

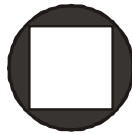
RESEARCH METHODOLOGY FOR ENGINEERING

1. A pot is fully filled (upto brims) with water. A cube of ice floating in it is partially submerged and partially seen above the water level. As the ice cube fully melts, what will happen to the level of water ?
 - (A) The water spills over
 - (B) The water level decreases
 - (C) The water level remains the same
 - (D) The water level increases

2. Suppose a 2-dimensional graph is to be plotted, with 's' as independent variable, 'p' as dependent variable and also showing the impact of a 3rd variable, 'q', on the 'p' variable, then :
 - (A) independent variable, 's', is plotted along the x-axis; dependent variable, 'p', is plotted along y-axis holding 'q' constant, then other plots of 's' vs. 'p' are done, each for a different value of 'q' held constant.
 - (B) 'p' is plotted along x-axis; 's' is plotted along y-axis holding 'q' constant, then other plots of 's' vs. 'p' are done, each for a different value of 'q' held constant.
 - (C) 's' is plotted along x-axis; 'q' is plotted along y-axis holding 'p' constant, then other plots of 'q' vs. 's' are done, each for a different value of 'p' held constant.
 - (D) 'p' is plotted along the x-axis; 'q' is plotted along the y-axis holding 's' constant, then other plots of 'q' vs. 'p' are done, each for a different value of 's' held constant.

3. In a laboratory experiment, while plotting a graph,
- (A) generally, 10 readings are taken, and a graph is plotted by connecting all the points plotted, even if it results in a zig-zag line.
 - (B) generally, 25 readings are taken, and a graph is plotted by connecting all the points plotted, even if it results in a zig-zag line.
 - (C) generally, 6 to 8 readings are taken, and a graph is plotted by connecting all the points plotted, even if it results in a zig-zag line.
 - (D) generally, 6 to 8 readings are taken, and a graph is plotted by drawing a smooth curve passing close to all points but may not touch all/several points.
4. The distinction between parameter and variable is :
- (A) Parameter is an intrinsic property of the system and exists even if no input is applied to a system, while variable shows up only in response to applied input(s).
 - (B) Parameter is a fixed property of the system and exists even if no input is applied to a system, while variable is a variable quantity that shows up only in response to applied input(s).
 - (C) Parameter is a variable property of the system, while variable is a fixed property of the system.
 - (D) Parameter is a fixed property of the system and exists only if input is applied to a system, while variable is a variable property that shows up even if no input(s) is (are) applied.
5. In a class, the ratio of number of boys to girls is 5 : 3. What percentage of the students in the class are girls ?
- (A) 37.5 %
 - (B) 50 %
 - (C) 60 %
 - (D) 62.5 %

6. If 25% of 260 equals 6.5% of P, what is P ?
- (A) 65 (B) 100
(C) 130 (D) 1000
7. How many different arrangements are there of the letters A, B, C and D ?
- (A) 6 (B) 12
(C) 24 (D) 18
8. In the figure below, a square of perimeter 24 is inscribed in a circle. What is the area of shaded region ?



- (A) $18\pi - 24$ (B) $18\pi - 36$
(C) $12\pi - 36$ (D) $9\pi - 36$
9. MULTAN : OUOTEN :: PURIFY: _____
- (A) RUUIJY (B) OQTVQS
(C) QVSJEZ (D) None of these
10. If word PLAYER is coded as AELPRY, then word MANAGER is coded as :
- (A) AEAGMNR (B) AAGEMNR
(C) AAEGMNR (D) AAEGNMR

11. In the sequence below, some letters are missing. From the choices, select the choice that gives the letters that can fill the blanks in the sequence :

a _ b _ _ _ a a _ b c _.

- (A) abcabc (B) abccba
(C) abccbc (D) ababcc

12. The entropy of the universe is :

- (A) decreasing
(B) increasing
(C) constant
(D) getting halved every year

13. How many 9's are there in the following sequence which are either immediately followed by 9 or immediately preceded by 9 :

793992896793579975

- (A) Four (B) Two
(C) Three (D) One

14. What is the next letter in the series ?

B, D, G, K, P, ___

- (A) S (B) V
(C) W (D) X

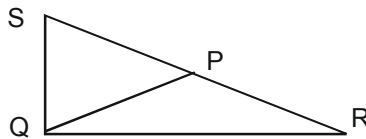
15. True value of a quantity can be practically obtained by :
- (A) mean of squares of a number of readings taken under no bias conditions such that positive deviations cancel out negative deviations.
- (B) mean of a large number of readings taken under no bias conditions such that positive deviations cancel out negative deviations.
- (C) whatever is measured by a laboratory or industrial meter.
- (D) the actual value obtained after removing parallax error.
16. The sum, s , of probabilities of all outcomes of an event or a statistical experiment is :
- (A) zero (B) $0 < s < 1$
- (C) $0 \leq s \leq 1$ (D) 1
17. If '+' stands for '-', '-' stands for '×', '×' stands for '÷', and '÷' stands for '+', then evaluate :
- $$56 \times 7 \div 13 - 11 + 15 - 8 \div 2 - 7$$
- (A) 30 (B) 45
- (C) 60 (D) 90
18. An engineer starts from home and travels 10 m towards West, then turns right and travels 40 m. He then travels 25 m East followed by 50 m towards the South to reach his factory. What is the approximate distance between his home and factory ?
- (A) 18 m (B) 125 m
- (C) 25 m (D) 105 m

19. A compass was damaged and its needle twisted / turned in such a manner that the pointer which was showing East, now showed North. A man went towards West as per the above mentioned compass. In which direction did he actually go ?
- (A) South-West (B) South
(C) North-East (D) North
20. One evening, a person was facing a pole. The shadow of the pole fell to his right. Which direction he was facing ?
- (A) East (B) West
(C) North (D) South
21. When a watch shows 3 : 45, the minute hand points towards East. When the watch shows 6 O'clock, in what direction will the hour hand point ?
- (A) North (B) South
(C) East (D) West
22. A is the husband of B. E is the daughter of C. A is the father of C. How is B related to E ?
- (A) Mother (B) Grandmother
(C) Aunt (D) Cousin
23. If we take the union and intersection respectively of a crisp/classical set with its compliment, what is the resultant in each case ?
- (A) 1 and 0 respectively.
(B) 0 and 1 respectively.
(C) Universal set, X, and Null set, \emptyset , respectively.
(D) Null set, \emptyset , and Universal set, X, respectively.

24. If P, Q and R are matrices, and if $PQ = PR$, then it :
- (A) does not imply that $Q = R$, except if P is non-singular.
 - (B) always implies that $Q = R$.
 - (C) never implies that $Q = R$.
 - (D) implies that Q and R are commutative under multiplication.
25. If P and Q are matrices, then :
- (A) order of PQ is always the same as that of QP
 - (B) $PQ = QP$ provided that matrices are conformable for multiplication in both cases
 - (C) in general, PQ may or may not be equal to QP
 - (D) both “A” and “B”
26. How many negative integers satisfy $|x + 4| + |x - 7| < 13$?
- (A) 2
 - (B) 3
 - (C) 4
 - (D) 5
27. If $x \in \mathbb{R}$, the greatest value that $x^4 / (1 + x^8)$ attains is :
- (A) $2/5$
 - (B) $1/3$
 - (C) $3/4$
 - (D) $1/2$
28. Researcher S’s teaching experience (in years) is twice that of researcher M. But 2 years back, S’s teaching experience was thrice that of M. How many years S has been teaching ?
- (A) 8 years
 - (B) 10 years
 - (C) 12 years
 - (D) 16 years

33. A researcher found that for the 1007 pages of his thesis, there were on an average 2 mistakes per page, while in the first 612 pages, there were only 434 mistakes, they seemed to increase for the latter pages. Find the average number of mistakes per page for the remaining pages :
- (A) 6 (B) 4
(C) 2 (D) 3
34. After enjoying a feast at my college canteen with 12 friends, I paid Rs. 145 but my each friend paid an equal amount, say X. Later we found that the average sum paid by all of us was Rs. 5 more than what was originally paid by each of my friends. What amount did each friend pay ?
- (A) Rs. 120 (B) Rs. 100
(C) Rs. 95 (D) Rs. 80
35. A tank of 60000 litres capacity has three inlet taps P, Q and R which can individually fill the tank in 20, 15 and 12 hours respectively. It has an outlet pipe S which can supply water to 100 houses. If all the pipes are opened simultaneously, how much water enters the tank every hour ?
- (A) 8000 litres (B) 9600 litres
(C) 11400 litres (D) 12000 litres
36. In domestic installations, we get phase to voltage which is about V while in industrial installations, we usually get phase to voltage which is about V:
- (A) neutral, 440, phase, 230 (B) neutral, 230, phase, 440
(C) neutral, 230, phase, 400 (D) phase, 230, neutral, 400

37. P, Q, R and S are motor wiremen. Working alone, wireman P can wire 1 motor in 12 hours. Q is 20% faster P. R is 50% faster than P. S is twice as fast as P. In how much time R alone can do wiring of 90 motors ?
- (A) 720 hours (B) 600 hours
(C) 320 hours (D) 480 hours
38. P and Q run a closed circuit race. Besides leading just after start, P overtakes Q twice per round. What is P's speed compared to Q's ?
- (A) 4 times (B) 3 times
(C) 2 times (D) 5 times
39. An upstream journey of 18 km takes a motor boat 3 hours more than the same distance downstream. If the motor boat speed in still water is twice the speed of the stream, find the speed of the stream :
- (A) 7.2 km/hr (B) 6 km/hr
(C) 4.5 km/hr (D) 4 km/hr
40. In the figure below, $PQ = PR = PS$ and angle $QRP = 30^\circ$. Find angle QSP .



- (A) 30° (B) 40°
(C) 45° (D) 60°

41. In the table below, Types of Research are given on left hand side. A few Characteristics are given on the right hand side. Then in the further underneath Table, possible matches are given; select the best choice :

Research Types	Characteristics
(a) Fundamental research	(i) Finding out the extent of perceived impact of an intervention.
(b) Applied research	(ii) Developing an effective foundation through theory building.
(c) Action research	(iii) Improving an existing situation through the use of apt interventions.
(d) Evaluative research	(iv) Exploring the possibility of a theory for use in various situations.

(a)	(b)	(c)	(d)
(A) (i)	(ii)	(iii)	(iv)
(B) (ii)	(iii)	(iv)	(i)
(C) (iii)	(iv)	(i)	(ii)
(D) (ii)	(iv)	(iii)	(i)

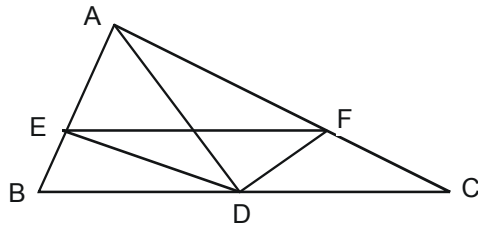
42. A researcher is asked, “What is the probability of finding an apple in the refrigerator ?” The researcher had no idea, neither knowledge nor prior information about an apple having been kept in the refrigerator. Yet he answers, without bias or inclination, as follows; what is his best answer ?

- | | |
|---------|----------|
| (A) 1.0 | (B) 0.75 |
| (C) 0.5 | (D) 0 |

43. While writing a research paper, which one of the following statements is most *true* ?
- (A) The 'Abstract' contains a gist of the entire paper but has no citation of references.
 - (B) The 'Abstract' contains a gist of the entire paper and has citation of references cited in the 'Abstract' part alone.
 - (C) The 'Future Directions' section must cite the possible offshoots which the authors perceive themselves as well as those perceived by previous researchers.
 - (D) The 'Materials and Methods' section, if detailed in the paper, must carry out a comprehensive analysis of results.
44. A chain has five links in it, each of which can individually carry a maximum weight of 2.3 Kg, 1.7 Kg, 5.3 Kg, 2.7 Kg and 0.7 Kg. Then which statement is most apt for this chain ?
- (A) The strength of this chain is that of the strongest link in it
 - (B) The strength of this chain is that of the weakest link in it
 - (C) The strength of this chain is 12.7 Kg
 - (D) The strength of this chain is the average of the individual link strengths
45. What type of reasoning is used in the following statement ?
- “Superiority of intellect depends on its power of concentration on one theme in the same way as a convex lens collects all the rays that strike upon it, into one point” :
- (A) Psychological
 - (B) Mathematical
 - (C) Deductive
 - (D) Analogical

46. In the context of publications, which statement is *true* for SCI ?
- (A) Scientific Citation Index is a citation index originally produced by the Institute for Scientific Information and created by Eugene Garfield.
 - (B) Super Citation Index is a citation index originally produced by the Institute for Scientist's Information and created by Bill Gates.
 - (C) Science Citation Index is a citation index originally produced by the Institute for Scientific Information and created by Eugene Garfield.
 - (D) Science Common Index is a citation index originally produced by the Institute for Scientific Information and created by Clarivate Analytics.
47. The term ICT usually refers to :
- (A) An acronym that stands for Indian Classical Technologies
 - (B) Convergence of audio-visual and telephone networks with computer networks through a single cabling or link system
 - (C) Unified communications and integration of telecommunications, computers, enterprise software, middleware, audio-visual systems and storage
 - (D) Both "B" and "C"
48. With reference to a fixed frame of reference, your competitor moves forward with a velocity of 9.8 m/second while you too move forward a velocity of 5.2 m/sec with reference to the same frame. What is your velocity vis-à-vis that of your competitor ?
- (A) 15 m/sec in forward direction
 - (B) 4.6 m/sec in forward direction
 - (C) 7.5 m/sec in forward direction
 - (D) 4.6 m/sec in backward direction

49. In the following figure (not drawn to scale), angle $DEF = 35^\circ$. Find the other two angles of triangle DEF if DE and DF are the angle bisectors of angles ADB and ADC respectively :



- (A) 30° and 120°
- (B) 65° and 80°
- (C) 55° and 90°
- (D) 70° and 75°
50. A publisher publishes journals in two modes – Subscription mode, and Open access mode. Which choice is most correct in the context of an open access journal :
- (A) It is a journal of which the subscription cost is borne by the subscriber.
- (B) It is a journal of which the contents are freely accessible by anybody in the world.
- (C) It is a journal of which the subscription cost per paper is borne by the respective author.
- (D) “B” and “C”

55. The rank of the matrix $\begin{pmatrix} 1 & 1 & 1 \\ 1 & -1 & 0 \\ 1 & 1 & 1 \end{pmatrix}$:
- (A) 0 (B) 1
(C) 2 (D) 3
56. The volume of oxygen at STP required for the complete combustion of 2 litres of CO at STP is :
- (A) $\frac{1}{2}$ litre (B) 1 litre
(C) 2 litres (D) 4 litres
57. Which sequence is followed for the flue-gas analysis in the Orsat gas analyzer ?
- (A) O₂, CO, CO₂ (B) O₂, CO₂, CO
(C) CO, O₂, CO₂ (D) CO₂, O₂, CO
58. The pyrogallol solution absorbs :
- (A) CO₂, as well as CO (B) CO₂, as well as O₂
(C) CO₂, CO and O₂ (D) CO as well as O₂
59. Select the *correct* statement :
- (A) Gaseous fuels are ideal from the standpoint of complete combustion
(B) Liquid fuels are ideal from the standpoint of complete combustion
(C) Solid fuels are ideal from the standpoint of complete combustion
(D) Liquid as well as solid fuels are ideal from the standpoint of complete combustion.

64. Select the *correct* statement :
- (A) Reactions with high activation energies are very temperature sensitive
 - (B) Reactions with high activation energies are relatively temperature insensitive
 - (C) Reactions with low activation energies are very temperature sensitive
 - (D) A given reaction is much more temperature insensitive at low temperature than at high temperature
65. A reaction is of zero order when the rate of reaction is :
- (A) Proportional to the concentration of reactant
 - (B) Inversely proportional to the concentration of reactant
 - (C) Independent of the concentration of reactant
 - (D) Independent of temperature
66. The irreversible reaction is simply the special case of the reversible reaction if :
- (A) The equilibrium constant is zero
 - (B) The fractional conversion of the reactant at equilibrium conditions is zero
 - (C) The concentration of the reactant at equilibrium conditions is zero
 - (D) The equilibrium constant is one
67. For identical feed composition and flow rate, N plug flow reactors in series with a total volume V gives the same conversion as a single :
- (A) Plug flow reactor of volume V
 - (B) CSTR of volume V
 - (C) Plug flow reactor of volume V/N
 - (D) Plug flow reactor of volume V/N^2

68. For identical feed composition and flow rate, conversion and for all positive reaction orders the ratio of the volume of mixed reactor to the volume of plug flow reactor :
- (A) is independent of the order of reaction
 - (B) increases with increase in the order of reaction
 - (C) decreases with increase in the order of reaction
 - (D) increases linearly with increase in the order of reaction
69. The catalytic activity of enzymes is due to their capacity to :
- (A) Lower the potential energy
 - (B) Lower the kinetic energy
 - (C) Increase the activation energy
 - (D) Lower the activation energy
70. Which of the following is a component of working capital investment ?
- (A) Process equipment
 - (B) Maintenance and repair inventory
 - (C) Utilities plants
 - (D) Depreciation
71. Select the *wrong* statement :
- (A) Depreciation is the unavoidable loss in the value of plant, equipment and materials with lapse in time
 - (B) Depreciation is a cash expense
 - (C) Depreciation does figure in the computation of the income tax liability on cash flows from an investment
 - (D) Annual depreciation costs are constant when the straight-line method is used

72. Potassic fertilizer is graded based on :
- (A) K_2O content (B) KOH content
(C) KNO_3 content (D) K content
73. The nitrogenous fertilizer with the highest percentage of nitrogen to :
- (A) urea (B) Ammonium sulphate
(C) Ammonium nitrate (D) Calcium nitrate
74. Nitrolime is used as nitrogenous fertilizer. Its composition is :
- (A) Ca_3N_2 (B) $Ca(CN)_2$
(C) $CaCN_2$ (D) $CaCN_2 + C$
75. Which of the following allotropic forms of phosphorus is used in the manufacture of safety matches ?
- (A) White phosphorus (B) Red phosphorus
(C) Black phosphorus (D) All forms of phosphorus
76. The collection efficiency of a cyclone separator :
- (A) Is directly proportional to the mass of the dust particle
(B) Is inversely proportional to the mass of the dust particle.
(C) Increases with increase in gas flow rate
(D) All of the above
77. The collection efficiency of electrostatic precipitator depends on :
- (A) Increases with increase in the electrode area
(B) Increases with increase in the particle drift velocity
(C) Decreases with increase in the gas flow rate
(D) All of the above

78. Which of the following devices of particulate collection is the least efficient ?
(A) Cyclone separator (B) Electrostatic precipitator
(C) Fabric filter (D) Wet scrubber
79. Which of the following is an extensive property ?
(A) Temperature (B) Pressure
(C) Specific Volume (D) Volume
80. The phase rule applicable to nonreacting system is :
(A) $F=2 + P+N$ (B) $F=2 - P+N$
(C) $F=2-P-N$ (D) $F=2+P-N$
where F = degree of freedom, P = number of phases, N = number of chemical species.
81. When the temperature of an ideal gas is increased from 27°C to 927°C , the kinetic energy will be :
(A) Same (B) Twice
(C) Eight times (D) Four times
82. The compressibility factor (Z) of a gas is defined as :
(A) The difference between the actual volume of the gas and the volume of the gas
(B) The ratio of the volume predicted by ideal-gas law to the actual volume of the gas
(C) The ratio of the actual volume of the gas to the volume predicted by ideal-gas law
(D) None of the above
83. The atomic heat capacities of all solid elements :
(A) Remains unaffected with change in temperature
(B) Increases greatly with decrease in temperature
(C) Decreases greatly with decrease in temperature
(D) Approaches a value of infinity at absolute zero temperature

84. An isentropic flow is one which is :
- (A) Isothermal and irreversible
 - (B) Adiabatic and irreversible
 - (C) Isothermal and reversible
 - (D) Adiabatic and reversible
85. Select the only *false* statement in the following :
- (A) The efficiency of a reversible engine is independent of nature and properties of working substance
 - (B) The entire amount of mechanical work can be converted into heat
 - (C) Heat engine is a device which converts heat into mechanical work
 - (D) The entire amount of heat produced can be converted into mechanical work
86. Corresponding to Prandtl number in heat transfer, the dimensionless group in mass transfer is :
- (A) Schmidt number
 - (B) Sheerwood number
 - (C) Peclet number
 - (D) Stanton number
87. In case of an absorber, the operating :
- (A) Line can be either above or below the equilibrium curve
 - (B) Line always lies below the equilibrium curve
 - (C) Line always lies above the equilibrium curve
 - (D) Velocity is more than the loading velocity
88. Raschig ring made of porcelain cannot be used for treating :
- (A) Concentrated sulphuric acid
 - (B) Concentrated nitric acid
 - (C) Alkalis
 - (D) Concentrated hydrochloric acid

89. Time constant is :
- (A) Same as dead time
 - (B) Same as transportation lag
 - (C) The time taken by the controlled variable to reach 63.2 per cent of its full change
 - (D) The time required by the measure variable to reach 62.3 per cent of its ultimate change
90. Transfer function of transportation lag is :
- (A) e^{-Ts}
 - (B) e^{-Ts}
 - (C) $1/Ts+1$
 - (D) None of the above
91. Response of a linear control system for a change in set point is called :
- (A) Frequency response
 - (B) Transient response
 - (C) Servo problem
 - (D) Regulator problem
92. In second order underdamped system :
- (A) Decay ratio = overshoot
 - (B) Larger damping co-efficient means smaller damping
 - (C) Overshoot increases for increasing damping co-efficient
 - (D) Decay ratio = (overshoot)²
93. Which of the following relates the absorption and evolution of heat at the junctions of a thermocouple to the current flow in the circuit ?
- (A) Seebeck effect
 - (B) Joule heating effect
 - (C) Peltier effect
 - (D) Thomson effect
94. For an opaque body sum of absorptivity and reflectivity is :
- (A) 0
 - (B) 1.0
 - (C) 0.5
 - (D) 0.08

95. If the distance between the object emitting radiation and that receiving is 'd', then the energy received is proportional to :
- (A) $d^{1/2}$ (B) d
 (C) d^2 (D) d^4
96. Dropwise condensation occurs on a :
- (A) smooth surface (B) oily surface
 (C) coated surface (D) glazed surface
97. Steam traps are used to :
- (A) remove condensate (B) remove liquid from vapour
 (C) regulate pressure (D) none of the above
98. Terminal conditions and heat transfer area remaining same, the ratio of capacity between a triple effect evaporator and single effect evaporator is :
- (A) 1/3 (B) 1
 (C) 3 (D) none of these
99. What is the *correct* formula for absolute pressure ?
- (A) $P_{\text{abs}} = P_{\text{atm}} - P_{\text{gauge}}$
 (B) $P_{\text{abs}} = P_{\text{vacuum}} - P_{\text{atm}}$
 (C) $P_{\text{abs}} = P_{\text{vacuum}} + P_{\text{atm}}$
 (D) $P_{\text{abs}} = P_{\text{atm}} + P_{\text{gauge}}$
100. According to Archimedes principle, if a body is immersed partially or fully in a fluid, then the buoyancy force is.....the weight of fluid displaced by the body.
- (A) more than (B) less than
 (C) equal to (D) unpredictable