SRI SRI ACADEMY

IIT Ramaiah Entrance Test Papers - SAT - 2010
MATHEMATICS

Time : Two Hours **Max. Marks: 50**
(8.30 AM – 10.30 AM)

NOTE :

1. *Attempt all questions. Rough work must be enclosed with answer book,*
2. *While answering, refer to a question by its serial number as well as section heading. (eg:Q2/Sec.A)*
3. *There is no negative marking.*
4. *Answer each of Sections A, B, C at one place. Elegant solutions will be rewarded*
5. *Use of calculators, slide rule, graph paper and logarithmic, trigonometric and statistical tables is not permitted.*

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

This section has Five Questions. Each question is provided with five alternative answers, One or more than one of them are correct answers. Indicate the correct answers by A, B, C, D, E. (5x2=10 MARKS)

1. Let l_1, l_2 be any two parallel lines and B, C be any two points on l_1 and $A_1, A_2, \ldots, A_{2010}$ be points on l_2. If Δ_i denotes the area of the triangle A_iBC and if $\sum_{i=1}^{2010} \Delta_i = 2010$, Then the area of $\Delta A_{2010} BC$ is

   A) 1 B) $\frac{1}{2}$ C) 2 D) 2010 E) 1005

2. Let $\{a_n\}$ be a sequence of integers such that $a_1 = 1$, $a_{m+n} = a_m + a_n + mn$ for all positive integers m and n. Then a_{12} is
   A) 6 B) 70 C) 78 D) 76 E) 72

3. ln a triangle ABC, a, b, c denote the lengths of the sides BC, CA, AB. If D is the midpoint of the side BC and AD is perpendicular to AC, then
   A) $3b^2 = a^2 - c^2$ B) $3a^2 = b^2 - 3c^2$ C) $b^2 = a^2 - c^2$ D) $a^2 + b^2 = 5c^2$ E) none of these

4. If k is an integer then which of the following is true?
   A) An integer of the form 4k+l can always be put in the form 2k-l
   B) An integer of the form 4k+3 can always be put in the form 2k+l
   C) An integer of the form 2k-1 can always be put in the form 4k+l
   D) An integer of the form 2k-l can always be put in the form 4k+3
   E) An integer of the form 2k+1 can always be put in the form 4k+3

5. The number of elements in $\{(a, b, c) / a=b, (a-c)^2 = 0, a + b + c = 0, a, b, c$ are real numbers$\}$ is
   A) 0 B) 1 C) 6 D) 3 E) infinitely many

SECTION-B

This section has Five Questions. In each question a blank is left. Fill in the blank.
(5x2=10 MARKS)

1. The no. of solutions of the equation xy(x+y)=2010, where *x and y* denote positive prime numbers, is _____
2. The number of elements in the set {n N/n^3 - $8n^2$ + 20n - 13 is a prime number} is ____
3. The solution set of the equation + (x - 2) = 0 is _____
4. Given any two diameters of a circle the convex quadrilateral formed by joining the extremities of the diameters is always a rectangle. True/False
5. If P = 3^{2010} + 3^{-2010}, Q = 3^{2010} – 3^{-2010} then P^2 - Q^2 = _____

SECTION-C

(5x2=10 MARKS)

1. Solve the equation $\log_{2010}(2009\ x) = \log_{2009}(2010x)$.
2. In a quadrilateral ABCD, AB = 3, BC = 4, CD = 5, ∠ABC = ∠BCD = 120°. Find the area of the quadrilateral.
3. I was trying to solve $\frac{4}{x-2} > 5$. While writing the question I mistakenly wrote a digit other than 5 and solved the inequality and got 2 < x < 4. What digit did I write possibly?
4. In a right angled triangle what is the relation between the square of the altitude on to the hypotenuse and the product of the segments of the hypotenuse?
5. Is it possible to find two functions f and g such that the domain of f is <u>not</u> finite, the domain of g is finite, gof is defined? Justify your answer.

SECTION-D

(5x4=20 MARKS)

1. If the last digits (unit places) of the products 1.2., 2.3, 3.4,....., n(n + l) are added, the result is 2010. How many products are used?
2. Show that four divides any perfect square or leaves a remainder 1. Also show that nine divides cube of any integer or leaves 1 or 8 as remainder.
3. Let AB be a line segment of length 26. Let C and D be located on the line segment AB such that AC = 1 and AD = 8. Let E and F be the points on one of the semi circles with diameter AB for which EC and FD are perpendicular to AB. Find the length of the line segment EF.
4. In each of the following cases give an example of a system of two linear equations in two variables x and y.
   i) A system having exactly one solution
   ii) A system having no solution
   iii) A system having infinitely many solutions
5. Using Mathematical Induction Prove that $3^{2n} + 7$ is divisible by 8, $\forall n \in N$.

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PHYSICS

Time : One Hour **Max. Marks : 50**

1 *Answers must be written either in English or the medium of instruction of the candidate in high school.*

2 *Answer all the questions in the booklets provided for the* purpose.

3 *There will be* no *negative marking.*

4 *The relevant working or the argument in* arriving *at an* answer has *to be included* in your answer.

5 *Use of calculators is not permitted.*

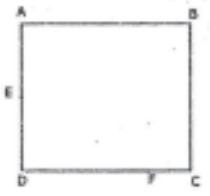
6 *Questions in Part A carry 5 marks each, questions in part B carry 2 marks each.*

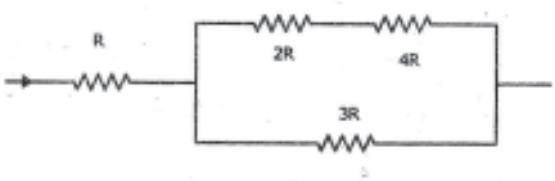
PART - A

1. A body dropped from a very large height , experiences resistance to its motion due to air and has a varying acceleration which decreases to zero in time t. Assume the displacement in this time and the velocity acquired at the end of this time are same as that due uniform acceleration of cg (c is a constant less than 1). The body then travels with a uniform speed acquired at the end of time t. Find the displacement of the body in time 2t.

2. A bright point object is kept at some distance from a lens of focal length 20 cm. If the object distance is changed 5/6 times, the distance of the screen from the lens has to be changed by 5/3 times to obtain a clear image on the screen. Find the distance through which the screen has been moved.

3. ABCD is a square of side 400 m. E and F are points 200 and 300 m away from corner D. Two persons starting from E and F and moving away from D, meet at B, Where would they meet if they were to travel towards D.





4. In the circuit shown PD across R is V. Find the PD across the resistance 2R

5. Two liquids of densities 2 gcm^{-3} and 4 gcm^{-3} of equal volumes form a homogenous mixture. A solid object made of materials of density 1 gcm^{-3} and 5 gcm^{-3} mixed homogenously is just found to just float in this mixture. What is ratio by volumes/

masses of the materials of the solid object?

6. A man is standing to the south of a vertical conductor carrying current facing the conductor. Direction of the magnetic field at a position in between him and the wire is from his left to right. What would be magnetic field direction behind him if he moved to a position (i) east of the conductor (ii) to the north of the conductor. Assume he always faces the conductor and current direction in the wire remains constant. {Express these directions as east or west etc.)

7. Average energy required by an adult to sustain himself is 1500 kilocalories per day . A medium sized banana is about 100 g and provides about 100 kilocalories. How many kg of bananas are required per day to sustain a population of 1000 million? If some how the biological processes were to be sustained by nuclear reactions, how many kg of mass must disappear to provide this energy?

8. A ray of light is incident at 45° on to a transparent slab of thickness 10 cm made of a material of refractive index $\sqrt{2}$. Find the lateral displacement of the ray as it emerges from the slab.

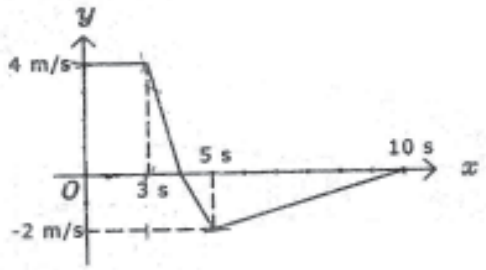
PART – B

9. Length of a wire of resistance R and resistivity ρ is doubled by stretching it. What will be its new resistance and resistivity?

10. A solid object made of material of density 0.79 gcm^{-3} of negligible coefficient of cubical expansion is floating in a liquid of density 0.8 gcm^{-3} at 20^0C. When the temperature is raised to 220 °C, the solid object starts sinking in the liquid.

Find the coefficient of cubical expansion of the liquid.

11. Velocity time graph of a body is as shown. Find it's displacement in 10 s



12. Sound wave of wavelength 0.5m in air passes in to water What is its wavelength in water? Also find the frequencies of the wave in air and water (Velocity of sound in air and water are 350 m/s and 1400 m/s respectively)

13. A 1000 MW thermal power plant burns 10^6 kg of coal in one hour. How many kg of coal is burnt to produce the power required to light up a 100 W lamp for 8 hours

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CHEMISTRY

Time : One Hour **Max. Marks : 50**

Instructions:

(1) Answer must be written either in English or the medium of instruction of the candidate in high school.

(2) There will be no negative marking

(3) Use of calculators or graph papers is not permitted. Answer all the questions. Each question carries $2\frac{1}{2}$ *Marks.*

1. What is the action of heat on following salts? Explain with balanced equations.

   a) $FeSO_4 \xrightarrow{\Delta}$ b) $AgNO_3 \xrightarrow{\Delta}$

2. Sugar forms clear solution but soap forms cloudy solutions. Why?
3. What is the composition of baking powder? Explain how it bakes the bread to make it spongy? (with chemical equations)
4. When iron is exposed to atmosphere surface of the metal becomes brown but silver under similar conditions becomes black. Explain with equations?
5. BH_3 acts as a Lewis acid whereas NH_3 acts as Lewis base. Explain with proper structures?
6. Write the cathodic and anodic reactions when aqueous solution of KNO_3 is electrolysed by using Pt electrodes.
7. What is electrolyte? What is the basic requirement for a substance to act as electrolyte?
8. In the given salt cation is called as basic radical and anion is called as acid radical. Why?
9. Why hydrogen peroxide acts as oxidising as well as reducing agent?
10. Hardness of lA-group elements gradually decreases down the group. Why?
11. What way thermochemical equations are more informative than skeletal and balanced chemical equations?
12. What are the simplest tests that are used for identification of purity of the chemical sample?
13. Total hardness of water cannot be removed by simple heating. Why?
14. CO_2 and SiO_2 are the oxides of elements of same group but CO_2 is a gas but SiO_2 is solid. Why?
15. All exothermic reactions are not spontaneous reactions. Why?
16. What are the internal factors that decide the physical state of the substance?

17. Aqueous solution of $CuSO_4$ cannot be stored in Zn container but aqueous solution of $ZnSO_4$ can be stored in Cu vessel. Why?

18. Match each of the chemical species in **Column I** with its property / properties given in corresponding **Column II & Column 111. No** partial marking.

Column-l	**Column-ll**	**Column-Ill**
a) BeH_2	1. sp^3d^2	(i) trigonal planar
b) CH_2BrCl	2. sp^3	(ii) octahedral
c) PF_6^-	3. sp^2	(iii) distorted tetrahedron
d) BF_3	4. sp	(iv) linear

19. Ethanol (density=0.7893 g/ml) and water (density=0.9931 g/ml) at 25°C are mixed in the volume ratio 1:2 to get solution of density 0.9571 g/ml. Calculate

    (i) the fractional change in volume and

    (ii) the molality of the final solution.

20. Indicate whether the following reaction is exothermic or endothermic by properly computing the given data:

    $^{2+}_{g}$ $^{-}_{g}$;

    IE_1 of M_g = 737.7 Kj mol^{-1}; IE_2 of Mg = 1451 Kj mol^{-1} ; EA_1 of X_g = -328 Kj mol^{-1}

    $$Mg + 2Xg \longrightarrow Mg^{2+} + 2X^{-}g$$