II.**

   Part I consists of 70 multiple choice questions of 1 (one) mark each, and
   Part II consists of 10 short answer questions of 3 (three) marks each.
4. All questions are COMPULSORY
5. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
6. **All answers should be written with correct numbering of Part, Section and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating correct Part, Section and Question Number will NOT be evaluated and no marks would be awarded.**
7. Begin each Part on a fresh page of the Answer Booklet.
8. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
9. Use of any other paper including paper for rough work is not permitted
10. **You must hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
11. The Question paper has **14 printed pages,** including this Instruction Page.

GOOD LUCK!

PART I

Multiple Choice Questions **[70 marks]**

Choose the correct answer and write down the letter of the correct answer chosen in the Answer Booklet against the question number. e.g. 71 (a). Each question carries ONE mark. Any double writing, smudgy answer or writing more than one choice shall not be evaluated.

SECTION A: MATHEMATICS

1. Let $f\,[2,\infty) \rightarrow R$ be the function defined by $f(x) = x^2 - 4x + 5$, then the range of f is _____.
   a) $[1,\infty)$
   b) $[\infty,1)$
   c) $[1,0)$
   d) $[0,1)$

2. The value of $\tan^2(\sec^{-1}2) + \cot^2(\operatorname{cosec}^{-1}3)$ is
   a) 11
   b) 5
   c) 13
   d) 15

3. The matrix $A = \begin{bmatrix} 0 & 0 & 5 \\ 0 & 5 & 0 \\ 5 & 0 & 0 \end{bmatrix}$
   a) Square matrix
   b) Scalar matrix
   c) Unit matrix
   d) Diagonal matrix

4. If $A = = \begin{bmatrix} 2 & -1 & 3 \\ -4 & 5 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 \\ 4 & -2 \\ 1 & 5 \end{bmatrix}$
   a) Only BA is defined
   b) Only AB is defined
   c) AB and BA both are defined
   d) AB and BA both are not defined

5. If $f(x)=|x|$, then $f(x)$ is differentiable at $x=0$?
   a) Yes
   b) No
   c) Differentiable from right only
   d) Differentiable from left only

6. If $f(x) = \begin{vmatrix} 0 & x-a & x-b \\ x+a & 0 & x-c \\ x+b & x+c & 0 \end{vmatrix}$, then

a) $f(a) = 0$
b) $f(b) = 0$
c) $f(0) = 0$
d) $f(1) = 0$

7. If $A = \begin{vmatrix} 2 & \lambda & -3 \\ 0 & 2 & 5 \\ 1 & 1 & 3 \end{vmatrix}$, then A^{-1} exists if

a) $\lambda = 2$
b) $\lambda \neq 2$
c) $\lambda \neq -2$
d) None of these

8. The function

$$f(x) = \begin{cases} \frac{\sin x}{x} + \cos x, & if\ x \neq 0 \\ k, & if\ x = 0 \end{cases}$$ is continuous at x=0, then the value of k is

a) 3
b) 2
c) 1
d) 1.5

9. The tangent to the curve $y = e^{2x}$ at the point (0,1) meets x-axis at

a) (0,1)
b) $(\frac{-1}{2}, 0)$
c) (2,0)
d) (0,2)

10. $f(x) = x^x$ has a stationary point at?

a) x = e
b) $x = \frac{1}{e}$
c) x = 1
d) $x = \sqrt{e}$

11. The slope of normal to the curve $y=2x^2 + 3 \sin x$ at x = 0 is:
    a) 3
    b) $\frac{1}{3}$
    c)-3
    d) $\frac{-1}{3}$

12. If $\int \frac{3e^x-5e^{-x}}{4e^x+5e^{-x}} dx$ = ax + b log| $4e^x + 5e^{-x}$ | + C, then
    a) a = $\frac{-1}{8}, b = \frac{7}{8}$
    b) a = $\frac{1}{8}, b = \frac{7}{8}$
    c) a = $\frac{-1}{8}, b = \frac{-7}{8}$
    d) a = $\frac{1}{8}, b = \frac{-7}{8}$

13. If x = $\int_0^y \frac{dt}{\sqrt{1+9t^2}}$ and $\frac{d^2y}{dx^2}$ = ay, then a is equal to
    a) 3
    b) 6
    c) 9
    d) 1

14. $\int_{-1}^{1} \frac{x^3 + |x| + 1}{x^2 + 2|x| + 1}$ dx is equal to
    a) log 2
    b) 2 log 2
    c) $\frac{1}{2}$ log 2
    d) 4 log 2

15. The degree of the differential equation $\frac{d^2y}{dx^2} + 3(\frac{dy}{dx})^2 = x^2 \log (\frac{d^2y}{dx^2})$ is
    a) 1
    b) 2
    c) 3
    d) Not defined

16. The vector having initial and terminal points as (2,5,0) and (-3,7,4) respectively is
    a) $-\hat{\imath} + 12\hat{\jmath} + 43\hat{k}$
    b) $5\hat{\imath} + 2\hat{\jmath} - 4\hat{k}$
    c) $-5\hat{\imath} + 2\hat{\jmath} + 4\hat{k}$
    d) $\hat{\imath} + \hat{\jmath} + \hat{k}$

17. The angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes √3 and 4 respectively and $\vec{a} \cdot \vec{b} = 2\sqrt{3}$ is
    a) $\frac{\pi}{6}$
    b) $\frac{\pi}{3}$
    c) $\frac{\pi}{2}$
    d) $\frac{5\pi}{2}$

18. P is the point on the line segment joining the points (3,2,-1) and (6,2,-2). If *x* co-ordinate of P is 5, then its *y* co-ordinate is
    a) 2
    b) 1
    c) -1
    d) -2

19. A box contains 3 yellow balls, 3 orange balls and 2 purple balls. There balls are drawn at random from the box without replacement. The probability of drawing 2 orange balls and one purple ball is
    a) $\frac{3}{28}$
    b) $\frac{2}{21}$
    c) $\frac{1}{28}$
    d) $\frac{167}{168}$

20. The area of the region bounded by the curve y = $\sqrt{16 - x^2}$ and x-axis is
    a) 8π sq units
    b) 20π sq units
    c) 16π sq units
    d) 256π sq units

SECTION B: Chemistry

21. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to _____.
    a) low temperature
    b) low atmospheric pressure
    c) high atmospheric pressure
    d) both low temperature and high atmospheric pressure

22. Methylamine reacts with HNO_2 to form
    a) $CH_3 - O - N = O$
    b) $CH_3 - O - CH_3$
    c) CH_3OH
    d) $CH_3 CHO$

23. In a reaction, when the concentration of reactant is increased two times, the increase in rate of reaction was four times. Order of reaction is
    a) 0
    b) 1
    c) 2
    d) 3

24. F_2 is formed by reacting K_2MnF_6 with
    a) SbF_5
    b) MnF_3
    c) $KSbF_6$
    d) MnF_4

25. Number of unpaired electrons in Ni^{2+} (Z = 28) is
    a) 4
    b) 2
    c) 6
    d) 8

26. The hybridization involved in $[Co(C_2O_4)_3]^{3-}$ is
    (a) sp^3d^2
    (b) sp^3d^3
    (c) d^2sp^3
    (d) dsp^3

27. Mercuric chloride is soluble in KI solution due to :
    a) the formation of complex ion
    b) common iodide ion
    c) none of the above
    d) both (a) and (b)

28. Which of the following electrolytes will have maximum coagulating value for AgI/Ag+ sol?
    a) Na_2S
    b) Na_3PO_4
    c) Na_2SO_4
    d) NaCl

29. Which one of the following functional group finally introduces the reaction of phenol with chloroform in presence of dilute sodium hydroxide?
    a) $–CHCl_2$
    b) –CHO
    c) $–CH_2Cl$
    d) –COOH

30. Which of the following test distinguishes aldehydes and ketones?
    (a) Lucas test
    (b) Tollen's test
    (c) $KMnO_4$ solution (Baeyer's test)
    (d) None of these

31. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?
    a) Methanol and acetone
    b) Chloroform and acetone
    c) Nitric acid and water
    d) Phenol and aniline

32. Among the following substance, the lowest vapour pressure is exerted by
    a) Water
    b) Alcohol
    c) Ether
    d) Mercury

33. Which of the following is the use of electrolysis?
    a) Electrorefining
    b) Electroplating
    c) Both (a) & (b)
    d) None of these

34. Calculate the molality of 34.5g of sugar dissolved in 215g of water.
    a) 0.559 m
    b) 0.613 m
    c) 0.603 m
    d) 0.554 m

35. A metal ribbon 'X' burns in oxygen with dazzling white flame forming a white ash 'Y'. The correct description of X, Y and the type of reaction is:
    a) X = Ca; Y= CaO; Type of reaction – Decomposition
    b) X= Mg; Y= MgO; Type of Reaction – Combination
    c) X= Al; Y= Al_2O_3; Type of reaction - Thermal Decomposition
    d) X= Zn; Y=ZnO; Type of reaction – Endothermic

36. In the following reaction:

$$ZnO + C \longrightarrow Zn + CO$$

Statement (S): ZnO undergoes reduction.

Reason (R): Carbon is a reducing agent that reduces ZnO to Zn.

Choose the correct answer.

a) Both Statement (S) and Reason (R) are true and Reason (R) is the correct explanation of the Statement (S)
b) Both Statement (S) and Reason (R) are true, but Reason (R) is not the correct explanation of the Statement (S)
c) Statement (S) is true, but Reason (R) is false
d) Statement (S) is false, but Reason (R) is true

37. Which of the following statement about the reaction given below are correct?

$$MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$$

i. HCl is oxidized to Cl_2
ii. MnO_2 is reduced to $MnCl_2$
iii. $MnCl_2$ acts as an oxidizing agent
iv. HCl acts as an oxidizing agent

a) ii, iii and iv
b) i, ii and iii
c) i and ii only
d) iii and iv only

38. A student took sodium sulphate solution in a test tube and added barium chloride solution to it. She observed that an insoluble substance has formed. The color and molecular formula of the insoluble substance is
    a) Grey, Ba_2SO_4
    b) Yellow, $Ba(SO_4)_2$
    c) White, $BaSO_4$
    d) Pink, $BaSO_4$

39. When lead nitrate powder is heated in boiling tube, we observe
    a) Brown fumes of nitrogen dioxide
    b) Brown fumes of lead oxide
    c) Yellow fumes of nitrogen dioxide
    d) Brown fumes of nitric oxide

40. The density of a solution prepared by dissolving 120 g of urea (mol.mass = 60 u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is:
    a) 2.05 M
    b) 1.02 M
    c) 0.50 M
    d) 1.78 M

SECTION C: Physics

41. The expression of energy stored in a capacitor is given by:
    a) $E = CV^2$
    b) $E = \frac{1}{2} CV^2$
    c) $E = \frac{1}{2} C^2V$
    d) $E = \frac{1}{2} (CV)^2$

42. Unit of energy density of electric field is
    a) JC^{-1}
    b) JV^{-1}
    c) Jm^{-3}
    d) JF^{-3}

43. The term "RC" has same unit as that of
    a) Potential
    b) Capacitance
    c) Energy
    d) Time

44. A wire of resistance R is cut into two equal parts, its resistance becomes R/2. What happens to resistivity?
    a) Double
    b) Same
    c) Half
    d) One fourth

45. Kirchhoff's first rule is based on conservation of:
    a) Energy
    b) Voltage
    c) Charge
    d) Mass

46. The electrons of mass ‘m’ and charge ‘e’ is moving in a circle of radius ‘r’ with speed ‘v’ in a uniform magnetic field of strength ‘B’. then
    a) $r \alpha m$
    b) $r \alpha B$
    c) $r \alpha \frac{1}{v}$
    d) $r \alpha \frac{1}{m}$

47. The direction of induced current is always so as to oppose the change which causes the current is called:
    a) Faraday's law
    b) Lenz's law
    c) Ohm's law
    d) Kirchhoff's 1st rule

48. If we make the magnetic field stronger, the value of induced current is:
    a) Decreased
    b) Increased
    c) Vanished
    d) Kept constant

49. For a good transformer the hysterics loop are _____in size.
    a) Small
    b) Large
    c) Zero
    d) None

50. The application of mutual induction is a
    a) Television
    b) Radio
    c) D.C. motor
    d) Transformer

51. A device that allows permits flow of DC through the circuit easily, is called:
    a) Inductor
    b) Capacitor
    c) AC generator
    d) Transformer

52. In parallel RLC circuit, at resonance frequency, there will be maximum
    a) Power
    b) Voltage
    c) Impedance
    d) None

53. If $V_{rms} = 10\sqrt{2}$ volts, then phase voltage V_o will be:
    a) 10 volts
    b) 20 volts
    c) 40 volts
    d) 15 volts

54. If the frequency of A.C. is doubled, the reactance of inductor will be

a) Half
b) Same
c) Double
d) Triple

55. A charge of 90C passes through a wire in 1 hour and 15 minutes. What is the current in the wire?
a) 20mA
b) 10mA
c) 5 mA
d) 0.35A

56. 5900 J of work is done by a machine to lift a mass of 100k vertically upward. The height to which the mass is lifted upward is
a) 6.02m
b) 6.01 m
c) 5.90m
d) 5.95m

57. A block A of mass 4 kg is placed on another block B of mass 5 kg, and the block B rests on a smooth horizontal table. If the minimum force that can be applied on A so that both the blocks move together is 12 N, the maximum force that can be applied to B for the blocks to move together will be
a) 30N
b) 25N
c) 27N
d) 40N

58. A concave mirror has a focal length of 5.00 cm. What is the image distance of an object placed 7.00 cm from the center of the mirror?
a) −17.5 cm
b) −2.92 cm
c) 2.92 cm
d) 17.5 cm

59. What is the gravitational force between two 60 kg people sitting 100m apart?
a) 2.4×10^{-11}N
b) 2.4×10^{-9}N
c) 3.6×10^{-1}N
d) 3.6×10^{1}N

60. A converging lens corrects farsightedness by
a) Dispersing the rays so they focus on the retina.
b) Bending the rays closer together so they do not focus on the retina.
c) Bending the rays closer together so they focus on the retina.
d) Dispersing the rays so they do not focus on the retina.

SECTION D: General IT Knowledge

61. An internet standard that allows for adding media attachments to an email is called
    a) MIME
    b) DHCP
    c) HDMI
    d) FTP

62. Identify the incorrect pair from the following:
    a) .jpg - graphic file
    b) .ttf - word text file
    c) .wav - audio file
    d) .exe - executable file

63. The ability to read and write each piece of information in a storage device in approximately the same length of time of its location is
    a) Sequential Access
    b) Raster scan
    c) Search
    d) Random Access

64. Which of the following is a component of cyber security?
    a) Internet Of Things
    b) AI
    c) Database
    d) Attacks

65. An artificially intelligent car decreases its speed based on its distance from the car in front of it. Which algorithm is used?
    a) Naïve-Bayes
    b) Decision Tree
    c) Linear Regression
    d) Logistic Regression

66. What is Machine learning?
    a) The selective acquisition of knowledge through the use of computer programs
    b) The selective acquisition of knowledge through the use of manual programs
    c) The autonomous acquisition of knowledge through the use of computer programs
    d) The autonomous acquisition of knowledge through the use of manual programs

67. A professor at the Stanford University coined the word 'artificial intelligence' in 1956 at a conference heId at Dartmouth college. The name of the professor is
    a)Joseph Weizenbaum
    b)David Levy
    c)Hans Berliner
    d)John McCarthy

68. Starlink is now technically active in Bhutan, making it the latest country to gain access to SpaceX's satellite internet service. In which type of orbit are Starlink satellites deployed to provide internet connectivity?
    a)Geostationary orbit (GEO)
    b)Medium Earth orbit (MEO)
    c)Low Earth orbit (LEO)
    d)Polar orbit

69. _____ type of cables are used in short-distance communication.
    a) Coaxial Cable
    b) Fiber Optic Cable
    c) Ethernet Cable
    d) Both a and b

70. Which of the following hardware was used by the first-generation computers?
    a) Transistors
    b) Vacuum tubes
    c) VLSI
    d) Integrated circuits

PART II
SHORT ANSWER QUESTIONS [30 MARKS]

This part consists of 10 Short Answer Questions. Answer all questions. Each question carries THREE marks.

1. Show that the points (2, 3, 4), (- 1, - 2, 1), (5, 8, 7) are collinear. **(3 marks)**
2. Find the differential equation of the family of lines through the origin. **(3 marks)**
3. Integrate the function $\frac{cos\ 2x + 2sin^2x}{cos^2x}\ dx$. **(3 marks)**
4. A zinc plate was put into a solution of copper sulphate kept in a glass container. It was found that blue colour of the solution gets faded with the passage of time. After few days, when zinc plate was taken out of the solution, a number of holes were observed on it. **(3 marks)**
   i. State the reason for changes observed on the zinc plate.
   ii. Write the chemical equation for the reaction involved.
5. A solution of Ni $(NO_3)_2$ is electrolyzed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of Ni is deposited at the cathode? **(3 marks)**
6. What is the pH of a solution of 0.005 M HBr? **(3 marks)**
7. Six lead-acid type of secondary cells each of emf 2.0V and internal resistance of 0.015 are joined in series to provide supply to a resistance of 8.5. What is the current drawn from the supply and its terminal voltage? **(3 marks)**
8. A coil of 0.1m x 0.01m and of 200 turns carrying a current of 1.0mA is placed in a uniform magnetic field of 0.1T. Calculate the maximum torque that acts on the coil. **(3 marks)**
9. Answer the following questions:
   a) A steady current flows in a metallic conductor of the non-uniform cross-section. Which of these quantities is constant along the conductor: current, current density, electric field, drift speed? **(1.5 marks)**
   b) Is Ohm's law universally applicable for all conducting elements? If not, give examples of elements that do not obey Ohm's law. **(1.5 marks)**
10. What are three advantages of using open-source software? **(3 marks)**

TASHI DELEK