RESEARCH METHODOLOGY-SCIENCE (2018)

1. What is the next term in the following sequence ?

7, 11, 13, 17, 19, 23, 29, ...

(A) 37 (B) 35

(C) 31 (D) 33

2. Which of the following numbers is a perfect square ?

(A) 1022121 (B) 2042122

(C) 3063126 (D) 4083128

3. If 42 $\rightarrow$ 26, 71 $\rightarrow$ 78, 33 $\rightarrow$ 16, then 62 $\rightarrow$

(A) 68 (B) 54

(C) 38 (D) 39

4. Approximately how much blood flows per day through a normal human heart beating 70 times per minute, having a relaxed volume of 110 cc and compressed volume of 70 cc ?

(A) 7150 litres (B) 4000 litres

(C) 28000 litres (D) 11100 litres

5. Find the missing word : A, AB, _____, ABBABAAB

(A) AABB (B) ABAB

(C) ABBA (D) BAAB

6. How many digits are there in 3^{16} when it is expressed in the decimal form ?

(A) Three (B) Six

(C) Seven (D) Eight

7. The sum of the first n natural numbers with one of them missed is 42. What is the number that was missed ?

(A) 1 (B) 2

(C) 3 (D) 4

8. If N, E and T are distinct positive integers such that N × E × T = 2013, then which of the following is the maximum possible sum of N, E and T ?

(A) 39 (B) 2015

(C) 671 (D) 675

9. Two plane mirrors facing each other are kept at 60º to each other. A point is located on the angle bisector. The number of images of the point is :

(A) 6 (B) 3

(C) 5 (D) infinite

10. A 3 m long car goes past a 4 m long truck at rest on the road. The speed of the car is 7 m/s. The time taken to go past is :

(A) 4/7 s (B) 1 s

(C) 7/4 s (D) 10/7 s

11. The dimensions of a floor are 18 × 24. What is the smallest number of identical square tiles that will pave the entire floor without the need to break any tile ?

(A) 6 (B) 24

(C) 12 (D) 8

12. I bought a shirt at l0% discount and sold it to a friend at a loss of l0%. If the friend paid me Rs. 729.00 for the shirt, what was the undiscounted price of the shirt ?

(A) Rs. 900 (B) Rs. 800

(C) Rs. 1000 (D) Rs. 911.25

13. How many non-negative integers less than 10,000 are there such that the sum of the digits of the number is divisible by three ?

(A) 1112 (B) 2213

(C) 2223 (D) 3334

14. 20 teachers of a school either teach mathematics or physics. 12 of them teach mathematics while 4 teach both the subjects. Then the number of teachers teaching physics only is :

(A) 8 (B) 12

(C) 16 (D) None of these

15. Let A, B be the ends of the longest diagonal of the unit cube. The length of the shortest path from A to B along the surface is :

(A) $\sqrt{3}$ (B) $1+\sqrt{2}$

(C) $\sqrt{5}$ (D) 3

16. In an examination, a student scores 4 marks for every correct answer and loses 1 mark for every wrong answer. If he attempts in all 60 questions and secures 130 marks, the number of questions he attempts correctly, is :

(A) 35 (B) 38

(C) 40 (D) 42

17. It takes 2 hours for Tiwari and Deo to do a job. Tiwari and Hari take 3 hours to do the same job. Deo and Hari take 6 hours to do the same job. Which of the following statements is *incorrect* ?

(A) Tiwari alone can do the job in 3 hours

(B) Deo alone can do the job in 6 hours

(C) Hari does not work at all

(D) Hari is the fastest worker

18. If you count 21 letters in the English alphabet from the end and 20 letters from the beginning, which letter will appear exactly in the middle of the sequence thus formed ?

(A) M (B) L

(C) K (D) N

19. A train running at 36 km/h crosses a mark on the platform in 8 sec and takes 20 sec to cross the platform. What is the length of the platform ?

(A) 120 m (B) 280 m

(C) 40 m (D) 160 m

20. Water is slowly dripping out of a tiny hole at the bottom of a hollow metallic sphere initially full of water. Ignoring the water that has flowed away, the centre of mass of the system :

(A) remains fixed at the centre of the sphere

(B) moves down steadily as the amount of water decreases

(C) moves down for some time but eventually returns to the centre of the sphere

(D) moves down until half of the water is lost and then moves up

21. The missing number is :

3	6	8
5	8	4
4	7	?

(A) 6 (B) 7

(C) 8 (D) 9

22. Reena is twice as old as Sunita. Three years ago, she was three times as old as Sunita. How old is Reena now ?

(A) 6 years

(B) 7 years

(C) 12 years

(D) 8 years

23. A bicycle tube has a mean circumference of 200 cm and a circular cross-section of diameter 6 cm. What is the approximate volume of water (in cc) required to completely fill the tube, assuming that it does not expand ?

(A) 600 π (B) 1200 π

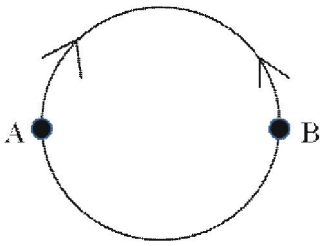
(C) 3600 π (D) 1800 π

24. Six persons P, Q, R, S, T and U are standing in a circle. Q is between S and R. P is between T and R. U is to the right of S. Who is between P and U ?

(A) Q (B) R

(C) T (D) S

25.



Two ants, initially at diametrically opposite points A and B on a circular ring of radius R, start crawling towards each other. The speed of the one at A is half of that of the one at B. The point at which they meet is at a straight line distance of :

(A) R from A

(B) $\frac{3R}{2}$ from A

(C) R from B

(D) $\frac{3R}{2}$ from B

26. A person completely under sea water tracks the Sun. Compared to an observer above water, which of the following observations would be made by the underwater observer ?

(A) Neither the time of sunrise or sunset nor the angular span of the horizon changes.

(B) Sunrise is delayed, sunset is advanced, but there is no change in the angular span of the horizon.

(C) Sunrise and sunset times remain unchanged, but the angular span of the horizon shrinks.

(D) The duration of the day and the angular span of the horizon, both decrease.

27. The number of boys in a class is three times the number of girls. Which one of the following numbers cannot represent the total number of children in the class ?

(A) 48

(B) 42

(C) 44

(D) 40

28. Two coconuts have spherical space inside their kernels, with the first having an inner diameter twice that of the other. The larger one is half filled with liquid, while the smaller is completely filled. Which of the following statements is *correct* ?

(A) The larger coconut contains 4 times the liquid in the smaller one.

(B) The larger coconut contains twice the liquid in the smaller one.

(C) The coconuts contain equal volumes of liquid.

(D) The smaller coconut contains twice the liquid in the larger one.

29. A tiger usually stalks its prey from a direction that is upwind of the prey. The reason for this is :

(A) the wind aids its final burst for killing the prey

(B) the wind carries the scent of the prey to the tiger and helps the tiger locate the prey easily

(C) the upwind area usually has denser vegetation and better camouflage

(D) the upwind location aids the tiger by not letting its smell reach the prey

30. A cellphone tower radiates 1W power while the handset transmitter radiates 0.1 mW power. The correct comparison of the radiation energy received by your head from a tower 100 m away (E_1) and that from a handset held to your ear (E_2) is :

(A) $E_1 >> E_2$

(B) $E_2 >> E_1$

(C) $E_1 = E_2$ for communication to be established

(D) insufficient data even for a rough comparison

31. The pitch of a spring is 5 mm. The diameter of the spring is 1 cm. The spring spins about its axis with a speed of 2 rotations/s. The spring appears to be moving parallel to its axis with a speed of :

(A) 1 mm/s (B) 5 mm/s

(C) 6 mm/s (D) 10 mm/s

32. A boy holds one end of a rope of length l and the other end is fixed to a thin pole of radius r ($l >> r$). Keeping the rope taut, the boy goes around the pole causing the rope to get wound around the pole. Each round takes 10 s. What is the speed (in units of s^{-1}) with which the boy approaches the pole ?

(A) $\frac{\pi r}{5}$ (B) $\frac{\pi l}{5}$

(C) $20\pi(r+l)$ (D) $\frac{20\pi(r-l)}{5}$

33. A rectangular flask of length 11 cm, width 8 cm and height 20 cm has water filled up to height 5 cm. If 21 spherical marbles of radius 1 cm each are dropped in the flask, what would be the rise in water level ?

(A) 8.8 cm (B) 10 cm

(C) 1 cm (D) 0 cm

34. Deepak starts walking straight towards east. After walking 75 metres, he turns to the left and walks 25 metres straight. Again he turns to the left, walks a distance of 40 metres straight, again he turns to the left and walks a distance of 25 metres. How far is he from the starting point ?

(A) 25 m (B) 50 m

(C) 115 m (D) 35 m

35. A leaf appears green in daylight. If this leaf were observed in red light, what colour would it appear to have ?

(A) green (B) black-brown

(C) red (D) blue

36. The sum of two numbers is equal to sum of square of 11 and cube of 9. The larger number is $(5)^2$ less than square of 25. What is the value of the sum of twice of 24 per cent of the smaller number and half of the larger number ?

(A) 415 (B) 400

(C) 410 (D) 420

37. For which one of the following statements is the converse NOT true ?

(A) If a patient dies even with excellent medical care, he likely had terminal illness.

(B) If a person gets employed, he has good qualifications.

(C) If an integer is even, it is divisible by two.

(D) If an integer is odd, it is not divisible by two.

38. How many numbers from 1 to 100 are there each of which is not only exactly divisible by 4 but also has 4 as a digit ?

(A) 21 (B) 10

(C) 20 (D) 7

39. If a plant with green leaves is kept in a dark room with only green light ON, which one of the following would we observe ?

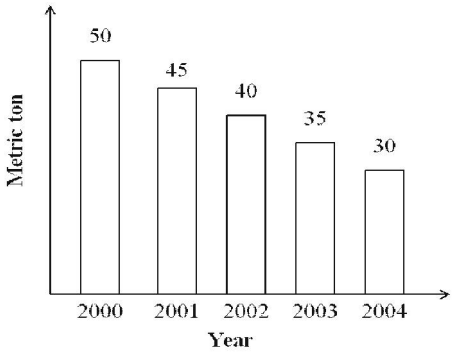
(A) The plant appears brighter than the surroundings

(B) The plant appears darker than the surroundings

(C) We cannot distinguish the plant from the surroundings

(D) It will have above normal photosynthetic activity

40. Wheat production of a country over a number of years is shown. Which year recorded highest per cent reduction in production over the previous year ?



(A) 2001

(B) 2002

(C) 2003

(D) 2004

41. L is the tallest and eldest of a group of five people K, L, M, N and P. M is elder to N and shorter than K. M and P are of same age and P is taller than K. N and K are of same height and K is younger to P. Which of the following inferences is certain ?

(A) P is taller than M

(B) N is the youngest

(C) N is elder to P

(D) N is elder to K

42. In a fast moving car with open windows, the driver feels a continuous incoming breeze. The pressure inside the car, however, does not keep increasing because :

(A) Air coming in from the front window goes out from the rear.

(B) Air comes in as well as goes out through every window but the driver only feels the incoming one.

(C) No air actually comes in and the feeling of breeze is an illusion.

(D) Cool air reduces the temperature therefore the pressure does not increase.

43. A tall metal cylinder is filled end-to-end with n snugly fitting spherical wax balls of diameter d. If the balls melt completely, the volume fraction occupied by the melted wax is :

(A) independent of both d and n

(B) dependent on both d and n

(C) independent of d, but dependent on n

(D) dependent on d, but independent of n

44. In each of the following groups of words is a hidden number, based on which you should arrange them in descending order. Pick the *correct* answer :

E. Papers I Xeroxed
F. Wi-Fi veteran
G. Yourself ourselves
H. Breaks even

(A) E, F, G, H
(B) E, G, F, H
(C) H, F, G, E
(D) H, E, F, G

45. Four circles of unit radius each are drawn such that each one touches two others and their centres lie on the vertices of a square. The area of the region enclosed between the circles is :

(A) π-1
(B) π-2
(C) 4-π
(D) 3-π

46. A film projector and microscope give equal magnification. But a film projector is not used to see living cells because :

(A) a living cell cannot be placed in a film projector.
(B) the viewer's eye is close to a microscope whereas it is far away from the projector's screen.
(C) a microscope produces a virtual image whereas a projector produces a real image.
(D) a microscope has greater resolving power than a projector.

47. Comparing numerical values, which of the following is different from the rest ?

(A) The ratio of the circumference of a circle to its diameter.
(B) The sum of the three angles of a plane triangle expressed in radians.
(C) 22/7.
(D) The net volume of a hemisphere of unit radius, and a cone of unit radius and unit height.

48. Seeds when soaked in water gain about 20% by weight and 10% by volume. By what factor does the density increase ?

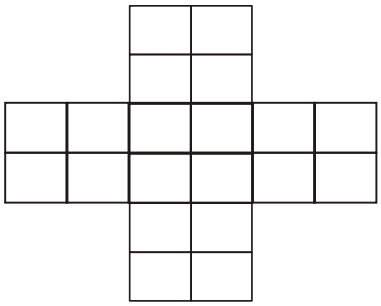
(A) 1.20

(B) 1.10

(C) 1.11

(D) 1.09

49.



The number of squares in the above figure is :

(A) 30 (B) 29

(C) 25 (D) 20

50. Five persons A, B, C, D, and E are sitting in a row with C in the middle of the group. If D is at an extreme end and there are at least two persons between B and E, then which of the following statements is *incorrect* ?

(A) E can be on extreme left

(B) E can be on extreme right

(C) A cannot be on extreme left

(D) A is always a neighbour of B or D

PHYSICS

51. The approximate value of $y(0.2)$ using Runge-Kutta method of fourth order for $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with $y(0) = 1$ at $x = 0.2$ is :

(A) 1.186 (B) 1.176

(C) 1.196 (D) 1.206

52. For an *n*-channel enhancement mode MOSFET, the voltage to be applied at the gate for operation in the ohmic region is :

(A) negative

(B) zero

(C) positive but less than the threshold value

(D) approximately same as the drain supply voltage

53. TTL circuits with active pull up are preferred because of their suitability for :

(A) wired-AND operation

(B) bus operated system

(C) wired logic operation

(D) reasonable dissipation and speed of operation

54. Let the contents of the register C be 00000000 before DCR C is executed. The contents of C after the execution of the instruction will be :

(A) 00000000 (B) 11111111

(C) 10000001 (D) 10011001

55. If f (0) = 1 and f (1) = 2.72, then the trapezoidal rule gives the approximate value of $\int_0^1 f(x)\,dx$ as :

(A) 3.72 (B) 1.86

(C) 1.72 (D) 0.86

56. A pair is constrained to move along the inner surface of a hemisphere, then the number of degrees of freedom of the particles is :

(A) one (B) two

(C) three (D) four

57. The ratio of electric field on the equatorial line and axial line of a linear quadrupole of quadrupole moment θ_d is :

(A) ½ (B) 1

(C) 2 (D) infinte

58. At a frequency less than the plasma frequency, the collision losses cause :

(A) total internal reflection

(B) partial reflection

(C) attenuation of the wave

(D) none of the above

59. The decay of a μ – meson supports :

(A) time dilation (B) length contraction

(C) relativity in energy (D) none of these

60. The angular frequency of a charged particle moving in a uniform magnetic field :

(i) depends upon the mass and velocity of the particle

(ii) depends upon the mass and radius of the circular path of the particle

(iii) depends upon the charge and velocity of the particle

(iv) neither depends upon the velocity nor the radius of the circular path of the particle.

Identify the *correct* statement. :

(A) (i) and (ii) (B) (ii) and (iii)

(C) (iv) only (D) (i) and (iii)

61. According to Langevin's theory of diamagnetism, the induced magnetic moment per unit volume is proportional to :

(A) mass of the electron

(B) external magnetic field

(C) radius of the orbit

(D) none of the above

62. The phase difference between displacement current and conduction current in a conducting medium is :

(A) 0 (B) $\pi/4$

(C) $\pi/2$ (D) π

63. A 4-bit presettable UP counter has preset input 0101. The presetting operation takes place as soon as the counter attains 1111. The modulus of the counter is :

(A) 5 (B) 10

(C) 11 (D) 15

64. The energy density of a radiation U_v in a frequency range v and v + dv according to Planck's radiation formula is given as :

(A) $(8\pi^2\ hv^3/c^3).\ (dv\ /e^{hv/kT} - 1)$

(B) $(8\pi^2\ hv^2/c^2).(dv\ /e^{hv/kT} - 1)$

(C) $(8\pi^3\ hv^2/c^3).(dv\ /e^{hv/kT} - 1)$

(D) $(8\pi hv^3/c^3).(dv\ /e^{hv/kT} - 1)$

65. In a real gas, the cooling due to Joule's free expansion is given by :

(A) $\Delta T = -\frac{1}{c_v}\frac{a}{v}\Delta V$ (B) $\Delta T = -\frac{1}{c_v}\frac{a^2}{v^2}\Delta V$

(C) $\Delta T = -\frac{1}{c_v}\frac{a}{v^2}\Delta V$ (D) $\Delta T = --c_v\frac{a}{v^2}\Delta V$

66. N similar coins are tossed simultaneously a large number of times.The probability of most probable and least probable combinations respectively are (P_{most}; P_{least})

(A) $\{N!/(N/2)!^2.2^N\};\ 1/2^{N/2}$ (B) $\{N!^2\ /(N/2)!^2.2^{N/2}\};\ 1/2^{N/2}$

(C) $\{N!^2\ /(N/2)!^2.2^N\};\ 1/2^{N/2}$ (D) $\{N!/(N/2)!^2.2^N\};\ 1/2^N$

67. If $\partial L/\partial q_j = 0$, where L is the Lagrangian for a conservative system without constraints and q_j is a generalized coordinate, then the generalized momentum is :

(A) a cyclic coordinate (B) a constant of motion

(C) equal to $\frac{d}{dt}\left[\frac{\partial L}{\partial \dot{q}_j}\right] = 0$ (D) none of these

68. Which of the following is *true* in case of an adiabatic process ? (Given $\gamma = C_p/C_v$)

(A) $P^{1-\gamma}T^{\gamma}$ (B) $P^{\gamma}T^{1-\gamma}$

(C) PT^{γ} (D) $P^{\gamma}T$

69. A particle of mass m is executing oscillation about the origin on the X-axis and with potential energy $U(x) = k\{1 - \exp(-x^2)\}$; k being a positive constant. If the amplitude of oscillation is a, then its time period T is :

(A) proportional to $1/a^{1/2}$ (B) independent of a

(C) proportional to $a^{1/2}$ (D) proportional to $a^{3/2}$

70. Which of the following statements related to diamagenetism is *not* true ?

(A) Diamagnetic materials do not have permanent magnetic moment

(B) Diamagnetic is explained in terms of electromagnetic induction

(C) Diamagnetic materials have a small positive susceptibility

(D) The magnetic moment of individual electrons neutralize each other

71. An arc making an angle 120° at the centre of a ring of mass m and radius r is cut from the ring. The arc is made to rotate about z-axis perpendicular to its plane and passing through the centre of the ring. The moment of inertia of the arc about the z-axis is :

(A) mr^2 (B) $mr^2/3$

(C) $mr^2/2$ (D) $mr^2/4$

72. A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 120 kV/m and B = 50 mT. If the beam strikes a target, the force exerted on the target for a beam current of 0.80 mA is :

(A) 80 μN (B) 45 μN

(C) 20 μN (D) 25 μN

73. A piece of blue glass heated to a high temperature and a piece of red glass at room temperature are taken inside a dimly lit room then :

(A) the blue piece will look blue and the red will look as usual

(B) the red piece looks brighter red and the blue looks ordinary blue

(C) the blue shines like brighter red compared to red piece

(D) both the pieces will look equally red

74. The atomic numbers of elements A, B, C and D are Z-1, Z Z+1 and Z + 2 respectively. If B is a noble gas, choose the correct answers from the following statements :

(i) A has higher electron affinity

(ii) C exists in +2 oxidation state

(iii) D is an alkaline earth material

(A) i & ii (B) ii & iii

(C) i & iii (D) i, ii & iii

75. The wave function of a spinless particle of mass in a one-dimensional potential V (x) is $\psi(x)$ = A exp ($-\alpha^2x^2$) corresponding to an eigenvalue $E_o = (\hbar^2\alpha^2/m)$. The potential V($x$) is :

(A) $2E_o(1 + \alpha^2x^2)$ (B) $2E_o(1 + 2\alpha^2x^2)$

(C) $2E_o(1 - \alpha^2x^2)$ (D) $2E_o\alpha^2x^2$

76. The correct relation between the magnetic vector potential 'A' and the electric potential 'V' is :

(A) $\text{curl}\,A - \varepsilon_0\mu_0\dfrac{\partial V}{\partial t} = 0$ (B) $\text{div}\,A - \varepsilon_0\mu_0\dfrac{\partial V}{\partial t} = 0$

(C) $\text{div}\,A + \varepsilon_0\mu_0\dfrac{\partial V}{\partial t} = 0$ (D) $\text{curl}\,A + \varepsilon_0\mu_0\dfrac{\partial V}{\partial t} = 0$

77. The electron in a hydrogen atom makes a transition from $n = n_1$ to $n = n_2$ state. The time period of electron in the initial state (n_1) is eight times to that in the final state (n_2). The possible values of n_1 & n_2 are :

(A) $n_1 = 8,\ n_2 = 1$ (B) $n_1 = 4,\ n_2 = 2$

(C) $n_1 = 2,\ n_2 = 4$ (D) $n_1 = 1,\ n_2 = 8$

78. Which of the following is true/applicable in Compton effect ?

(A) Energy conservation (B) Momentum conservation

(C) Charge conservation (D) All of these

79. The frequency of a sound wave for acoustic in a diatomic system containing two identical atoms per unit cell with interatomic spacing of 1.75 Å is :

(A) 5.71×10^{12} rad s^{-1} (B) 2.85×10^{12} rad s^{-1}

(C) 5.71×10^{11} rad s^{-1} (D) 2.85×10^{10} rad s^{-1}

80. In a wire having resistivity 1.6×10^{-8} ohm m (at room temperature) and charge carrier density of 5.8×10^{28} electrons/m^3, the relaxation time of electrons is :

(A) 2.44×10^{-16} s (B) 1.91×10^{-12} s

(C) 3.82×10^{-14} s (D) 0.95×10^{-14} s

81. Consider the following two statements and select the *correct* option :

i. Linear momentum of the system remains constant

ii. Centre of mass of the system remains at rest

(A) i. implies ii. and ii. implies i.

(B) i. does not imply ii. and ii. does not imply i.

(C) i. implies ii. but ii. does not imply i.

(D) ii. implies i. but i. does not imply ii.

82. A heavy ring is clamped on the periphery of a light circular disc. A small particle having equal mass is clamped at the centre of the disc. The system is rotated in such a way that the centre moves in a circle of radius with a uniform speed v. One concludes that an external force :

(A) mv^2/r must be acting on the central particle

(B) $2mv^2/r$ must be acting on the central particle

(C) $2mv^2/r$ must be acting on the system

(D) $2mv^2/r$ must be acting on the ring

83. Two concave lenses L_1 and L_2 are kept in contact with each other. If the space between the two lenses is filled with a material of refractive index $\mu = 1$, the magnitude of the focal length of the combination :

(A) becomes undefined (B) remains unchanged

(C) increases (D) decreases

84. For high voltage gain, BJT is normally used in :

(A) CE configuration (B) CB configuration

(C) CC configuration (D) both (A) and (B)

85. When light is refracted into a medium, then :

(A) its wavelength and frequency both increase

(B) its wavelength increases but frequency remains unchanged

(C) its wavelength decreases but frequency remains unchanged

(D) its wavelength and frequency both decrease

86. If the source of light used in Young's double slit experiment is changed from red to violet, then :

(A) the fringes will become brighter

(B) consecutive fringes will come closer

(C) the intensity of minima will increase

(D) the central bright fringe will become a dark fringe

87. The ideal value of stability factor S can be achieved in :

(A) Common base amplifier

(B) Common emitter amplifier

(C) Common collector amplifier

(D) All of the above

88. The correct order of packing efficiency (%) in cell of following 3 dimensional crystals is :

(A) Simple cubic < Body-centred cubic > Face-centred cubic

(B) Simple cubic > Body-centred cubic < Face-centred cubic

(C) Simple cubic < Body-centred cubic < Face-centred cubic

(D) Simple cubic > Body-centred cubic > Face-centred cubic

89. Which of the following is the configuration of a tetragonal crystal ?

(A) $a = b = c$; $\alpha = \beta = \gamma = 90^\circ$

(B) $a = b \neq c$; $\alpha = \beta = 90^\circ \neq \gamma$

(C) $a = b \neq c$; $\alpha = \beta = \gamma = 90^\circ$

(D) $a \neq b = c$; $\alpha = \beta = \gamma = 90^\circ$

90. The ground state electronic configuration of ^{22}Ti is [Ar] $3d^2 4s^2$. Which state, in the standard spectroscopic notations, is not possible in this configuration ?

(A) $^1F_3$ (B) $^1S_0$

(C) $^1D_2$ (D) $^3P_0$

91. In a normal Zeeman effect experiment under a magnetic field strength of 0.3 T, the splitting between the components of a 660 nm spectral line is :

(A) 12 pm (B) 10 pm

(C) 8 pm (D) 6 pm

92. In a one-dimensional chain of atoms, if the frequency of phonons is proportional to the wave-vector, then the Debye frequency for a cluster of atoms with number density n and speed of phonons being 'c' will be :

(A) $2\pi cn$ (B) $\sqrt{2}\ \pi cn$

(C) $\sqrt{3}\ \pi cn$ (D) $\frac{\pi cn}{2}$

93. In a gas of Cs atoms with density of 10^{12} atoms/cc, the temperature at which the inter particle separation equals the thermal de-Broglie wavelength is approximately

(A) 1×10^{-9} K (B) 7×10^{-5} K

(C) 1×10^{-3} K (D) 2×10^{-8} K

94. Out of the following nuclei of mass no. A = 125, the binding energy calculated on the basis of liquid drop model is maximum for :

[Given that the coefficients for Coulomb and asymmetry energy are a_c = 0.7 MeV and a_{asym} = 22.5 MeV respectively]

(A) $^{125}_{54}\mathrm{Xe}$ (B) $^{125}_{53}\mathrm{I}$

(C) $^{125}_{52}\mathrm{Te}$ (D) $^{125}_{51}\mathrm{Sb}$

95. The reaction $^{2}_{1}\mathrm{D}+{}^{2}_{1}\mathrm{D}\rightarrow{}^{4}_{2}\mathrm{He}+\pi^{0}$ cannot proceed via strong interactions as it violates the law of conservation of :

(A) angular momentum (B) electric charge

(C) baryon number (D) isospin

96. The transverse electric modes (TE) propagating in a rectangular wave guide with transverse dimensions 2m × 1m driven with an angular frequency $\omega = 10^9$ rad/s are :

(A) TE_{01}, TE_{10}, TE_{20} (B) TE_{10}, TE_{11}, TE_{20}

(C) TE_{01}, TE_{10}, TE_{11} (D) TE_{01}, TE_{10}, TE_{22}

97. In a two state system, the transition rate of a particle from state 1 to state 2 is t_{12} and that from state 2 to state 1 is t_{21}. The probability of finding the particle in state 1 under steady state is :

(A) $t_{21}/ (t_{12} + t_{21})$ (B) $t_{12}/ (t_{12} + t_{21})$

(C) $t_{12}t_{21}/ (t_{12} + t_{21})$ (D) $(t_{12} - t_{21})/ (t_{12} + t_{21})$

98. A plane EM wave incident normally on the surface of a material is partially reflected. If the ratio of the electric field amplitude at the maxima and minima of the standing wave in the region in front of the interface is 5, then the ratio of reflected intensity to the incident intensity is :

(A) 4/9 (B) 2/3

(C) 2/5 (D) 1/5

99. The time evolution of a one-dimensional dynamical system is described by $dx/dt = -(x+1)(x^2 - b^2)$. The necessary condition for one stable and two unstable fixed points, is :

(A) $0 < b < 1$ (B) $b > 1$

(C) $b < -1$ (D) $b = 2$

100. If the entropy S of a system is related to the internal energy U and volume V as $S = cU^{3/4} V^{1/4}$, then the Gibbs free potential for this system with pressure 'p' and temperature 'T' is [c is a constant] :

(A) $3pU/4T$ (B) $cU/3$

(C) zero (D) US/4V