No.1 FOR IIT FOUNDATION

SRI SRI ACADEMY

Since 2001

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IIT Ramaiah Entrance Test Papers - SAT - 2013

Time : Three Hours **Max. Marks : 180**

NOTE:-

1. **Attempt all questions. There is no negative marking. No additional sheets are provided.**
2. **Answer all the questions of the same subject at one place**
3. **Students may take around 80 minutes for Mathematics, 50 minutes for Physics and 50 minutes for Chemistry**
4. **Use of calculators, slide rule, graph paper and logarithmic, trigonometric and statistical tables is not permitted**

PART-A : MATHEMATICS

Note:- All answers to questions in **Section-A, Section-B** and **Section-C** must be supported by mathematical arguments. In each of these sections order of the questions must be maintained.

SECTION-A

(4 x 3 = 12 Marks)

This section has Four Questions. Each question is provided with 4 alternative answers. One or more than one of them are correct answers. Indicate the correct answer by A, B, C, D.

(4 x 3 = 12 Marks)

1. The number of solutions of x + [x] = 2013, where [x] is greatest integer less than or equal to x, is

   A) 2013 B) 0 C) 1 D) not finite

2. If $x \neq -1$, $y \neq -1$ and $x^3 + y^3 + 3xy = 1$ then

   A) $x + y = 1$ B) $x + y = -1$ C) $x^2 + y^2 = 1$ D) $(x + y)^2 = 1$

3. A point lying in the plane of a triangle is equidistant from its sides as well as its vertices then the triangle is

   A) Isosceles but not equilateral B) Scalene

   C) Equilateral D) right angled isosceles

4. The complete solution set of $\sqrt{x - 2} < 2$ is

A) (6, ∞) B) (-∞ , 6) C) (2, 6) D) (-∞, 4)

SECTION – B

This section has Four Questions. In each question a blank is left. Fill in the blank. (4 x 3 = 12 M)

5. The smallest positive integer n such that 2013 is a term in the finite sequence of four numbers 4n, 4n + 7, 4n + 14, 4n + 21 is _____

6. The radius of the circumscribed circle of an isosceles triangle of unit base is also unity. The diameter parallel to the base of the triangle cuts off a smaller triangle. The exact lengths of the base and legs of the smaller triangle are _____

7. The number of pairs (f(x) , g (y)) of functions such that $x^2 + xy + y^2 = f(x) + g(y)$ for all $x,y \in R$ is _____

8. In a parallelogram ABCD if the lengths of two adjacent sides are 2,6 and the length of the smallest diagonal BD is 6 then AC^2 = _____

SECTION – C

State True or False in each of the following statements. (4 x 3 = 12 Marks)

9. The number of elements in the set {x : x (x + 8) (x + 58) = 2013, x is an integer} is 1.

10. The area of the region bounded by $\sqrt{x^2} + \sqrt{y^2} = 1$ is ½ sq. units

11. In a triangle ABC if the internal and external bisectors of angle A meet the circum circle at X and Y then XY is a diameter of the circum circle.

12. If $\frac{x^4 + x^2 + 1}{x^2 + x + 1} = px^2 + qx + r$ then p + q + r = 1

SECTION – D (4 x 6 = 24 Marks)

13. In a triangle ABC, D and E are points on the sides AB and AC such that the line segment DE is parallel to the side BC. F is a point on the line segment AD such that FE is parallel to the line segment DC. If AF = 4, FD = 6 then find DB.

14. If a, b, c are integers such that c > o. Determine condition(s) on a, b, c to put $a + b\sqrt{c}$ in the form $(\sqrt{p} \pm \sqrt{q})^2$ where p and q are integers.

15. The coordinates of seven vertices of a 7-gon are generated by the following rule :

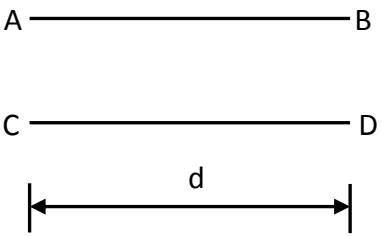
f(x) = $(x - 7)^2 + 3$ for $x \in \{4, 5, 6, 7, 8, 9, 10\}$. Find the area of the polygon.

16. Find all integers n such that $|2n^3 - 6n^2 + 4n + 3|$ is prime.

PART – B : PHYSICS

(10 x 6 = 60 Marks)

17. AB and CD are parallel paths of equal length d. Two persons P and Q start simultaneously from A and C and walk towards B and D with speeds V_1 and V_2. On reaching the destination they reverse their directions. If V_1 is greater than V_2 where do they cross ?



18. A particle starting from rest accelerates uniformly and travels a distance d for some time. It then travels uniformly at the speed acquired after the initial acceleration for an equal time, after which it decelerates and comes to rest. The magnitude of the deceleration is twice the initial acceleration. If total distance travelled is nd, find n.

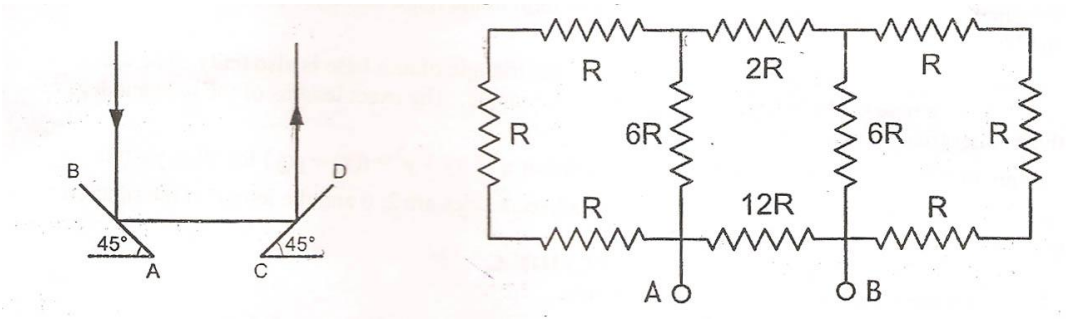
19. A long straight horizontal wire AB carries some current. A is to the north of B. Magnetic field below the wire is eastward. If the wire is now held vertically with A above B with the current in the wire flowing the same way as earlier, find the direction of the magnetic field to the north of the wire

20. A body of weight W loses 1/3 of its weight when completely submerged in a liquid A. Find the weight of the body when completely' submerged in another liquid B, whose density is half of that of liquid A.

21. Two mirrors AB and CD are placed as shown with their reflecting surfaces towards each other. A ray of light incident on AB at 45° on reflection from AB and CD emerges parallel to the original direction. Through what angle does the ray reflected by CD turn if

    i) AB is turned in a clock wise sense through a small angle 5°.

    ii) CD is turned in anticlockwise sense through a small angle 5°.



22. Find the equivalent resistance between A and B. Also find the equivalent resistance between A and B if the two resistances of 6R are removed.

23. If a nanogram (10^{-9} g) of mass were to be completely converted into electrical energy

and used to power a 40 W lamp, find the time for which the lamp can be run. Assume the mass is converted at a uniform rate to produce the power required by the lamp.

24. A proton moving eastward at right angles to a uniform magnetic field experiences a northward force. What is the direction of the force on a beta particle moving southward?

25. Velocity of sound in air at pressure P and temperature T is V. Find the velocity of sound in air if it's (i) pressure alone is doubled (ii) Temperature alone is doubled (iii) pressure and temperature are both doubled

26. What temperature raise does a 500 W heater cause in 2.5 kg of water in 4.2 min? If this water were to be mixed with another liquid of mass 5 kg whose specific heat is half of that of water, what temperature raise would occur in the mixture in 4.2 min? Assume and average loss of 20% of heat to the surroundings.

PART-C : CHEMISTRY

SECTLON-A: Each question is provided with 4 alternative answers. One or more than one of them are correct answers. Indicate the correct answer by A, B, C, D. (5x3=15 MARKS)

27. If an element with atomic number 119 is discovered. What is the position of the element in the modern periodic table
A) 2^{nd} vertical column B) 13^{th} vertical column
C) 9^{th} vertical column D) 1^{st} vertical column

28. Now a days there is very important world wide discussion about Environmental pollution and global warming, the Global warming is mainly due to
A) UV radiation B) VIS radiation
C) IR radiation D) Depletion of ozone layer

29. The molarity of resultant solution when 100 ml of 0.3 M HNO_3 and 200 ml of 0.3 M H_2SO_4 solution mixed together
A) 0.4 M B) 0.2M C) 0.3 M D) 0.12 M

30. Your science master has purchased a Hydrogen peroxide bottle from a chemical shop. It was labeled as 10 -volume ,what do you understand by that
A) 10ml of H_2O_2 on decomposition produce 1 ml of O_2
B) 1 ml of H_2O_2 on decomposition produce 1 ml of O_2
C) 1 ml of H_2O_2 on decomposition produce 10 ml of O_2
D) The entire bottle carry only 10ml of H_2O_2

31. Which of the following is correct for white phosphorous (P_4) molecule
A) The total number of σ bonds in P4 molecule is six

B) The total number of lone pairs in P4 molecule is four

C) The bond angle in P_4 molecule is 60°

D) In P_4 molecule each p-atom link to four σ bonds

SECTION-B: In each question a blank is left. Fill in the blank. (5x3=15 MARKS)

32. Among Ti^{+2} Co^{+3}, Mn^{+3}, M^{+3}, Ni^{+2} the number ions with two unpaired electrons _____

33. A radio active cobalt used for cancer chemotherapy having half life 3 hrs. It was sent to a hospital which is received after 12 hrs. At the time of receiving it was left only 3gms. What was the initial amount_____

34. CO_2 gas at -78^oC gets solidified, known as dry ice. The type of bonds present between CO_2 molecules in dry ice_____

35. For a reaction the equilibrium constant is 1, rate constant for the forward reaction is 100, then find the rate constant for the backward reaction_____

36. When Mercury comes in contact with ozone it loses its meniscus sticks to the walls of the container, known as tailing of mercury. This due to formation of a mercury compound_____.

SECTION-C: Name the compound. (5x3=15 MARKS)

37. Sodium chloride on reaction with $K_2Cr_2O_7$ of in presence of conc. H_2SO_4 in a dry test tube liberates a red fumes. Name of the red fumes.

38. Magnesium on reaction with atmospheric nitrogen forms nitride. This on Hydrolysis in produces gas.

39. Name of the carbon compound formed when Mg_2C_3 is hydrolysed.

40. Name the Nitrogen compound produced by the decomposition of NH_4NO_3

41. Chemical name of Tear gas.

SECTION-D (5x3=15 MARKS)

42. For a reaction $2SO_2 + O2 \rightarrow 2SO_3$. The rate of consumption of SO_2 is 4×10^{-2} moles/lit/sec. What is the rate of consumption of O_2 is

43. The periodic table consists of 18 groups. An isotope of copper, on bombardment with protons, undergoes a nuclear reaction yielding element X as shown below. To which group, element X belongs in the periodic table?

$$\begin{array}{cccccccc} 63 & & 1 & & 1 & & 1 & \\ Cu & + & H & \rightarrow & 6 & n + \alpha + 2 & H + X & \\ 29 & & 1 & & 0 & & 1 & \end{array}$$

44. Substance A is a gas of vapour density 8.5. On oxidation with pt -catalyst at high temperature it gave a colour less gas B. Which rapidly turned brown in air forming gas C. What are A,B and C.

Give balanced Equations for Q.No. 45-46

45. Cold and dilute NaOH on reaction with Cl_2 produce two compound A and B along with water. In which Cl oxidation number in A is -1 and B is +1.

46. On heating orange solid (P) giving Cr_2O_3 a colorless gas (Q) and water. (Q is most abundant gas in atmosphere)