INVENTORS™ Education Pvt. Ltd.
JEE | NEET | NTSE | KVPY | OLYMPIADS

I-SAT INVENTORS SCHOLARSHIP CUM ABILITY TEST

STREAM [ENGINEERING]

[SAMPLE PAPER]

FOR CLASS

11th GOING TO 12th

TIME : 2 Hours | **FULL MARKS : 300**

INSTRUCTIONS

[A] General

1. This Question paper contains THREE Parts, A, B and C (Physics, Chemistry, and Mathematics).
2. This Question Paper contains 11 pages including cover page.
3. This question paper contains total 75 questions (Each subject have 20 MCQ type questions and 5 Numerical Value.)
4. The Question Paper has blank spaces at the bottom of each page for rough work. No additional sheets will be provided for rough work.
5. Blank papers, clip boards, log tables, slide rule, calculators, cellular phones, pagers and electronic gadgets, in any form, are NOT allowed.
6. The OMR (Optical Mark Recognition) sheet shall be provided separately.

[B] Answering on the OMR

7. In all the parts, each question will have 4 choices out of which only one choice is correct.
8. Darken the bubble with Ball Pen (Blue or Black) ONLY.

[C] Filling OMR

9. On the OMR sheet, fill all the details properly and completely, otherwise your OMR will not be checked.
10. Do not write anything or tamper the barcode in the registration no. box.

[D] Marking Scheme:

11. For each question you will be awarded 4 marks if you darken the bubble corresponding to the correct answer ONLY and zero (0) marks if no bubble is darkened. In all other cases, minus one (–1) mark will be awarded.

Name :.....

Registration No.: | | | | | | | | | | | | | | |

SECTION – A : PHYSICS

1. Find points at which the tangent to the curve $y = x^3 - 3x^2 - 9x + 7$ is parallel to the x–axis

(A) (3,–20) and (–1, 12) (B) (3, 20) and (1, 12)

(C) (3,–10) and (1, 12) (D) None of these

2. Let $\vec{A} = \hat{i}A\cos\theta + \hat{j}A\sin\theta$, be any vector. Another vector $\vec{B}$ which is normal to $\vec{A}$ is :–

(A) $\hat{i}B\cos\theta + \hat{j}B\sin\theta$ (B) $\hat{i}B\sin\theta + \hat{j}B\cos\theta$

(C) $\hat{i}B\sin\theta - \hat{j}B\cos\theta$ (D) $\hat{i}A\cos\theta - \hat{j}A\sin\theta$

3. If $|\vec{A}\times\vec{B}| = \sqrt{3}\vec{A}.\vec{B}$, then the value of $|\vec{A}+\vec{B}|$ is :–

(A) $\left(A^2+B^2+\frac{AB}{\sqrt{3}}\right)^{1/2}$ (B) A + B

(C) $\left(A^2+B^2+\sqrt{3}AB\right)^{1/2}$ (D) $\left(A^2+B^2+AB\right)^{1/2}$

4. A bird moves from point (1, – 2, 3) to (4, 2, 3) . If the speed of the bird is 10 m/s, then the velocity vector of the bird is :-

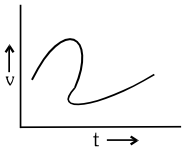
(A) $5\left(\hat{i}-2\hat{j}+3\hat{k}\right)$ (B) $5\left(4\hat{i}+2\hat{j}+3\hat{k}\right)$

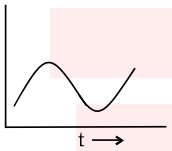
(C) $0.6\hat{i}+0.8\hat{j}$ (D) $6\hat{i}+8\hat{j}$

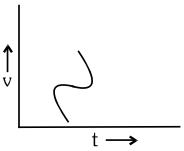
5. The coordinates of a moving particle at time t are given by $x = ct^2$ and $y = bt^2$. The speed of the particle is given by :–

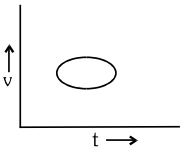
(A) $2t(c+b)$ (B) $2t\sqrt{c^2-b^2}$ (C) $t\sqrt{c^2+b^2}$ (D) $2t\sqrt{c^2+b^2}$

6. Which of the following velocity–time graph shows a realistic situation for a body in motion:–

(A) 

(B) 

(C) 

(D) 

7. Raindrops are falling vertically with a velocity 10m/s. To a cyclist moving on a straight road the rain drops appear to be coming with a velocity of 20m/s. The velocity of cyclist is :-

(A) 10m/s (B) $10\sqrt{3}$ m/s (C) 20 m/s (D) $20\sqrt{3}$ m/s

Space for Rough Work

8. If angular velocity of a disc depends an angle rotated θ as $\omega = \theta^2 + 2\theta$, then its angular acceleration α at θ = 1 rad is :

(A) 8 rad/s^2 (B) 10 rad/s^2 (C) 12 rad/s^2 (D) None of these

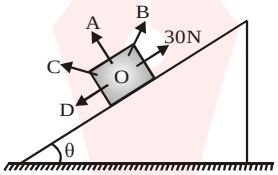
9. If the radii of circular path of two particles are in the ratio of 1 : 2, then in order to have same centripetal acceleration, their speeds should be in the ratio of :

(A) 1 : 4 (B) 4 : 1 (C) $1:\sqrt{2}$ (D) $\sqrt{2}:1$

10. A body of mass m_1 exerts a force on another body of mass m_2. If the magnitude of acceleration of m_2 is a_2, then the magnitude of the acceleration of m_1 is (considering only two bodies in space)

(A) Zero (B) $\frac{m_2 a_2}{m_1}$ (C) $\frac{m_1 a_2}{m_2}$ (D) a_2

11. A block of mass of 10 kg lies on a rough inclined plane of inclination $\theta = \sin^{-1}$ with the horizontal when a force of 30N is applied on the block parallel to and upward the plane, the total force exerted by the plane on the block is nearly along (coefficient of friction is =) (g = 10 m/s^2)

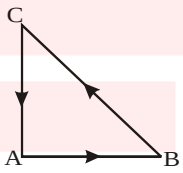


(A) OA (B) OB (C) OC (D) OD

12. When forces F_1, F_2, F_3 are acting on a particle of mass m such that F_2 and F_3 are mutually perpendicular, then the particle remains stationary. If the force F_1 is now removed then the acceleration of the particle is-

(A) F_1/m (B) F_2F_3/mF_1 (C) $(F_2 - F_3)/m$ (D) F_2/m

13. Three forces start acting simultaneously on a particle moving with velocity $\vec{v}$. These forces are represented in magnitude and direction by the three sides of a triangle ABC (as shown). The particle will now move with velocity-

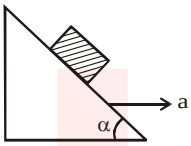


(A) Less than $\vec{v}$ (B) greater than $\vec{v}$

(C) |v| in the direction of largest force BC (D) $\vec{v}$, remaining unchanged

Space for Rough Work

14. A block is kept on a frictionless inclined surface with angle of inclination α. The incline is given an acceleration a to keep the block stationary. Then a is equal to-

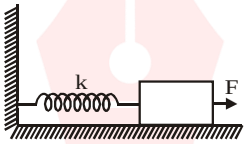


(A) g/tanα (B) g cosec α (C) g (D) g tan α

15. Work done in time t on a body of mass m which is accelerated from rest to a speed v in time t_1 as a function of time t is given by :

(A) $\frac{1}{2}m\frac{v}{t_1}t^2$ (B) $m\frac{v}{t_1}t^2$ (C) $\frac{1}{2}\left(\frac{mv}{t_1}t\right)^2 t^2$ (D) $\frac{1}{2}m\frac{v^2}{t_1^2}t^2$

16. A block attached to a spring, pulled by a constant horizontal force, is kept on a smooth surface as shown in the figure. Initially, the spring is in the natural state. Then the maximum positive work that the applied force F can do is : [Given that spring does not break]



(A) $\frac{F^2}{k}$ (B) $\frac{2F^2}{k}$ (C) ∞ (D) $\frac{F^2}{2k}$

17. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement x is proportional to-

(A) x^2 (B) e^x (C) x (D) $\log_e x$

18. A particle of mass 100 g is thrown vertically upwards with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is-

(A) – 0.5 J (B) –1.25 J (C) 1.25 J (D) 0.5 J

19. A projectile can have the same range R for two angles of projection. If t_1 and t_2 be the times of flights in the two cases, then the product of the two times of flights is proportional to-

(A) R^2 (B) $\frac{1}{R^2}$ (C) $\frac{1}{R}$ (D) R

20. If $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$, then the angle between $\vec{A}$ and $\vec{B}$ is-

(A) π (B) $\pi/3$ (C) $\pi/2$ (D) $\pi/4$

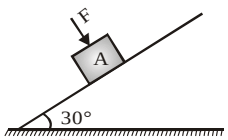
Space for Rough Work

INTEGER TYPE

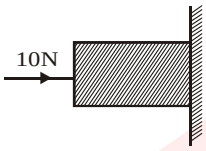
21. Force 3N, 4N and 12N act at a point in mutually perpendicular directions. The magnitude of the resultant force (in N) is :–

22. Particle is dropped from the height of 20m on horizontal ground. There is wind blowing due to which horizontal acceleration of the particle becomes 6 ms^{-2}. Find the horizontal displacement (in meter) of the particle till it reaches ground.

23. A block of mass m = 2 kg is resting on a rough inclined plane of inclination 30° as shown in figure. The coefficient of friction between the block and the plane is μ = 0.5. What minimum force F (in N) should be applied perpendicular to the plane on the block, so that block does not slip on the plane (g = 10m/s^2)



24. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block (in N) is-



25. A person A of 50 kg rests on a swing of length 1m making an angle 37° with the vertical. Another person B pushes him to swing on other side at 53° with vertical. The work done (in J) by person B is: [g = 10 m/s^2]

Space for Rough Work

SECTION – B : CHEMISTRY

26. If velocity of an electron in I orbit of H atom is V, what will be the velocity of electron in 3rd orbit of Li^{+2}

(A) V (B) V/3 (C) 3 V (D) 9 V

27. The difference between the wave number of 1st line of Balmer series and last line of paschen series for Li^{2+} ion is :

(A) $\frac{R}{36}$ (B) $\frac{5R}{36}$ (C) 4R (D) $\frac{R}{4}$

28. de-Broglie wavelength of electron in second orbit of Li^{2+} ion will be equal to de-Broglie of wavelength of electron in

(A) n = 3 of H-atom (B) n = 4 of C^{5+} ion (C) n = 6 of Be^{3+} ion (D) n = 3 of He^{+} ion

29. For an electron, with n = 3 has only one radial node. The orbital angular momentum of the electron will be

(A) 0 (B) $\sqrt{6}\,\frac{h}{2\pi}$ (C) $\sqrt{2}\,\frac{h}{2\pi}$ (D) $3\left(\frac{h}{2\pi}\right)$

30. The MRI (magnetic resonance imaging) body scanners used in hospitals operate with 400 MHz radio frequency energy. The wavelength corresponding to this radio frequency is

(A) 0.75 m (B) 0.75 cm (C) 1.5 m (D) 2 cm

31. Which of the following contains the greatest number of atoms ?

(A) 1.0 g of butane (C_4H_{10}) (B) 1.0 g of nitrogen (N_2)

(C) 1.0 g of silver (Ag) (D) 1.0 g of water (H_2O)

32. Vapour density of a gas if its density is 0.178 g/L at NTP is :

(A) 0.178 (B) 2 (C) 4 (D) 0.089

33. The atomic weights of two elements A and B are 40 and 80 respectively. If x g of A contains y atoms, how many atoms are present in 2x g of B?

(A) $\frac{y}{2}$ (B) $\frac{y}{4}$ (C) y (D) 2y

34. For the reaction $2P + Q \rightarrow R$, 8 mol of P and 5 mol of Q will produce

(A) 8 mol of R (B) 5 mol of R (C) 4 mol of R (D) 13 mol of R

35. What approximate volume of 0.40 M $Ba(OH)_2$ must be added to 50.0 mL of 0.30 M NaOH to get a solution in which the molarity of the OH^- ions is 0.50 M?

(A) 33 mL (B) 66 mL (C) 133 mL (D) 100 Ml

Space for Rough Work

36. If the pressure of a gas contained in a closed vessel is increased by 0.4 % when heated by 1ºC its initial temperature must be:

(A) 250 K (B) 250ºC (C) 25ºC (D) 25 K

37. Equal weights of ethane & hydrogen are mixed in an empty container at 25º C, the fraction of the total pressure exerted by hydrogen is:

(A) 1: 2 (B) 1: 1 (C) 1: 16 (D) 15: 16

38. X ml of H_2 gas effuses through a hole in a container in 5 sec. The time taken for the effusion of the same volume of the gas specified below under identical conditions is:

(A) 10 sec. He (B) 20 sec. O_2 (C) 25 sec. CO_2 (D) 55 sec. CO_2

39. The R.M.S. speed of the molecules of a gas of density 4 kg m^{-3} and pressure 1.2×10^5 N m^{-2} is:

(A) 120 m s^{-1} (B) 300 m s^{-1} (C) 600 m s^{-1} (D) 900 m s^{-1}

40. The values of Vander Waal's constant "a" for the gases O_2, N_2, NH_3 & CH_4 are 1.36, 1.39, 4.17, 2.253 L^2 atm $mole^{-2}$ respectively. The gas which can most easily be liquified is:

(A) O_2 (B) N_2 (C) NH_3 (D) CH_4

41. Consider the following statements

1. IE_1 of nitrogen atom is more than IE_1 of oxygen atom.
2. Electron affinity of oxygen is less than sulpur atom
3. Electronegativity on pauling scale is 2.8 times than electronegativity on mullikan scale,

The above statements 1, 2, 3 respectively are (T = True, F = False)

(A) T F F (B) T T F (C) F T F (D) T F F

42. Which is not correctly matched?

(1) Basic strength of oxides $Cs_2O < Rb_2O < K_2O < Na_2O < Li_2O$

(2) Stability of peroxides $Na_2O_2 < K_2O_2 < Rb_2O_2 < Cs_2O_2$

(3) Stability of bicarbonates $LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$

(4) Melting point NaF < NaCl < NaBr < NaI

(A) 1 and 4 (B) 1 and 3 (C) 1 and 2 (D) 2 and 3

43. The correct order of size of the ions is:

(A) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$ (B) $Na^+ > Mg^{2+} > Li^+ > Be^{2+}$

(C) $Mg^{2+} > Be^{2+} > Na^+ > Li^+$ (D) $Mg^{2+} > Na^+ > Be^{2+} > Li^+$

Space for Rough Work

44. In the long form of the periodic table, silver (Atomic number 47) belongs to the group

(A) 1st (B) 10th (C) 16th (D) 11th

45. What is the position of the element in the periodic table satisfying the electronic configuration $(n-1)\,d^1\,ns^2$ for n = 4

(A) 3rd period and 3rd group (B) 4th period and 4th group

(C) 3rd period and 2nd group (D) 4th period and 3rd group

INTEGER TYPE

46. No. of visible lines when an electron returns from 5th orbit to ground state in H spectrum-

47. What volume (in litre) of hydrogen gas at 273 K and 1 atm pressure will be consumed in obtaining 21.6 gm of elemental boron (atomic mass = 10.8) from the reduction of boron trichloride by hydrogen-

48. A container contains the mixture of water vapour and oxygen gas with total pressure 1.1 atm at certain temperature. If volume is made one third then find the total pressure (assume aqueous tension of water at this temperature is 0.1 atm.)?

49. At what temperature would the most probable speed of CO_2 molecules be twice that at 127ºC

50. The electron affinity of a hypothetical element 'A' is 3 eV per atom. How much energy in kcal is released when 10g of 'A' is completely converted to A^- ion in a gaseous state?

(1 eV = 23 kcal mol^{-1}, Molar mass of A = 30 g)

Space for Rough Work

SECTION – C : MATHEMATICS

51. The co-ordinates of a point P on the line 2x – y + 5 = 0 such that |PA – PB| is maximum where A is (4, – 2) and B is (2, – 4) will be -

(A) (11, 27) (B) (–11, – 17) (C) (–11, 17) (D) (0, 5)

52. A ray of light passing through the point A (1, 2) is reflected at a point B on the x-axis line mirror and then passes through (5, 3). Then the equation of AB is -

(A) 5x + 4y = 13 (B) 5x – 4y = – 3 (C) 4x + 5y = 14 (D) 4x – 5y = – 6

53. Let the algebraic sum of the perpendicular distances from the points (3, 0), (0, 3) & (2, 2) to a variable straight line be zero, then the line passes through a fixed point whose co-ordinates are-

(A) (3, 2) (B) (2, 3) (C) $\left(\frac{3}{5}, \frac{3}{5}\right)$ (D) $\left(\frac{5}{3}, \frac{5}{3}\right)$

54. The line PQ whose equation is x – y = 2 cuts the x axis at P and Q is (4, 2). The line PQ is rotated about P through 45° in the anticlockwise direction. The equation of the line PQ in the new position is –

(A) $y = -\sqrt{2}$ (B) y = 2 (C) x = 2 (D) x = – 2

55. The maximum value of the sum of the A.P. 50, 48, 46, 44, ... is –

(A) 325 (B) 648 (C) 650 (D) 652

56. Let a_n be the n^{th} term of a G.P. of positive numbers. Let $\sum_{n=1}^{100} a_{2n} = \alpha$ & $\sum_{n=1}^{100} a_{2n-1} = \beta$ such that $\alpha \neq \beta$. Then the common ratio of the G.P. is –

(A) $\frac{\alpha}{\beta}$ (B) $\frac{\beta}{\alpha}$ (C) $\sqrt{\frac{\alpha}{\beta}}$ (D) $\sqrt{\frac{\beta}{\alpha}}$

57. If $\ell n (a + c)$, $\ell n (c – a)$, $\ell n (a – 2b + c)$ are in A.P., then :

(A) a, b, c are in A.P. (B) a^2, b^2, c^2 are A.P.

(C) a, b, c are in G.P. (D) a, b, c are in H.P.

58. The sum to n terms of the series $\frac{3}{1^2} + \frac{5}{1^2+2^2} + \frac{7}{1^2+2^2+3^2} + ...$ is –

(A) $\frac{3n}{n+1}$ (B) $\frac{6n}{n+1}$ (C) $\frac{9n}{n+1}$ (D) $\frac{12n}{n+1}$

Space for Rough Work

59. If $\frac{1}{1^4}+\frac{1}{2^4}+\frac{1}{3^4}+.....+$ to $\infty=\frac{\pi^4}{90}$, then $\frac{1}{1^4}+\frac{1}{3^4}+\frac{1}{5^4}+.....+$ to ∞ is equals to –

(A) $\frac{\pi^4}{96}$ (B) $\frac{\pi^4}{45}$ (C) $\frac{89\pi^4}{90}$ (D) None of these

60. The expression $\frac{\sin(\alpha+\theta)-\sin(\alpha-\theta)}{\cos(\beta-\theta)-\cos(\beta+\theta)}$ is –

(A) independent of α (B) independent of β

(C) independent of θ (D) independent of α andβ

61. If $\cos\theta=\frac{1}{2}\left(a+\frac{1}{a}\right)$ then cos 3θ in terms of 'a' =

(A) $\frac{1}{4}\left(a^3+\frac{1}{a^3}\right)$ (B) $4\left(a^3+\frac{1}{a^3}\right)$ (C) $\frac{1}{2}\left(a^3+\frac{1}{a^3}\right)$ (D) none

62. If A and C are two angles such that $A+C=\frac{3\pi}{4}$, then (1+ cot A)(1+ cot C) equals -

(A) 1 (B) 2 (C) –1 (D) –2

63. If $(a+b)\tan(\theta-\phi)=(a-b)\tan(\theta+\phi)$, then $\frac{\sin(2\theta)}{\sin(2\phi)}$ is equal to –

(A) ab (B) $\frac{a}{b}$ (C) $\frac{b}{a}$ (D) a^2b^2

64. $\frac{1}{\log_{\sqrt{bc}}abc}+\frac{1}{\log_{\sqrt{ca}}abc}+\frac{1}{\log_{\sqrt{ab}}abc}$ has the value equal to –

(A) $\frac{1}{2}$ (B) 1 (C) 2 (D) 4

65. The value of the expression, $\log_4\left(\frac{x^2}{4}\right)-2\log_4\left(4x^4\right)$ when x = – 2 is –

(A) – 6 (B) – 5 (C) – 4 (D) meaningless

66. $\frac{1}{1+\log_b a+\log_b c}+\frac{1}{1+\log_c a+\log_c b}+\frac{1}{1+\log_a b+\log_a c}$ is equal to-

(A) abc (B) $\frac{1}{abc}$ (C) 0 (D) 1

Space for Rough Work

67. If A and B be any two sets, then $(A \cap B)'$ is equal to-

(A) $A' \cap B'$ (B) $A' \cup B'$ (C) $A \cap B$ (D) $A \cup B$

68. Let A and B be two sets such that n(A) = 70, n(B) = 60 and $n(A \cup B) = 110$. Then $n(A \cap B)$ is equal to-

(A) 240 (B) 20 (C) 100 (D) 120

69. If A = {– 2, – 1, 0, 1, 2} & f : A $\rightarrow$ Z; f (x) = x^2 + 1, then the range of f is

(A) {0, 1, 2, 5} (B) {1, 2, 5}

(C) {– 5, – 2, 1, 2, 3} (D) A

70. If f : R $\rightarrow$ R satisfies f(x + y) = f(x) + f(y), for all x, y $\in$ R and f(1) = 7, then $\sum_{r=1}^{n} f(r)$ is –

(A) $\frac{7n}{2}$ (B) $\frac{7(n+1)}{2}$

(C) 7n (n + 1) (D) $\frac{7n(n+1)}{2}$

INTEGER TYPE

71. The value of the expression $\frac{1-4\sin 10^\circ \sin 70^\circ}{2\sin 10^\circ}$ is –

72. The expression $\sqrt{\log_{0.5}^2 8}$ has the value equal to _____.

73. If f(x) = cos (log x), then f(x) f(y) $-\frac{1}{2}$ [f(x/y) + f(xy)] is equal to –

74. The line x + y = p meets the axis of x and y at A and B respectively. A triangle APQ is inscribed in the triangle OAB, O being the origin, with right angle at Q. P and Q lie respectively on OB and AB. If the area of the triangle APQ is 3/8th of the area of the triangle OAB, then $\frac{AQ}{BQ}$ is equal to –

75. Given sin $B = \frac{1}{5}\sin(2A + B)$ then, tan (A + B) = k tan A, where 2k has the value equal to

Space for Rough Work