Question Booklet Series: **A** *Question Booklet Serial No.:* **100078**

PULEET – 2023

Important: *Please consult your Admit Card/Roll No. slip before filling your Roll Number on the Test Booklet and Answer Sheet.*

Roll No. ***(In Figure)*** ***(In Words)***

O.M.R. Answer Sheet Serial No.

Signature of Candidate: _____ *Signature of Invigilator:* _____

Time: 100 Minutes **Number of Questions: 100** **Maximum Marks: 100**

DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO.

INSTRUCTIONS:

1. Write your Roll No. on the Questions Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Question Booklet Serial No. on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Gel Pen**.
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. Please check that this Question Booklet contains **100** Questions. In case of any discrepancy, inform the Assistant Superintendent within 10 minutes of the start of Test.
5. Each question has four alternative answer (A,B,C,D) of which only one is correct. For each question, darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Gel Pen. There shall be negative marking for wrong answer, ¼ of the marks of the question will be deducted for every wrong answer.**
6. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Booklet. No marks will be deducted in such cases.
7. The mediums of examination shall be English only.
8. **35 minutes extra would be given to the visually handicapped/PwD Candidates.**
9. **Darken** the bubbles in the OMR Answer Sheet according to the Serial No. of the question given in the Question Booklet.
10. If you want to change an already marked answer, erase the shade in the darkened bubble completely.
11. For rough work only the blank sheet at the end of the Question Booklet be used.
12. The University will provide Logarithmic table. Borrowing of log table or other material is not allowed.
13. The Answer Sheet is designed for computer evaluation. Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e. not following the instructions completely, shall be of the candidate only.**
14. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
15. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so would be expelled from the examination.
16. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistant or found giving or receiving assistant or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent/Observer whose decision shall be final.
17. **Communication equipment such as Pager, Cellular phones, wireless set, scanner, camera or any electronic/digital gadget etc., is not permitted inside the examination hall. Use of calculators is not allowed.**
18. The candidates will not be allowed to leave the Examination Hall/Room before the expiry of the allotted time.

1. If α, β are roots of $x^2 - 3x + 1 = 0$, then the value of $\alpha^4 + \beta^4$ is
   (A) 57 (B) 37 (C) 47 (D) 27

2. Rank of a matrix $A = \begin{bmatrix} 1 & 3 & 5 \\ 2 & -1 & 4 \\ -2 & 8 & 2 \end{bmatrix}$ is
   (A) 3 (B) 2 (C) 1 (D) 0

3. The value of $\frac{sec8\theta - 1}{sec\,4\theta - 1}$ is equal to
   (A) $\frac{tan\,2\theta}{tan8\theta}$ (B) $\frac{tan\,8\theta}{tan4\theta}$ (C) $\frac{tan6\theta}{tan2\theta}$ (D) $\frac{tan\,8\theta}{tan2\theta}$

4. Slope of a line making an angle 30° with y-axis and lie in first quadrant and passing though the origin is
   (A) $\frac{1}{\sqrt{3}}$ (B) $\sqrt{3}$ (C) $\frac{1}{2}$ (D) $\frac{\sqrt{3}}{2}$

5. The curvature and radius of curvature of the curve $x^2 + y^2 = a^2$ at (x, y) is
   (A) a & $\frac{1}{a}$ (B) $\frac{1}{a}$ & a (C) a & a (D) $\frac{1}{a}$ & $\frac{1}{a}$

6. The limit $\lim_{(x,y)\to(0,1)} \tan^{-1}\left(\frac{y}{x}\right)$ is
   (A) 1 (B) $\pm\frac{2}{\pi}$ (C) $\pm\frac{\pi}{2}$ (D) $\pm\frac{\pi}{4}$

7. The differential equation: $xy^3\,dx + a\,x^2y^2dy = 0$ is exact when a is equal to
   (A) 3 (B) 2 (C) $\frac{2}{3}$ (D) $\frac{3}{2}$

8. The value of double integral $\iint_R e^{x^2\,dx\,dy}$, where the region R is given by
   (A) $\frac{1}{4}(e^4 - 1)$ (B) $\frac{1}{4}(e^4 + 1)$ (C) $(e^4 - 1)$ (D) $(e^4 + 1)$

9. The gradient of a scalar field $f(x, y) = y^2 - 4\,x\,y$ at $(1, 2)$ is
   (A) $6\,\hat{i}$ (B) $8\hat{i}$ (C) $-6\,\hat{i}$ (D) $-8\hat{i}$

10. The line integral $\int_C (x^2 + y\,z)\,dz$, where C is given by $x = t, y = t^2, z = 3\,t, 1 \le t \le 2$ is equal to
    (A) $\frac{163}{4}$ (B) $\frac{153}{4}$ (C) $\frac{143}{4}$ (D) $\frac{133}{4}$

11. The displacement of a particle is given by $x = t^2 + 3t + 2$, where x is in meters and t is in seconds. The distance covered by the particle in the first 3 seconds and velocity acquired at the end of 3 seconds are respectively:
    (A) 10 m and 5 m/s (B) 10 m and 9 m/s
    (C) 20 m and 5 m/s (D) 20 m and 9 m/s

12. The angle of friction between two surfaces in contact is 30°. The coefficient of friction between them is:
    (A) $\sqrt{3}$ (B) $1/\sqrt{3}$ (C) 0 (D) 1

13. The rotation of earth about its axis is:
(A) periodic and simple harmonic motion
(B) non-periodic and simple harmonic motion
(C) periodic but not simple harmonic motion
(D) non-periodic and not simple harmonic motion

14. The specific heat of a gas during an isothermal change is:
(A) zero
(B) positive and finite
(C) negative and finite
(D) infinite

15. In Young's double slit experiment with monochromatic light, fringes are obtained on a screen at some distance D from the slits. If the screen is moved 5×10^{-2} m towards the slits, the change in fringe width is 3×10^{-5} m. What is the wavelength of light used, if the distance between slits is 10^{-3}m?
(A) 300 nm (B) 600 nm (C) 750 nm (D) 900 nm

16. The electrostatic field due to a point electric dipole is proportional to r^{n}, where r is the distance of the observation point from the mid-point of the dipole. The value of n is
(A) -2 (B) -3 (C) 2 (D) 3

17. Two parallel wires carrying current in the same direction experience:
(A) no mutual force
(B) attraction
(C) repulsion
(D) sometimes attraction sometimes repulsion

18. In a photoelectric effect experiment, maximum kinetic energy of the photoelectrons is 1eV for incoming radiation of frequency v_0 and 3 eV for incoming radiation of frequency $1.5v_0$. What will be the maximum kinetic energy of photoelectrons for incoming radiation of frequency $9v_0/4$.
(A) 3 eV (B) 6 eV (C) 9 eV (D) 12 eV

19. Two spherical nuclei have mass numbers 216 and 64 with their radii R_1 and R_2 respectively. The value of R_1/R_2 is:
(A) 3:2 (B) 2:3 (C) 1:3 (D) 1:2

20. The focal length of a thin lens in the vacuum is *f*. If the material of the lens has a refractive index of 3/2, its focal length in water (refractive index of water is 4/3) is:
(A) *f* (B) $4f/3$ (C) $2f$ (D) $4f$

21. The commutator segments of a DC machine are made up of
(A) Stainless steel
(B) Brass
(C) Hard drawn copper
(D) Bronze

22. The copper-loss and core-loss of a transformer at various loads are:

Load	*Core-loss*	*Copper-loss*
(A) 50 kVA	320 W	500 W
(B) 40 kVA	320 W	320 W
(C) 30 kVA	320 W	180 W
(D) 20 kVA	320 W	80 W

At what load will the efficiency of the transformer be maximum?

23. A transformer when supplying a load maintained 11 kV across load terminals. When the load was switched off, the terminal voltage became 11550 V. What is the voltage regulation at this load?

(A) 11.55% (B) 5.5% (C) 5% (D) 55%

24. To attain the higher starting torque in a three-phase slip-ring induction machine

(A) Extra resistance should be connected across the slip-ring terminals
(B) The phase-sequence of the supply to the motor should be reversed
(C) The supply voltage should be increased
(D) The winding should first connected in star and then in delta

25. In a split phase capacitor start induction motor, a time-phase difference between the currents in the main and auxiliary winding is achieved by

(A) Placing the two windings at an angle of 90° electrical in the stator slots
(B) Applying two-phase supply across the two windings
(C) Introducing capacitive reactance in the auxiliary winding circuit
(D) Connecting the two windings in series across a single-phase supply

26. Calculate the current, I drawn from the battery shown in figure-1.

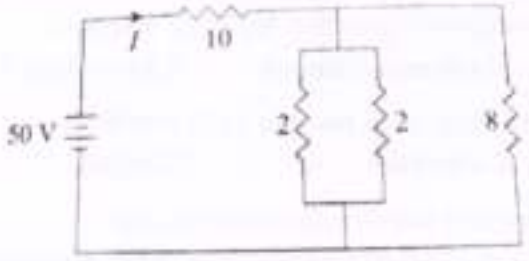


Figure-1

(A) 4.52 A (B) 45.2 A (C) 0.452 A (D) 10.8 A

27. When a sinusoidal voltage of maximum 1 V is applied to a pure capacitor a current of maximum 1 A flows through the circuit. The average power in the circuit is

(A) 0 W (B) 0.707 W (C) 0.5 W (D) 1.0 W

28. A balanced three-phase star connected load of 200 kW takes a leading current of 100 A with a line voltage of 1200 V, 60 Hz. What will be the phase impedance of this load?

(A) 120 Ω (B) 12 Ω (C) $12\times\sqrt{3}$ Ω (D) $12/\sqrt{3}$ Ω

29. The magnetic permeability, μ_0 of free space is represented by
(A) $\pi \times 10^{-7}$ wb/amp meter
(B) $3\pi \times 10^{-7}$ wb/amp meter
(C) $4\pi \times 10^{-7}$ wb/amp meter
(D) $4\pi \times 10^{-9}$ wb/amp meter

30. A sinusoidal voltage source is applied onto a pure inductor. Which is the correct statement?
(A) Voltage across the inductor lags by 90° to the current flowing through the inductor
(B) Voltage across the inductor leads by 90° to the current flowing through the inductor
(C) Voltage across the inductor partially lags the current flowing through the inductor
(D) Voltage across the inductor partially leads the current flowing through the inductor

31. The average value of a full-wave rectified voltage with a peak value of 75 V is
(A) 53 V (B) 47.8 V (C) 37.5 V (D) 23.9 V

32. To saturate a BJT
(A) $I_B = I_{C\,(sat.)}$
(B) $I_B > \frac{I_{C\,(sat.)}}{\beta_{DC}}$
(C) V_{CC} must be at least 10 V
(D) the emitter must be grounded

33. An n-channel D-MOSFET with a positive V_{GS} is operating in
(A) the depletion mode
(B) the enhancement mode
(C) cutoff
(D) saturation

34. The midrange open-loop gain of an op-amp
(A) rolls off at 20 dB/decade beginning at 0 Hz
(B) is infinity
(C) extends from the lower critical frequency to the upper critical frequency
(D) extends from 0 Hz to the upper critical frequency

35. The Wien-bridge oscillator's positive feedback circuit is
(A) an RL circuit (B) an LC circuit (C) a voltage divider (D) a lead-lag circuit

36. Binary equivalent of Gray code number 1111 would be
(A) 1010 (B) 1101 (C) 0101 (D) 1100

37. A master –slave flip-flop has the characteristic that
(A) Change in the input is immediately reflected in the output
(B) Change in the output occurs when the state of master is affected
(C) Change in the output occurs when the state of slave is affected
(D) Both the master and slave states are affected at the same time

38. Signal $v(t) = 5[\cos(10^6\pi t) - \sin(10^3\pi t) \times \sin(10^6\pi t)]$ represents
(A) SSB signal
(B) DSB suppressed carrier signal
(C) AM signal
(D) Narrow-band FM signal

39. An ammeter is convertible to a voltmeter by
(A) Changing the scale
(B) Simply installing the instrument in parallel with the circuit
(C) Putting a large resistance in parallel with the actual measuring part of the instrument
(D) Putting a large resistance in series with the actual measuring part of the instrument

40. A varactor diode exhibits
(A) a variable capacitance that depends on reverse voltage
(B) a variable resistance that depends on reverse voltage
(C) a variable capacitance that depends on forward current
(D) a constant capacitance over a range of reverse voltages

41. What will be the output of following program on 64 bit machine?

```
#include <stdio.h>
  union Sti
  {
    int nu;
    char m;
  };
  int main()
  {
    union Sti s;
    printf("%ld", sizeof(s));
    return 0;
  }
```

(A) 6 (B) 5 (C) 4 (D) 8

42. Which is valid C expression?
(A) int my_num = 100,000; (B) int my_num = 100000;
(C) int my num = 1000; (D) int $my_num = 10000;

43. What is the output of below program if the input is "puleet":-

```
#include <stdio.h>

  int main()
  {
   char x [10], *ptr = x;
  scanf ("%s", x);
    change(&x[3]);
  }
 change(char a[ ])
{
  puts(a);
}
```

(A) eet (B) leet (C) pule (D) puleet

44. The concept of having two functions with same signatures in base and derived class is known as?

(A) Operator Overloading
(B) Function Overloading
(C) Function Overriding
(D) Function renaming

45. What will be the output of following program?

```
#include <stdio.h>

int main()
   {
   int a = 1, b = 2, c = 3;
   printf("%d", a += (a += 3, 5, a) );
 }
```

(A) 12 (B) 6 (C) 9 (D) 8

46. Which of the following declaration is not supported by C language?

(A) String str;
(B) char *str;
(C) float str = 3e2;
(D) Both "String str;" and "float str = 3e2;"

47. When fopen() is not able to open a file, it returns

(A) EOF (B) NULL (C) Run-time Error (D) True value

48. Which of the following operators takes only integer operands and raises error when used with other operands?

(A) + (B) * (C) / (D) %

49. What will be the output of following code?

```
int main()
   {
   int a,b,c;
   a=1;
    b = 110;
    c = 20;
   a = b = c*=5;
   printf("%d",a);
   }
```

(A) 110 (B) 100 (C) 20 (D) 1

50. What will be the ouput of following C program

```
#include <stdio.h>
  void reverse(int i);
  int main()
  {
    reverse(5);
  }
  void reverse(int i)
  {
    if (i > 10)
      return ;
    printf("%d ", i);
    return reverse((i++, i--));
  }
```

(A) 5 6 7 8 9 10 (B) 5 4 3 2 1 (C) 5 (D) 5 4

51. In which method of fluid flow analysis do we describe the motion parameters at a point?

(A) Langragian method (B) Eulerian Method

(C) Control volume analysis (D) Control mass analysis

52. Find the discharge through totally drowned orifice of width 2.3 m if the difference of water levels on both side of the orifice be 40 cm. The height of water from to and bottom of the orifice are 2.6 m and 2.75 m respectively.

(A) 0.56 m^3/s (B) 0.64m^3/s (C) 0.75 m^3/s (D) 0.55 m^3/s

53. Air can be cooled and dehumidified by

(A) circulating chilled water in tube across air flow

(B) placing evaporator coil across air flow

(C) spraying chilled water to air

(D) A, B, C

54. The mean effective pressure of an Otto Cycle increases with an increase in _____

(A) pressure ratio (B) compression ratio

(C) temperature ratio (D) expansion ratio

55. If in a fluid, while applying Newton's second law of motion, compressibility force is neglected then what equation is obtained?

(A) Navier Stoke's Equation (B) Reynold's equation of motion

(C) Euler's Equation of motion (D) Continuity Equation for fluid flow

56. According to Bernoulli equation for steady fluid flow

(A) principle of conservation of mass holds

(B) velocity and pressure are inversely proportional

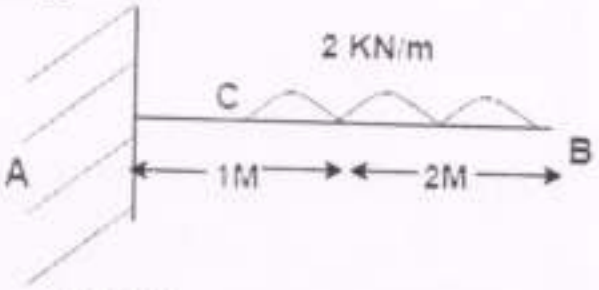
(C) total energy is constant throughout

(D) the energy is constant along streamline but may vary across streamlines

57. Which of the following is the result of a reduction in operating pressure in the Air refrigeration cycle?
(A) decrease in C.O.P.
(B) always decreases
(C) increase in C.O.P.
(D) no change in C.O.P.

58. _____ mechanism is a crossed four bar chain mechanism in early steam engines to guide the piston rod in a cylinder to have an approximate straight-line motion.
(A) Chebychev's
(B) Watt's
(C) Peaucellier's
(D) Grasshopper

59. What is the SF at support B?



(A) 5 kN (B) 3 kN (C) 2 kN (D) 0 kN

60. Find the moment of inertia of a rectangular section of 40 mm width and 80 mm depth about the base.
(A) $632\times10^4 mm^4$ (B) $682\times10^4 mm^4$ (C) $734\times10^4 mm^4$ (D) $568\times10^4 mm^4$

61. A partially saturated sample of soil has a unit weight of 2.0 g/cm^3 and specific gravity of soil particles is 2.6. If the moisture content in the soil is 20%, the degree of saturation is
(A) 20% (B) 77% (C) 92% (D) 98%

62. In the cement the compound quickest to react with water, is
(A) Tricalcium aluminate
(B) Tetra-calcium alumino-ferrite
(C) Tricalcium silicate
(D) Dicalcium silicate

63. The maximum area of tension reinforcement in beams shall not exceed
(A) 0.15% (B) 1.5% (C) 4% (D) 1%

64. If the atmospheric pressure on the surface of an oil tank (sp. gr. 0.8) is 0.1 kg/cm^2, the pressure at a depth of 2.5 m, is
(A) 1 metre of water
(B) 2 metres of water
(C) 3 metres of water
(D) 3.5 metres of water

65. A district road with a bituminous pavement has a horizontal curve of 1000 m for a design speed of 75 km ph. The super-elevation is
(A) 1 in 40 (B) 1 in 50 (C) 1 in 60 (D) 1 in 70

66. A beam is defined as a structural member subjected to
(A) axial loading
(B) transverse loading
(C) axial and transverse loading
(D) torsional loading

67. The surface of freshly cut timber should be:
(A) Soft and shining (B) Hard and shining (C) Perfectly round (D) Light in colour

68. According to IS: 800-2007 plastic analysis may be performed if the ratio of tensile strength to the yield stress specified for the grade of steel is
(A) Greater than 1.2 (B) Less than 1.2 (C) Greater than 1.5 (D) Less than 1.5

69. For ensuring quality of concrete, use
(A) single sized aggregates (B) two sized aggregate
(C) graded aggregates (D) coarse aggregates

70. The sensitiveness of a level tube decreases if
(A) radius of curvature of its inner surface is increased
(B) diameter of the tube is increased
(C) length of the vapour bubble is increased
(D) both viscosity and surface tension are increased

71. What is the unit of specific gravity?
(A) Dimensionless (B) m/s^2 (C) N/m^3 (D) Kg/m^3

72. Which of the following has the same number of moles as in 398 grams of $CuSO_4$?
(A) 35 grams of nitrogen (B) 58.5 grams of Sodium chloride
(C) 2 grams of hydrogen (D) 40 grams of oxygen

73. What is the weight of 10 moles of a mixture with composition 15% O_2, 25% SO_2, 30% $COCl_2$, 25% SO_3 and 5% N_2?
(A) 564 (B) 475 (C) 867 (D) 719

74. Which of the following composition can be controlled by a bypass stream?
(A) Feed (B) Process (C) Exit stream (D) None of these

75. Which of the following is not true about ideal gas molecules?
(A) They do not have attractive forces (B) They have negligible size
(C) They move in random motion (D) They do not apply pressure

76. Which of the following is true about compressibility of real gases?
(A) $Z < 1$ (B) $Z > 1$
(C) $Z = 1$ (D) Both $Z < 1$ and $Z > 1$

77. Which of the following is not the equation of state?
(A) Charles Equation (B) Holborn Equation
(C) Peng Robinson Equation (D) Van der Waals Equation

78. Which of the following is true about limiting reagents?
(A) Consumes partially
(B) Does not react
(C) Consumes completely
(D) None of these

79. In the humidity chart, what does the horizontal axis represent?
(A) Air temperature
(B) Dry-Bulb temperature
(C) Wet-Bulb temperature
(D) Molar volume

80. What happens to water in the humidification process?
(A) Evaporates (B) Freezes (C) Saturated (D) None of these

81. Na^+, Mg^{2+}, Al^{3+}, Si^{4+} are isoelectronic. Their ionic size will follow the order
(A) $Na^+ > Mg^{2+} > Al^{3+} > Si^{4+}$
(B) $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$
(C) $Na^+ > Mg^{2+} < Al^{3+} < Si^{4+}$
(D) $Na^+ < Mg^{2+} > Al^{3+} > Si^{4+}$

82. Ionic radii are:
(A) Inversely proportional to effective nuclear charge
(B) Directly proportional to effective nuclear charge
(C) Inversely proportional to the square of effective nuclear charge
(D) Directly proportional to square of effective nuclear charge

83. The artificial zeolite used for softening hard water has the formula
(A) $Na_2Al_3Si_2O_8.xH_2O$
(B) $Na_2Al_2Si_2O_8.xH_2O$
(C) $Na_2Al_2Si_2O_6.xH_2O$
(D) $Na_2Al_3Si_2O_6.xH_2O$

84. Why is the high percentage of moisture undesirable for coal?
(A) It increases the rate of combustion
(B) It increases the cost of coal
(C) It reduces the calorific value of coal
(D) It decreases its ignition temperature

85. The ignition characteristics of diesel are expressed in terms of
(A) Octane number
(B) Cetane number
(C) Viscosity
(D) Flash and fire point

86. Montreal protocol signed in 1987 was signed to
(A) Ban nuclear testing in tropical oceans
(B) Protect endangered species
(C) Phase out use of CFC's
(D) Reduce green house effect

87. A river with high BOD value is
(A) Highly polluted
(B) Highly clean
(C) Highly productive
(D) BOD is not applicable to rivers

88. The localized attack of a corroding environment leading to the formation of holes in an otherwise relatively unattackedsurface of a metal is called

(A) Water line corrosion (B) Pitting corrosion

(C) Concentration cell corrosion (D) Wet corrosion

89. The cathodic inhibitors slow down the corrosion reaction by decreasing

(A) Diffusion of hydrated H^+ ion to the anode

(B) Diffusion of Cl^- ion to the cathode

(C) Diffusion of hydrated H^+ ion to the cathode

(D) Diffusion of Cl^- ion to the anode

90. If the largest value of m for an electron is +2, then the electron may be present in which type of sub shell?

(A) s subshell (B) d subshell (C) p subshell (D) f subshell

91. In a certain code, COMPUTER is written as PMOCRETU, how is DECIPHER written in that code?

(A) ICEDREHP (B) ICDEERHP (C) DEICPHRE (D) REHPICED

92. Radha walks towards South-East for 7 km, and then she walks towards West and travels a distance of 14 km. From here she moves towards North-West a distance of 7 km and finally she moves a distance of 4 km towards East. How far is she now from the starting point?

(A) 3 km (B) 4km (C) 10 km (D) 11 km

93. In a family, there are six members A, B, C, D, E and F. A and B are a married couple, A being the male member. D is the only son of C, who is the brother of A. E is the sister of D. B is the daughter-in-law of F. How is F related to E?

(A) Uncle (B) Grandmother (C) Aunt (D) Mother

94. Which of the following word is correctly spelt?

(A) Questionnaire (B) Questionaire

(C) Questionare (D) Questionnare

95. She said that she _____ to the party tonight.

(A) Will come (B) Shall come (C) Would come (D) Will be coming

96. Select the options that correctly complete the sentence:

The officer had _____ the documents carefully before _____ it.

(A) reads, signed (B) reading, signed

(C) read, signing (D) read, signs

97. Select the correct option that identifies the noun in the following sentence:
Most of the calls to this Company are placed on lengthy holds.
(A) Most (B) Placed (C) Lengthy (D) Holds

98. Identify the underlined word in the following sentence:
Beauty is in the eye of the beholder.
(A) Adjective (B) Adverb (C) Abstract noun (D) Common noun

99. Select the segment of the sentence, which contains grammatical errors. If there is no error in the sentence, mark 'no error'.
The Police (I) / is becoming more(II) / and more inactive (III) / No error (IV)
(A) I (B) II (C) III (D) IV

100. Did he show you what to do?
Select the correct passive form from the options given below.
(A) Has anybody been shown? (B) Has anybody shown you what to do?
(C) Has you been shown what to do? (D) Were you shown by him what to do?

x-x-x

SPACE FOR ROUGH WORK