ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2016
EXAMINATION CATEGORY: <u>TECHNICAL</u>

PAPER II: GENERAL SUBJECT KNOWLEDGE FOR ENGINEERING GROUP

Date   : 1 October 2016
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 being provided to check the number of pages, printing error, clarify doubts and to read instructions in Question Paper. You are NOT permitted to write during this time.

3. This paper consists of **TWO parts: – namely Part I and 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 in 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. You are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.

10. The Question paper has **15 pages** including this Instruction Page.

GOOD LUCK!

PART – I : MULTIPLE CHOICE QUESTIONS

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(c). Any doubt writing, smudgy answer or writing more than one choice shall not be evaluated. Each question carries ONE mark.

SECTION A: Mathematics

1. Integrate $\int_1^2 9x\sqrt{5 - x^2}\, dx$

    a) 8
    b) 12
    c) 14
    d) 21

2. Simplify $\begin{vmatrix} 1 & x & y \\ 0 & \cos x & \sin y \\ 0 & \sin x & \cos y \end{vmatrix}$

    a) $\cos(x + y)$
    b) $\cos x \cos y + \sin x \sin y$
    c) $1 - \cos x \sin y$
    d) $2\sin x + \cos y$

3. (3-4i) is a complex number and the square root of which is

    a) $\pm(\sqrt{3} - 2i)$
    b) $\pm(2 - i)$
    c) $\pm(\sqrt{3} + 2i)$
    d) $\pm(2 + i)$

4. The sequence $(0.15, 0.015, 0.0015, \ldots \ldots \ldots)$ is a called as

    a) Arithmetic sequence
    b) Geometric sequence
    c) Fibonacci sequence
    d) None of the above

5. Find $\lim_{x \to 10} \dfrac{x^2 - 100}{x - 10}$

    a) 0
    b) 10
    c) 20
    d) ∞

6. A box of apples cost Nu. 800 in 2014. If the cost increases by 10% in the 2015 and decreases by 5% in 2016, what is the cost of the box of apples in 2016?

   a) Nu. 920
   b) Nu. 840
   c) Nu. 836
   d) Nu. 680

7. Mr. Kaka takes 2.5 hours to travel from place A to B. If the distance between A and B is 120 Km, by how much should he increase his initial speed to reach place B in 2 hours?

   a) 12 km/hr
   b) 48 km/hr
   c) 53 km/hr
   d) 60 km/hr

8. From the group of 8 students, the chief student councilor and the 2 deputy chief councilors need to be selected. In how many ways can this be done?

   a) 168 ways
   b)   224 ways
   c) 448 ways
   d) 960 ways

9. The value of $\log_3 27^4$ is

   a)   1
   b) 3
   c) 6
   d) 12

10. Solve $\int \frac{\sin(logx)}{x} dx$

   a) $-\cos(logx) + c$
   b) $\sin x + c$
   c) $\cos x + c$
   d) $\sin^2 x + c$

11. If the radius of a sphere is 3 cm, the volume will be equal to

   a) 67.02 cm^3
   b) 84.82 cm^3
   c) 113.1 cm^3
   d) 150.8 cm^3

12. If Karma deposits Nu. 1000 in the bank and receives annual interest at the rate of 10% compounded annually. What will be the value of this deposit at the end of 3rd year?

    a) Nu. 1300
    b) Nu. 1331
    c) Nu. 1030
    d) Nu. 1330

13. The sum of the arithmetic series $5 + 11 + 17 + \ldots + 95$ is

    a) 800
    b) 750
    c) 600
    d) 550

14. If the sum of diameter and height of a cone is 10 cm, what will be radius of the cone when the volume is maximum?

    a) 3.33 cm
    b) 5 cm
    c) 6.66 cm
    d) 7 cm

15. In a shooting competition, on a scale of 1 to 10, five participants secured 3, 4, 5, 7 and 9 points. Find the mean of the scores.

    a) 6.43
    b) 4.64
    c) 5.60
    d) 2.15

16. The base of a triangle is 5 cm longer than its height and the area of the triangle is 42 sq. cm, then base of the triangle is

    a) 21 cm
    b) 12 cm
    c) 8.4 cm
    d) 13.4 cm

17. If points A (3,-2) and B (-1,1) are two points on a diameter of a circle, the length of the radius will be

    a) 2 cm
    b) 2.5 cm
    c) 3 cm
    d) 3.5 cm

18. Which of the following identities is NOT Correct?

    a) $\sin(2\Theta) = 2\sin\Theta\cos\Theta$
    b) $\cos(2\Theta) = 1 - \sin^2\Theta$
    c) $\sin(90° - \Theta) = \cos\Theta$
    d) $\sin^2\Theta = 1 - \cos^2\Theta$

19. The students at a school each participates in 2 extracurricular activities. They can choose from gardening, dancing, basketball, cooking, singing and football. What is the probability that a student participate in gardening and either cooking, dancing or gardening?

    a) 0.33
    b) 0.20
    c) 0.15
    d) 0.10

20. If $y = \dfrac{8x^3 + 1}{2x + 1}$, find $\dfrac{dy}{dx}$

    a) $8x - 2$
    b) $4x^2 - 1$
    c) $8x + 1$
    d) $4x^2 - 2x + 1$

SECTION B: Chemistry

21. Which apparatus is used for the measurement of quantity of electricity?

    a) Calorimeter
    b) Cathetometer
    c) Coulometer
    d) Colorimeter

22. Which solution will have the highest boiling point?

    a) 1% solution of glucose in water
    b) 1% solution of NaCl in water
    c) 1% solution of $ZnSO_4$ in water
    d) 1% solution of urea in water

23. The compound which contains both ionic and covalent compound is

    a) CH_4
    b) H_2

    c) KCN
    d) KCl

24. H_2SO_4 has

    a) ionic bond
    b) both Ionic and covalent bonds
    c) ionic, covalent and coordinate bonds
    d) covalent bond

25. Hybridization of carbons in $CH_3\text{-}CH = C = CH_2$ is

    a) sp^3, sp^3, sp^2, sp^2
    b) sp^3, sp^2, sp, sp^3
    c) sp^3, sp^3, sp^2, sp^3
    d) sp^3, sp^2, sp, sp^2

26. Solid NaCl is a bad conductor of electricity, since

    a) in solid NaCl there are no ions
    b) solid NaCl is covalent
    c) in solid NaCl ions are not mobile
    d) in solid NaCl there are no electrons

27. Glass is a

    a) micro-crystalline solid
    b) super cooled liquid
    c) gel
    d) polymeric mixture

28. Precipitation takes place when the product of concentration of ions

    a) equals the solubility product
    b) exceeds the solubility product
    c) is less than the solubility product
    d) is negligible

29. Which of the following has lowest pH value?

    a) 1 M HCl
    b) 1 M NaOH
    c) 1 M H_2SO_4
    d) 1 M C_2H_5OH

30. Which is correct for an endothermic reaction?

    a) ΔH is positive
    b) ΔH is negative
    c) ΔE is negative
    d) ΔH = zero

31. The function of flux during the smelting of the ore is

    a) to make the ore porous
    b) to remove gangue
    c) to facilitate reduction
    d) to facilitate oxidation

32. A yellow precipitate is obtained on adding I_2 and NaOH to

    a) $Pb(NO_3)$ (aq)
    b) $CuSO_4$ (aq)
    c) $CaCl_2$ (aq)
    d) $MgCl_2$ (aq)

33. Flourine (F_2) reacts with water to give

    a) $HF + O_2$
    b) $HF + OF_2$
    c) $HF + O_3$
    d) $HF + O_2 + O_3$

34. The chemical name of bleaching powder is

    a) Calcium hypochlorite
    b) Calcium chlorohypochlorite
    c) Calcium chlorate
    d) Calcium perchlorate

35. A solution of SO_2 in water reacts with H_2S to precipitate sulphur. Here SO_2 acts as

    a) an oxidizing agent
    b) a reducing agent
    c) an acid
    d) a catalyst

36. $CH_2 = CH_2$ is

    a) Monomer
    b) Polymer

c) Isomer

d) Epimer

37. Faraday's laws of electrolysis are related to the

a) atomic number of the cation

b) atomic number of anion

c) equivalent weight of the electrolyte

d) speed of the cation

38. Which is not affected by temperature?

a) Normality

b) Molality

c) Molarity

d) All of the above

39. Malachite is a mineral of

a) Mg

b) Cu

c) Al

d) Fe

40. A catalyst increases the rate of reaction because it

a) Increases the activation energy

b) Decreases the energy barrier for the reaction

c) Decreases the collision diameter

d) Increases the temperature coefficient

SECTION C: Physics

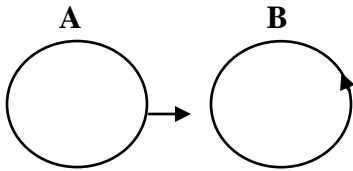41. In the Fleming Left Hand Rule, what does the thumb indicate?

a) Current

b) Magnetic field

c) Voltage

d) Direction of force

42. A man picks up a 50 kilogram block and carries it up a flight of stairs 10 meters high. He then carries the block back down the stairs and places the block in its original position. What is the NET work done on the block?

a) 1,000 joules

b) 750 joules

    c) 500 joules
    d) 0 joules

43. If the resultant force acting on a body of constant mass is zero, the body's momentum is

    a) increasing
    b) decreasing
    c) always zero
    d) constant

44. The maximum power dissipated in a 10,000 Ω resistor is 1 W. What is the maximum current?

    a) 1 A
    b) 0.001A
    c) 0.01A
    d) 0.1A

45. A hemisphere is uniformly charged positively. The electric field at a point on a diameter away from the center is directed

    a) perpendicular to the diameter
    b) parallel to the diameter
    c) at an angle tilted towards the diameter
    d) at an angle tilted away from the diameter

46. When a nucleus in an atom undergoes a radioactive decay, the electronic energy levels of the atom

    a) do not change for any type of radioactivity
    b) change for α and β radioactivity and not for γ-radioactivity
    c) change for α-radioactivity and not for others
    d) change for β-radioactivity and not for others

47. If a body weighs 12N on the surface of the earth, how much will it weigh on the surface of the moon where acceleration due to gravity is only one-sixth of that on earth's surface?

    a) 12 N
    b) 2 N
    c) 10 N
    d) 6 N

48. There are two coils A and B as shown in the figure below. Current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counter clockwise. B is kept stationary when A moves. We can infer that

a) there is a constant current in the clockwise direction in A
b) there is a varying current in A
c) there is no current in A
d) there is a constant current in the counter clockwise direction in A

49. The self inductance L of a solenoid of length l and area of cross section A, with a fixed number of turns N increases as

a) l and A increase
b) l increases and A decreases
c) l decreases and A increases
d) both l and A decrease

50. In which mirror can a virtual image be formed?

a) Plane mirror
b) Concave spherical mirror
c) Convex spherical mirror
d) All of the above

51. The Tesla and the Gauss are units of

a) Conductance
b) Magnetic field strength
c) Magnetic flux
d) Electrical current

52. An infinitely long wire carries a current of 3A. The magnetic field outside the wire

a) points radially away from the wire
b) points radially inward
c) circles the wire
d) is zero

53. Whose principle or law states that each point on a wave front may be considered a new wave source?

    a) Snell's Law
    b) Huygen's Principle
    c) Young's Law
    d) Hertz's Law

54. In the sun, helium is produced from hydrogen by

    a) radioactive decay
    b) disintegration
    c) fission
    d) fusion

55. To convert a galvanometer to a voltmeter, you should add a

    a) high resistance in series
    b) high resistance in parallel
    c) low resistance in series
    d) low resistance in parallel

56. A satellite of mass "M" is in orbit around the earth. If a second satellite of mass "2M" is to be placed in the same orbit, the second satellite must have a velocity which is

    a) half the velocity of the first satellite
    b) the same as the velocity of the first satellite
    c) twice the velocity of the first satellite
    d) four times the velocity of the first satellite

57. A 10 kilogram ball falls from a height of 5 meters and rebounds from the floor to a height of 3 meters. The energy lost by the ball is

    a) 20 joules
    b) 98 joules
    c) 196 joules
    d) 294 joules

58. In N-type semiconductors the majority of the carriers are

    a) wholes
    b) electrons
    c) protons
    d) neutrons

59. If two different gases having the same volume, temperature, and pressure and behave like ideal gases, they will also be identical in which one of the following ways?

   a) Average molecular velocity
   b) Total mass
   c) Total molecular kinetic energy
   d) Average momentum per molecule

60. Weather satellites transmit cloud cover and temperature-humidity profiles back to Earth using images of which combination of the electromagnetic radiation types?

   a) Infra-red and visible light
   b) Ultraviolet and nuclear magnetic
   c) Ultraviolet and infra-red
   d) Ultraviolet and visible light

SECTION D: General IT Knowledge

61. The operating system is usually preinstalled on your computer and is responsible for managing the computer. Which of the following is NOT an example of operating system

   a) Windows XP
   b) Microsoft Word
   c) Linux
   d) MS-DOS

62. The performance of a _____is measured in bits per second

   a) Modem
   b) CPU
   c) RAM
   d) ROM

63. Which of the following is NOT a network device

   a) Router
   b) Hub
   c) Modem
   d) Joystick

64. Application software allows end users to accomplish specific tasks, the examples of application software includes the following EXCEPT

   a) Video games
   b) Microsoft word
   c) Mozilla Firefox
   d) Windows Vista

65. _____ involves using a code to convert the file into an unreadable format.

   a) Coding
   b) Encryption
   c) Spamming
   d) Trojan

66. ADSL is a data communications technology that enables faster data transmission over copper telephone lines rather than a conventional voice band modem can provide and ADSL stands for

   a) Asymmetric Digital Subscriber Line.
   b) Access Dielectric Standard Link
   c) Asymmetric Direct Subscriber Link
   d) American Digital Subscriber Link

67. A component that stores data so that future requests for that data can be served faster is known as

   a) Database
   b) Cache
   c) Hard disk
   d) Memory

68. In which of the following form, data is stored in computer?

   a) Decimal
   b) Binary
   c) Hexa Decimal
   d) Octal

69. A memory bus is mainly used for communication between

   a) Processor and memory
   b) Memory and input devices
   c) Input/Output devices and memory
   d) Input and output devices

70. A temporary storage area attached to the CPU for input/output operations is known as

   a) Chip
   b) Buffer
   c) Register
   d) Core

PART II : SHORT ANSWER QUESTIONS

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

1. The sum of 3 numbers A, B and C is 18 and if the ratio of A to B is 2:3 and the ratio of B to C is 3:4. Find the values of A, B and C. (**3 marks**)

2. Given that $y(x) = (x+2)(2x+1)^2$, determine the equation of the tangent to the curve at the point $x = -3$. (**3 marks**)

3. Following marks were scored by a class of 20 students in a mathematics test.

   15, 20, 30, 25, 30, 45, 50, 70, 60, 43, 33, 42, 45, 38, 80, 55, 40, 70, 78, 50

   a) What is the mean mark of the class? (**1 mark**)
   b) What is the standard deviation of the marks? (**1 mark**)
   c) What percentage of the students scored within one standard deviation of the mean?
   (**1 mark**)

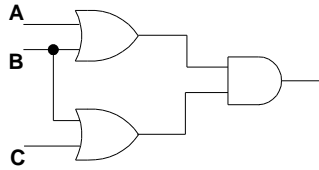4. Complete the following reactions and balance the equations:

   a) ……..+ NaCl $\longrightarrow$ $NaHCO_3$ + NH_4Cl (**1 mark**)

   b) Cu + HNO_3 $\longrightarrow$ CuO + …….+ H_2O (**1 mark**)

   c) H_2SO_4 + …….. $\longrightarrow$ $Al_2(SO_4)_3$ + H_2O (**1 mark**)

5. Calculate pH of the buffer solution containing 0.15 moles of NH_4OH and 0.25 moles of NH_4Cl. (K_b for NH_4OH is 1.98×10^{-5}) (**3 marks**)

6. Briefly answer the following questions:

   a) What is the word that describes a substance which reacts with both strong bases and strong acids? (**1 mark**)

   b) What is the name of the point on a phase diagram which indicates the temperature above which a gas cannot be converted to a liquid? (**1 mark**)

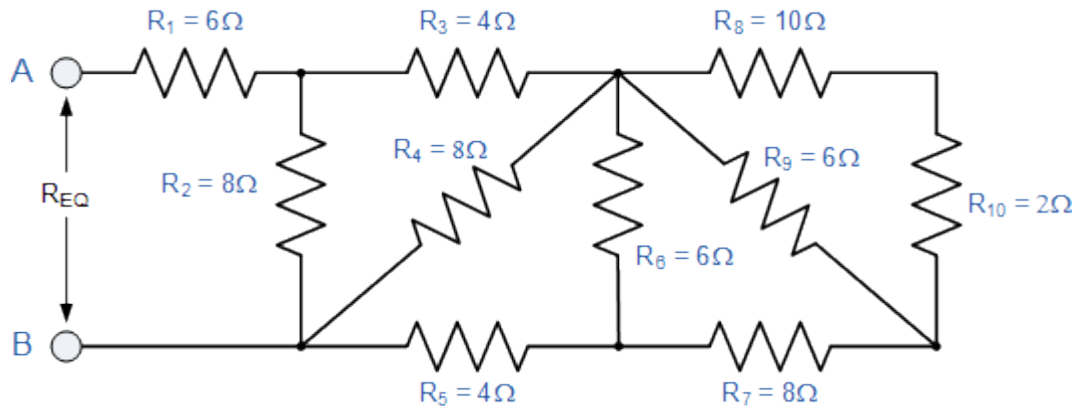   c) What is the most abundant element in the human body? (**1 mark**)

7. Answer the following with reference to the following circuit diagram.

a) Write the Boolean expression for the circuit diagram above. (**1 mark**)
b) Name four types of gates. (**1 mark**)
c) What is used in a gate to establish how the input values map to the output value? (**1 mark**)

8. Find the equivalent resistance, R_{EQ} for the following resistor combination circuit.
(**3 marks**)

9. Explain why an object, orbiting the Earth, is said to be freely falling. Use your explanation to point out why objects appear weightless under certain circumstances.
(**3 marks**)

10. What is an IP address? How do you view the IP address on your computer? Provide an example of the IP address format. (**3 marks**)