

PAPER II: GENERAL SUBJECT KNOWLEDGE PAPER FOR ENGINEERING

**ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2022
EXAMINATION CATEGORY: TECHNICAL**

PAPER II: GENERAL SUBJECT KNOWLEDGE PAPER FOR ENGINEERING

Date	: October 8, 2022
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. If $y = ax^2 + b$, then dy/dx at $x = 2$ is equal to
 - a) $2a$
 - b) $3a$
 - c) $4a$
 - d) None of the above
2. Let the $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = 2x + \cos x$, then f
 - a) has a maximum, at $x = 0$
 - b) has a minimum at $x = 3t$
 - c) is an increasing function
 - d) is a decreasing function
3. $\int_0^2 x^2 dx =$
 - a) 2
 - b) $\frac{2}{3}$
 - c) $\frac{8}{3}$
 - d) None of these
4. $\int_0^\pi \sin^2 x dx =$
 - a) $\frac{\pi}{2}$
 - b) $\frac{\pi}{4}$
 - c) 2π
 - d) 4π
5. The curve for which the slope of the tangent at any point is equal to the ratio of the abscissa to the ordinate of the point is:
 - a) an ellipse
 - b) parabola
 - c) circle
 - d) hyperbola
6. The addition of matrices is only possible if they are of the same order.
 - a) True
 - b) False

7. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 9 & 3 & 6 \\ 1 & 0 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 & 0 \\ 2 & 8 & 1 \\ 0 & 2 & 1 \end{bmatrix}$, then find $A+B$.

a) $A+B = \begin{bmatrix} 1 & 3 & 6 \\ 2 & 9 & 6 \\ 4 & 5 & 8 \end{bmatrix}$

b) $A+B = \begin{bmatrix} 2 & 3 & 3 \\ 11 & 11 & 7 \\ 1 & 2 & 3 \end{bmatrix}$

c) $A+B = \begin{bmatrix} 2 & 3 & 3 \\ 9 & 9 & 7 \\ 1 & 4 & 5 \end{bmatrix}$

d) $A+B = \begin{bmatrix} 10 & 3 & 4 \\ 9 & 9 & 6 \\ 1 & 7 & 8 \end{bmatrix}$

8. Find the transpose of $A = \begin{bmatrix} 2 & -1 \\ -3 & 6 \end{bmatrix}$

a) $A = \begin{bmatrix} 2 & -3 \\ -1 & 6 \end{bmatrix}$

b) $A = \begin{bmatrix} 2 & -1 \\ -3 & 6 \end{bmatrix}$

c) $A = \begin{bmatrix} 6 & -1 \\ -3 & 2 \end{bmatrix}$

d) $A = \begin{bmatrix} -2 & 1 \\ 3 & -6 \end{bmatrix}$

9. Find the order of the differential equation $9d^2y/dx^2 = 1$

- a) 1
- b) 3
- c) 2
- d) 4

10. Find the integral of $\frac{7x^4}{\sqrt{x^5+20}}$

- a) $\sqrt{x^5+20}$
- b) $2\sqrt{x^5+20}$
- c) (x^5+20)
- d) $2(x+20x^4)$

11. If $\cos^{-1}x=y$, then which of the following is correct?
- a) $0 < y < \pi$
 - b) $-\pi/2 \leq y \leq \pi/2$
 - c) $-\pi/2 < y < \pi/2$
 - d) $0 \leq y \leq \pi$
12. Dema has 6 kira, 8 tegos and 5 wonjus. How many different combinations of each kira, tego and wonju can Dema wear?
- a) 240
 - b) 360
 - c) 180
 - d) 120
13. What is the probability of throwing at least one six in three rolls of a regular dice?
- a) $\frac{1}{1296}$
 - b) $\frac{1}{126}$
 - c) $\frac{1}{216}$
 - d) $\frac{1}{296}$
14. Solve for x: $x(x+3) = 0$
- a) $x = 0$ or 3
 - b) $x = 0$ or -3
 - c) $x = -3$ or $+3$
 - d) $x = 0$ or 1
15. If $x = 2$ is a root of the equation $3x^2 - 5x - 2k = 0$, determine the value of k
- a) 2
 - b) -2
 - c) 1
 - d) 3
16. $\sin[\pi/3 - \sin^{-1}(-1/2)]$ is equal to:
- a) $1/2$
 - b) $1/3$
 - c) -1
 - d) 1
17. Solve $8x^2+10x+3$
- a) $(4x+3)(3x+2)$
 - b) $(4x+3)(2x+1)$
 - c) $(4x-3)(2x+1)$
 - d) $(4x-3)(2x-1)$

18. $\int_0^{\pi} \sin^2 x \, dx =$

- a) $\pi/4$
- b) 2π
- c) $\pi/2$
- d) 4π

19. Where the dimension of matrices is defined as *rows* × *columns*, you can multiply a 3 × 2 matrices on the left by a 2 × 3 matrix on the right?

- a) True
- b) False

20. The area of the region bounded by the curve $x^2 = 4y$ and the straight line $x = 4y - 2$ is

- a) 3/8 sq. units
- b) 5/8 sq. units
- c) 7/8 sq. units
- d) 9/8 sq. units

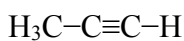
SECTION B: Chemistry

21. Silver Mirror test is given by which one of the following compounds?

- 1. Benzophenone
- 2. Acetaldehyde
- 3. Acetone
- 4. Formaldehyde

- a) 2 & 4
- b) Only 1
- c) Only 2
- d) 1 & 3

22. What is the IUPAC name for the following compound?



- a) Methyl acetylene
- b) Acetylene
- c) Butanol
- d) Decanoic Acid

23. A 'breath test' used by Traffic Police to check drunk driving uses _____.

- a) potassium dichromate-sulphuric acid
- b) turmeric on filter paper
- c) potassium permanganate-sulphuric acid
- d) silica gel coated with silver nitrate

24. _____ is not acidic.

- a) CCl_4
- b) SbCl_4
- c) PCl_4
- d) PCl_3

25. Many marine animals use _____ dissolved in sea-water to make their shells.
- Carbonates
 - Acids
 - Alkalis
 - Silica
26. Which combination of atoms can form a polar covalent bond?
- H and Br
 - H and H
 - Na and Br
 - N and N
27. Consider the following chemical reaction:
- $$a\text{Fe}_2\text{O}_3(\text{s}) + b\text{CO}(\text{g}) + c\text{Fe}(\text{s}) + d\text{CO}_2$$
- In the balanced chemical equation of the above, which of the following will be the values of the coefficients a, b, c and d respectively?
- 3, 2, 3, 1
 - 2, 3, 3, 1
 - 1, 3, 2, 3
 - 3, 3, 2, 1
28. Which one of the following is an element?
- Topaz
 - Ruby
 - Diamond
 - Sapphire
29. The outer electron configuration of Gd (Atomic No : 64) is
- $4f^3 5d^5 6s^2$
 - $4f^7 5d^1 6s^2$
 - $4f^8 5d^0 6s^2$
 - $4f^4 5d^4 6s^2$
30. How many optical isomers are there in Glucose?
- 8
 - 12
 - 16
 - Cannot be predicted
31. When water is added to anhydrous white copper sulphate, the color will change to:
- Yellow
 - Green
 - Blue
 - Red

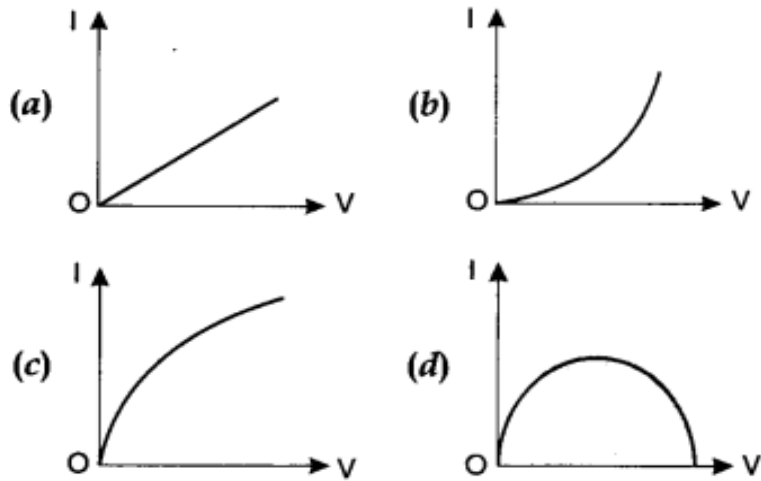
32. The organic reaction represented by equation $\text{CH}_3\text{-CH}=\text{O} + \text{H}_2\text{NOH}$ gives $\text{CH}_3\text{-CH-NH} + \text{H}_2\text{O}$ is an example of
- an addition reaction.
 - a condensation reaction.
 - an oxidation reaction.
 - an elimination reaction.
33. Identify the **WRONG** statement in the following.
- Atomic radius of the elements increases as one moves down the first group of the periodic table.
 - Atomic radius of the elements decreases as one moves across from left to right in the second group of the periodic table.
 - Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius.
 - Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius.
34. What is the normality of a 1M solution of H_3PO_4 ?
- 0.5 N
 - 2.0 N
 - 1.0 N
 - 3.0 N
35. A buffer is made from equal concentrations of a weak acid and its conjugate base. Doubling the volume of the buffer solution by adding water has what effects on its pH?
- It significantly increases the pH
 - It significantly decreases the pH
 - It has no effect
 - It has little effect
36. A student performs five titrations and obtains a mean result of 0.110 M with a standard deviation of 0.001 M. if the actual concentration of the titrated solution is 0.100 M, which of the following is **TRUE** about the titration results?
- Accurate but precise
 - Both accurate and precise
 - Precise but not accurate
 - There are insufficient data to determine the accuracy and precision of the results
37. Which of the following is a primary standard for use in standardizing bases?
- Ammonium hydroxide
 - Sulfuric acid
 - Acetic acid
 - Potassium hydrogen phthalate

38. When ferric oxide, Fe_2O_3 , is dissolved in 6 M HNO_3 , which iron-containing species predominates in solution?
- FeO_2^-
 - $\text{Fe}(\text{OH})_4^-$
 - $\text{Fe}(\text{OH})_3$
 - $\text{Fe}(\text{H}_2\text{O})_6^{3+}$
39. Of the following ionic substances, which has the greatest lattice enthalpy?
- MgO
 - MgS
 - NaF
 - NaCl
40. The strongest base in liquid ammonia is
- NH_3
 - NH_2^-
 - NH_4^+
 - OH^-

SECTION C: Physics

41. The force per unit charge is known as _____.
- electric current
 - electric potential
 - electric field
 - electric space
42. What happens when a plastic scale is rubbed against your hair?
- Gains protons from hair
 - Gains electrons from hair
 - Gives electrons to hair
 - Gives protons to hair
43. The work done against electrostatic force gets stored in which form of energy?
- Thermal energy
 - Kinetic energy
 - Potential energy
 - Solar energy
44. In a parallel plate capacitor, the capacity increases if
- area of the plate is decreased.
 - distance between the plates increases.
 - area of the plate is increased.
 - dielectric constant decreases.

45. Which of the following graph represents ohmic conductors?



46. Which of the following apparatus construction uses electromagnetic induction?

- a) Voltmeter
- b) Galvanometer
- c) Generator
- d) Electric Motor

47. An alternating current can be produced by:

- a) Choke Coil
- b) Dynamo
- c) Electric Motor
- d) Transformer

48. Power factor of an ac circuit is a measure of:

- a) virtual power
- b) Power lost in the circuit
- c) Mean power
- d) All of the above

49. Which of the following phenomenon is used in optical fibre?

- a) Refraction
- b) Diffraction
- c) Scattering
- d) Total Internal Reflection

50. For a total internal reflection, which of the following is **CORRECT**?

- a) Light travels from rarer to denser medium.
- b) Light travels from denser to rarer medium.
- c) Light travels in air only.
- d) Light travels in water only.

51. Light year is the unit of:
- a) Distance
 - b) Time
 - c) Intensity of light
 - d) None of these
52. Polaroid glasses are used in sunglasses because
- a) they are cheaper.
 - b) they are lighter in weight.
 - c) they look fashionable.
 - d) they reduce the light intensity to half on account of polarization.
53. A laser beam is used for locating distant objects because
- a) it is monochromatic.
 - b) it is not chromatic.
 - c) it is not observed.
 - d) it has small angular spread.
54. Compared to liquids and solids, gases are
- a) good conductors of electricity.
 - b) best conductors of electricity.
 - c) very poor conductors of electricity.
 - d) good or bad conductors of electricity depending upon the nature of the gas.
55. The photoelectric effect is based on the law of conservation of:
- a) Energy
 - b) Momentum
 - c) Mass
 - d) Angular momentum
56. Electrons in the atom are held to the nucleus by:
- a) Nuclear Force
 - b) Coulomb's Force
 - c) Gravitational Force
 - d) Van Der Waal's Force
57. Half-life of an radio active substance depends on:
- a) Pressure
 - b) Temperature
 - c) Density
 - d) None of the above

58. Fusion takes place at high temperature because
- a) atom are ionised at high temperature.
 - b) molecules break up at high temperature.
 - c) nuclei break up at high temp.
 - d) kinetic energy is high enough to overcome repulsion between nuclei.
59. What bonds are present in a semiconductor?
- a) Monovalent
 - b) Bivalent
 - c) Trivalent
 - d) Covalent
60. A microphone converts
- a) sound signals into electrical signals.
 - b) electrical signals into sound signals.
 - c) both (a) and (b)
 - d) Neither (a) nor (b)

SECTION D: General IT Knowledge

61. The octal equivalent of the number 11010.1011 is:
- a) 63.51
 - b) 32.27
 - c) 32.54
 - d) None of the above
62. Mnemonic codes and variable names are used in
- a) a machine language.
 - b) an assembly language.
 - c) a high-level language.
 - d) All of the above
63. What was the first ARPANET message?
- a) "hello world"
 - b) "lo"
 - c) "mary had a little lamb"
 - d) "cyberspace, the final frontier"
64. Who co-founded Hotmail in 1996 and then sold the company to Microsoft?
- a) Shawn Fanning
 - b) Sabeer Bhatia
 - c) Ada Byron Lovelace
 - d) Ray Tomlinson

65. The main purpose of a data link content monitor is to
- determine the type of transmission used in data link.
 - detect problems in protocols.
 - determine the type of switching used in data link.
 - determine the flow of data.
66. Protection of data from a natural disaster such as a flood, storm belongs to which of the following network issue?
- Performance
 - Reliability
 - Security
 - Management
67. MICR has made possible to
- cashless society.
 - smart wearables society.
 - technology savvy society.
 - None of the above
68. When used with I/O devices, the term intelligent implies
- a colour output capability.
 - speech processing capability.
 - high speed printing capability.
 - features to support off-line and online tasks.
69. Which of the following does not affect the resolution of a video display image?
- Bandwidth
 - Raster scan rate
 - Screen size
 - Vertical and horizontal lines of resolution
70. Why is BCC used in an e-mail?
- It allows the recipient to identify all the other recipients in the list when a group email address is used.
 - It allows sender to indicate who the email is for if there is more than one recipient.
 - It allows the sender of a message to conceal the recipient entered in the BCC field from the other recipients.
 - It allows recipients to be visible to all other recipients of the message.

Part II

Short Answer Questions [30 marks]

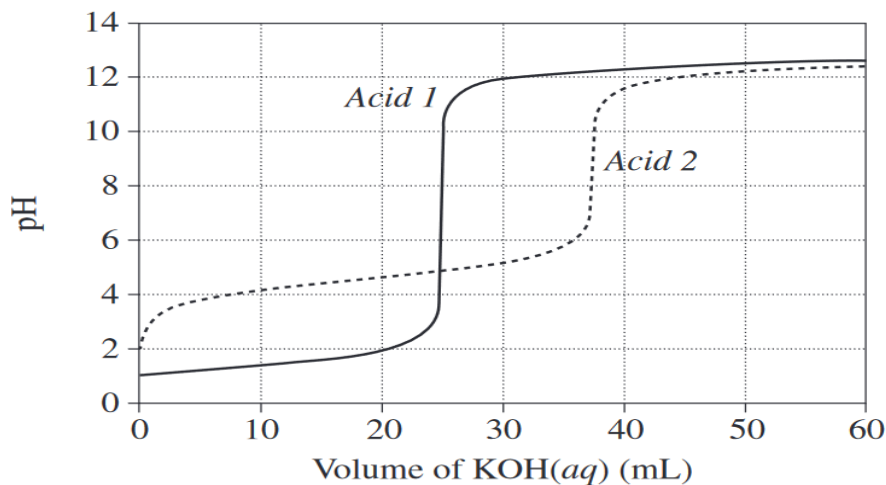
Answer ALL 10 short answer questions. Each question carries 3 marks.

1. Find the area bounded by the curves $y^2 = 4x$ and $y = x$ **(3 marks)**
2. Compute dy/dx if $y = \sqrt{\sin x + y}$ **(3 marks)**
3. The table below represents Mathematics test scores and frequency for each score.

Scores (x)	Frequency (f)
13	5
17	7
20	4
25	9

- a) Determine the median **(1.5 marks)**
 - b) Determine the mean **(1.5 marks)**
4. Answer the following questions. **(3x1=3 marks)**
 - a) Explain, in terms of molecular polarity, why N_2H_4 is very soluble in water.
 - b) Explain, in terms of chemical activity, why copper is better than iron to make a bracelet.
 - c) Explain, in terms of electrons, why the radius of a potassium atom is larger than the radius of potassium ion in the ground state.
 5. Justify that the reaction $2 Na(s) + H_2(g) \rightarrow 2 NaH(s)$ is an oxidation-reduction reaction. **(3 marks)**

6. The graph shows changes in pH for the titrations of equal volumes of solutions of two monoprotic acids, Acid 1 and Acid 2.



Explain the differences between Acid 1 and Acid 2 in terms of their relative strengths and concentrations. **(3 marks)**

7. To check the over speeding vehicles, police uses Radar speed gun. Please explain the physics behind the working of a Radar speed gun. **(3 marks)**
8. Explain the first and second law of thermodynamics with an everyday example. **(3 marks)**
9. Explain briefly how electricity is generated in a nuclear fission power plant. **(3 marks)**
10. Answer the following questions on cyber security. **(2x1.5=3 marks)**
- What is cyber security?
 - Why is it a cause of concern these days?

TASHI DELEK