

Paper Type: AD

**M. Prakash Academy and Sri Chaitanya Entrance  
Examination for IIT JJE Training Batch 2017-19**

April 9, 2017

1.00 pm to 5.00 pm

Total marks: 200

Student's Name:

Receipt Number:

**Chemistry****Useful data:****Atomic numbers:** H:1; C:6; O:8; Na:11; S:16; Cl:17; Ca: 20; Fe:26; Cu:29, Zn:30**Atomic masses:** H:1; C:12; O:16; Na: 23; S:32; Ca: 40; Cl:35.5; Fe: 56; Cu: 64,Zn:66**Avogadro number :**  $6 \times 10^{23}$  per mole.

1. Rain water containing  $CO_2$  passes over limestone. It forms a soluble substance 'A' . On heating  $X$  grams of 'A', 0.5 mol of  $CO_2$  gas and a salt are produced. Find the value of  $X$  grams.

2. 4 grams of a hydrocarbon on complete combustion gave 11 grams of  $CO_2$ . Find the percentage of Carbon in the hydrocarbon.

3. A liquid trivalent metal 'M' in group 'A' of the modern periodic table. Element 'M' reacts with a liquid non- metal 'Y' . 'Y' belongs to group 'B'. Write the value of 'A + B ' in your bubble sheet.

4. According to long form periodic table, element 'X' with atomic number 21 belongs to group 'A' and period 'B' . Write the atomic number of element 'Y' placed in group (A -2) and period (B+1).

5. 'x' moles of an oxide of a metal 'A' is heated with with 'y' moles of the sulphide of the same metal. 6 moles of the element 'A' is obtained with 1 mole of a pungent smelling gas 'B'

Element 'A' reacts with moist  $CO_2$  in air and slowly loses its shine to form a green coat .

Determine the weight in grams of the sulphide of 'A' required if  $\frac{1}{2}$  mole of gas 'B' is produced.

6. 3.55 grams of Chlorine is produced when  $\frac{1}{x}$  moles of bleaching powder (It is used in preparation of Chloroform) reacts with  $\frac{1}{y}$  mole of  $CO_2$ . Write the value of 'X + Y' in your bubble sheet.

7. For hydrocarbon with molecular formula  $C_5H_{12}$ , write the number of possible isomers .

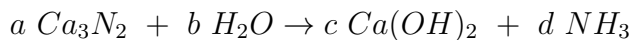
8. Excess of Sodium reacts with 10 moles Ethanol to produce gas 'X'. All of the 'X' produced reacts completely with 'A' mole of Ethene to produce 'Y' when heated in the presence of Pd as catalyst. Write the value of 'A'.

9. How many moles of Chlorine will be needed for complete chlorination of 1 mole of Acetic acid ?

10. From the following list of mixtures, write the number of homogeneous mixtures in your bubble sheet.

Brass, Bronze, Common salt in water, Air, Mist, Ethanol in water, Fog, Milk, Blood, Mud, Urine, Starch in water, Duralumin, Stainless steel, Gemstones, Ammonia in water, Vinegar in water, Sodium amalgam, Ice cream, Toothpaste, Nail polish, Printing ink, Gum, Shaving cream, Soot, Aerated water.

11. Balance the following chemical reaction. Write the value of a+ b+ c + d in your bubble sheet.



12. One gram of Zinc contains  $\frac{1}{x} \times 10^{23}$  atoms. Write the value of 'x' in your bubble sheet. 'x' is a double digit number.

**13.** According to Modern Periodic table, 5 elements a,b,c,d,e are mentioned below with their group number (x), period number (y), and atomic number (z), total  $T_n = (x + y + z)$

Elements	Group number (x)	Period number (y)	Atomic number (z)	Total ( $T_n$ )
a	$x_1$	3	13	$T_1$
b	11	4	$z_1$	$T_2$
c	8	$y_1$	26	$T_3$
d	$x_2$	$y_2$	19	$T_4$
e	$x_3$	$y_3$	47	$T_5$

Study the following reactions and write the total ( $T_n$ ) for the most reactive element .

- (i)  $b + \text{soluble salt of a} \rightarrow \text{No reaction}$
- (ii)  $c + \text{soluble salt of b} \rightarrow \text{No reaction}$
- (iii)  $c + \text{soluble salt of e} \rightarrow \text{Reaction takes place}$
- (iv)  $d + \text{soluble salt of a} \rightarrow \text{Reaction takes place}$

### Physics

Take  $g = 10 \text{ m/s}^2$ , density of water =  $1 \text{ g/cc}$   $\sin 15^\circ = 0.25$ ,  $\sin 30^\circ = 0.5$

**14.** A man, with a mass of 100 kg, while traveling on a skateboard crashes into a brick wall. The wall exerts a retarding force that is twice his weight. Due to this he comes to a halt in 0.4 seconds. Find the velocity of the man when he crashed into the wall. Express your answer in m/s.

**15.** A stone released from a cliff requires 2 s to travel the last 30 m before hitting the ground. From what height above the ground did it fall? Express your answer in m/s. Write the integer part of your answer in the bubble sheet.

**16.** A polar bear climbs onto a piece of floating ice block that has a volume of  $5 \text{ m}^3$ . What is the weight of the heaviest polar bear that the ice block can support so that bear is completely above water? Consider density of ice as  $917 \text{ kg/m}^3$ , and the density of sea water as  $1025 \text{ kg/m}^3$ . Express your answer in Newton. Divide your answer by 100 and write that number in bubble sheet.

**17.** Two ships started simultaneously from a port, one to the north and other to the east. Two hours later, the distance between them was 60 km. If one ship was moving 6 km/hr faster than the other find the speed of the slower ship. Express your answer in km/hr.

**18.** At the instant the traffic light turns green, a car that has been waiting at an intersection starts ahead with a constant acceleration of  $2.50 \text{ m/s}^2$ . At the same instant, a truck, traveling with a constant speed of 15 m/s, overtakes and passes the car. How far beyond its starting point is the car when it overtakes the truck? Express your answer in meters. Divide your answer by 10 and enter the number in the bubble sheet.

**19.** A 72 kg father and his 48 kg daughter are both wearing skates (assume zero friction with the surface). Father is traveling eastward with 5 m/s towards the daughter who is at rest. He pushes the daughter, sending her eastward with a speed of 9 m/s. Determine the distance of separation between them 5 seconds after the push. Express your answer in meter.

**20.** The ropeway used to carry people up a mountain having slope  $15^\circ$ , has 5 carts of 30 kg each. Each cart can carry maximum 3 people of 80 kg. During holiday season, it is running at full capacity. It is powered by a 2.7 kW motor which operates so that carts travel with constant velocity. What will be vertical height in meter covered per minute by the cart.

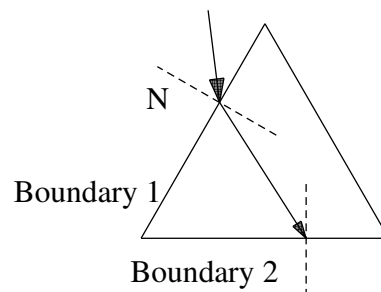
Given  $\sin 15^\circ = 0.25$

**21.** One of the screens in a multiplex is 14.7 m wide. The projector located at 42.1 m from the screen uses the movie film of 35 mm width only. Calculate the focal length of the projector lens system. Express your answer in cm.

**22.** Two iron wires of length 1 m and cross-sectional area  $1 \text{ mm}^2$  are connected in parallel at room temperature. This circuit is used in high temperature furnace where due to high temperature total resistance changes by 12 %. Find the equivalent resistance of circuit inside the furnace. Express your answer in *mili* $\Omega$ .

Given: resistivity of iron at room temperature is  $10 \mu\Omega - cm$ .

**23.** As shown in the diagram below, a red laser light enters one face of an equiangular ( $60^\circ - 60^\circ - 60^\circ$ ) prism (having refractive index 2) i.e. boundary 1, refracts and then is incident on second face of the glass prism, boundary 2. The further path of the ray is not depicted in the diagram. The laser light is incident at an angle of  $60^\circ$  with boundary 1. When the ray finally departs away from boundary 2, what angle it would make with boundary 2.



Given:  $\sin 15^\circ = 0.25$ ,  $\sin 30^\circ = 0.5$ ,  $\sin 60^\circ = \frac{\sqrt{3}}{2}$

**24.** A 20 gm bullet is fired horizontally at a bunch of identical planks placed touching each other. It loses  $1/20^{th}$  of its velocity in passing through the first plank. If all planks offer same constant resistive force to the passage of bullet, find the minimum number of such planks required to stop the bullet.

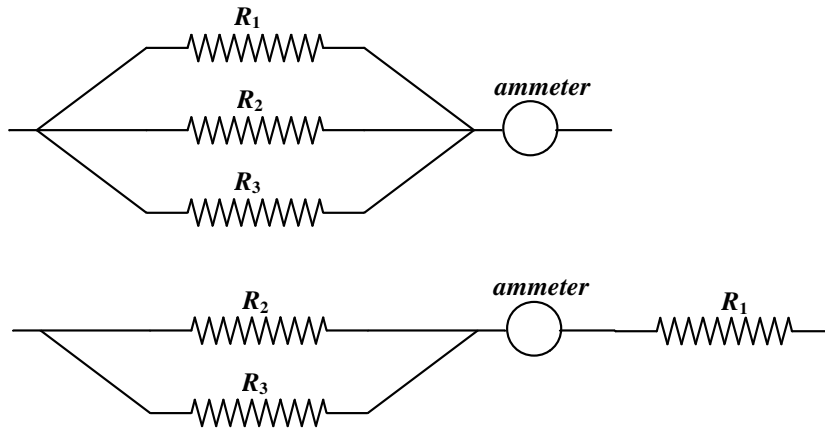
**25.** An 4.8 cm tall object is positioned 15 cm from a mirror. Determine the radius of curvature which the mirror must have in order to produce an upright image that is 7.2 cm tall? Express your answer in cm.

If the image described above is real image, add 5 to your answer.

If it is virtual image, subtract 5 from your answer.

Enter this number in the bubble sheet.

**26.** A part of an electric circuit is shown in the figure. The circuit is connected to an ideal voltage source. Given  $R_2 = 10$  ,  $R_3 = 10$ . The ideal ammeter shown in the figure indicates a current of 0.8 A. Total power dissipated in the circuit is X Watt. Now keeping  $R_2$  and  $R_3$  as they are, resistance  $R_1$  is removed and joined in series with the ammeter. Now the total power dissipated is found to be only 16% of X. If  $R_1$  is not less than  $5\Omega$ , determine value of  $R_1$  in  $\Omega$ .



### Mathematics

**27.** In trapezium  $\square ABCD$ ,  $\overline{AB} \parallel \overline{CD}$ . Diagonals  $\overline{AC}$  and  $\overline{BD}$  intersect at  $P$ . Area of  $\triangle PAB = 16$  and area of  $\triangle PCD = 25$ . Find the area of trapezium  $\square ABCD$ .

**28.** In  $\triangle ABC$ ,  $AB = 26$ ,  $BC = 28$  and  $CA = 30$ . A circle  $S$  with radius  $R$  is drawn such that its center  $D$  is on segment  $BC$  and it touches sides  $AB$  and  $AC$ . Find the value of  $R + BD$ .

**29.**  $\square ABCD$  is a convex quadrilateral. Rays  $AB, BC, CD, DA$  are respectively extended to  $E, F, G, H$  such that  $BE = \frac{AB}{2}$ ,  $CF = \frac{BC}{2}$ ,  $DG = \frac{CD}{2}$ ,  $AH = \frac{DA}{2}$ . Area of  $\square ABCD = 18$ . Find the area of  $\square EFGH$ .

**30.** A circle  $S$  whose center is  $M$  and radius  $R$  touches the sides of  $\angle KAL$  at  $D, E$ . Point  $P$  is on the minor arc  $DE$  of  $S$  such that  $m\angle DAP = 2m\angle EAP$ .

Tangent to  $S$  at  $P$  intersect rays  $AK, AL$  at  $B, C$  respectively.  $AM = 41$  and  $R = 9$ . Find the perimeter of  $\triangle ABC$ .

**31.** Consider acute angle  $\triangle ABC$  whose circum-radius is  $R$ .  
If  $\sec B + \tan B = 2$  and  $AC = 12$  then find the value of  $4R$ .

**32.** If  $x, y$  are positive real numbers such that  
 $x^4 + x^2y^2 + y^4 = 195$  and  $x^2 - xy + y^2 = 13$  then find the value of  $(x^3 + y^3)$ .

**33.** Find the sum of all the real solutions of the following equation.

$$\sqrt{x-2} + \sqrt{2x-5} + \sqrt{x+2} + 3\sqrt{2x-5} = 7\sqrt{2}.$$

Note that:  $\sqrt{K}$  represents the non negative square root of non negative real number  $K$ .

**34.** Let  $A = 15^\circ$  and  $K = \frac{2\sin^6 A + 2\cos^6 A + 1}{\sin^4 A + \cos^4 A}$ . Find the value of  $12K$ .

**35.** In  $\triangle ABC$ ,  $B = 90$ . Coordinates of  $A = (1, 2)$ ,  $B = (X_B, Y_B)$ ,  $C = (5, 4)$ .  
Equation of line  $AB$  is  $3x - y - 1 = 0$ . Find the value of  $(X_B^2 + Y_B^2)$ .

**36.** In  $\triangle ABC$  the equation of (i) median  $AD$  is  $4x + 3y = 36$  (ii) median  $BE$  is  $x - 3y = -16$  and (iii) altitude  $AK$  is  $x + 2y = 14$ . If  $D = (X_D, Y_D)$  then find the value of  $(5X_D + 2Y_D)$ .

**37.** In a certain group of students, each student likes at least two of the three subjects  $S_1, S_2, S_3$ . There are (i) 27 students who like both  $S_1$  and  $S_2$  (ii) 28 students who like both  $S_2$  and  $S_3$  and (iii) 29 students like both  $S_3$  and  $S_1$ . Whereas there are exactly 24 students who do not like exactly one of these subjects. Find the total number of students in this group.

**38.** If  $(x^2 + bx + 3)$  exactly divides polynomial  $p(x) = 3x^3 + ax^2 + 2x - 21$  then find the remainder when  $(x - 3)$  divides  $p(x)$ .

**39.** In an Arithmetic Progression, the sum of the first 2017 terms is 381213. The value of 1000th term is 18. Find the value of the common difference of the A.P.

**40.** There is a straight path between two points  $P$  and  $Q$ . A person travels from point  $P$  to point  $Q$  at a constant speed of 40km per hour. With what constant speed should he travel from  $Q$  to  $P$  so that his average speed during the round trip from  $P$  to  $Q$  to  $P$  will be 48km per hour?