

Paper Type: AD

**M. Prakash Institute Entrance Examination
for IIT JEE Training Batch 2019-21**

April 2019

1.00 pm to 5.00 pm

Total marks: 200

Student's Name:

Invoice Number:

Chemistry

Useful data:

Atomic numbers: H:1; Li:3; C:6; N:7; O:8; Na:11; Mg:12; Al:13; P:15; S:16; Cl:17; K:19; Ca:20; Mn:25; Fe:26; Co:27; Ni:28; Cu:29; Zn:30; Ga:31; Ag:47; Ba:56; Pt:78; Au:79; Hg:80.

Atomic masses: H:1; Li:7; C:12; N:14; O:16; Na:23; Mg:24; Al:27; P:31; S:32; Cl:35.5; K:39; Ca:40; Mn:54.9; Fe:56; Ni:58.7; Co:58.9; Cu: 63.5; Zn:65; Ga:70; Ag:108; Ba:137; Pt:195; Au:197; Hg:200.

Avogadro number : 6×10^{23} per mole.

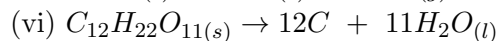
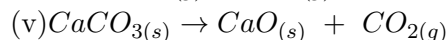
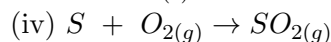
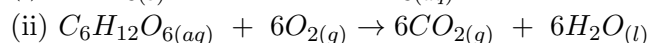
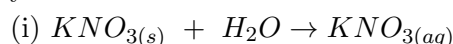
1. When oil gets converted to fat , reaction is carried out in presence of a metal catalyst, 'A' that belongs to the fourth period. Write the atomic number of 'A' in your bubble sheet.

2. An element of group 13 exists in liquid state at room temperature. Its boiling point is 2400°C . Identify the element and write its atomic number in your bubble sheet.

3. There are in all 28 'f' block elements. The Lanthanides belong to group 'X' and period 'Y' . The actinides belong to group 'X' and period 'Z' Write the value $X + Y + Z$ in your bubble sheet.

4. An element 'E' combines with oxygen and carbon in two separate reactions to produce E_2O_3 (Molecular mass: 102) and E_4C_3 (Molecular mass: 144) respectively. Identify 'E' and write the number of neutrons in one atom of 'E' in your bubble sheet.

5. Write the **number** of **endothermic** chemical reactions /processes from the following list in your bubble sheet.

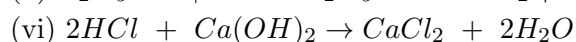
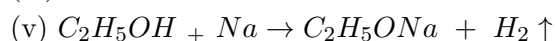
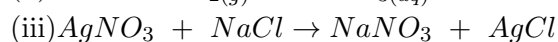
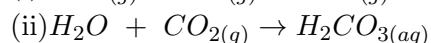
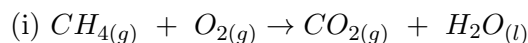


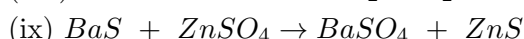
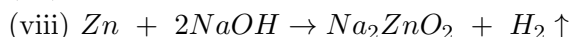
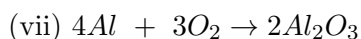
(vii) Addition of NaCl to water.

(viii) A piece of Sodium metal dropped in a trough of water.

6. An octa-atomic element 'M' reacts with Hydrogen and Oxygen in two separate reactions to form H_2M and MO_2 respectively. If the atomic masses of H_2M and MO_2 are 34 and 64 respectively, find the molar mass of the sodium salt of 'M'.

7. From the following, write the **number** of reactions that are **NOT** redox reactions in your bubble sheet.





8. From the following list of elements, identify the elements that produce Hydrogen gas on reaction with water. Write the sum of the atomic numbers of all such elements in your bubble sheet:

Na, Ag, Hg, Ba, Au, Pt

9. Two elements 'A' and 'B' belong to the second group of the Modern periodic table. The molecular mass of carbonate of 'A' and nitride of 'B' are same. Identify 'A' and 'B' and write the difference in the atomic mass numbers of 'A' and 'B'.

10. Write the molar mass of the acid produced when ethanol reacts with PCl_3 .

11. Write the **number** of elements from the following list that produce one of the following oxides of Nitrogen : NO , N_2O or NO_2 on reacting with HNO_3 :

Zn, Cu, Ag, Hg, Ca, Au, Pt

12. In electrolytic reduction of molten NaCl, 1 mole of Na is deposited at cathode by gaining 'x' mole of electrons. 1 mole of Chlorine gas is liberated at the anode by losing 'y' moles of electrons. Write the value of 'x' + 'y' in your bubble sheet (where x and y are whole numbers).

13. Carbonates and bicarbonates of Sodium produce CO_2 on treatment with Vinegar. If equal quantities (in mole) of both are taken, find the compound that contains greater percentage of CO_2 . Call it 'A'. If the molecular mass of 'A' is 'M', write the value of $\frac{M}{2}$ in your bubble sheet.

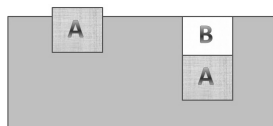
Physics

Important:

Take $g = 10 \text{ m/s}^2$, $k = 9 \times 10^9 \text{ N.(m/C)}^2$ and $G = 6.67 \times 10^{-11} \text{ m}^3/\text{kg.s}^2$

14. Several people are riding in a hot air balloon. The combined mass of people and the balloon is 425 kg. Air provides the force (called buoyant force) such that the balloon in this case is motionless in the air. If the buoyant force remains constant, how much mass should be removed from the balloon, so that it acquires an upward acceleration of 0.18 m/s^2 . Express your answer in kg. Multiply your answer by 2 and mark it in the bubble sheet.

15. A solid wooden cube A ($10\text{cm} \times 10\text{cm} \times 10\text{cm}$) is floating in water such that 20% of cube is above water. Now another block of material B having cross section area $10\text{cm} \times 10\text{cm}$ is placed on top of the wooden block A such that no part of block is outside water. If specific gravity of material B is 1.4. Calculate height of the new block. Express your answer in cm.



16. A thermally insulated container has 24 gm of ice at 0°C . 10 gm of steam at 100°C is introduced in the container. When equilibrium is reached, calculate amount of water in the container. Express your answer in grams.

Given data for water: L for fusion = $L_f = 80 \text{ cal/g}$.

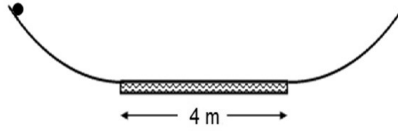
L for evaporation = $L_f = 540 \text{ cal/g}$

and Specific Heat Capacity = $1 \text{ cal/g } ^\circ\text{C}$

17. In a hundred meter race, Ram gave Sham a start of half a meter and still beat him by $1/5$ th of a second. If Sham had received a start of 4.5 meters, he would have beaten Ram by $1/5$ th of a second. What is Ram's race time for the 100 meter race. Multiple your answer in seconds with 4 and mark the value in the bubble sheet.

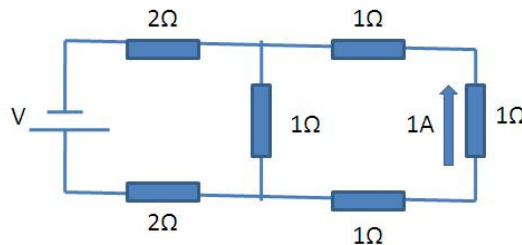
18. Study the figure shown below. Two smooth inclined planes are joined by a rough horizontal section. The rough section is 4 m long.

A ball is set in motion which moves from left to right and back. It is placed at a height of 124 cm from the base on the left side (as shown) and released from rest, reaching a maximum height of 108 cm on the right side, before sliding back down again.



When the ball first travels from a height of 108 cm on the right, how high will it rise on the left hand side? Express your answer in cm.

19. In a given circuit diagram, 1A current flows through resistance block of 1Ω as shown in the figure. Find the value of V in volts. Multiple your answer by 4 and mark it in the bubble sheet.

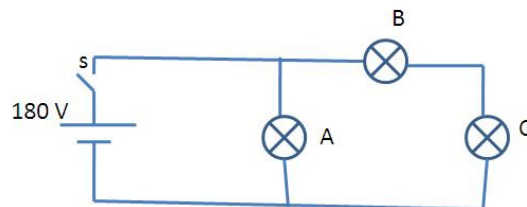


20. A grocer used a defective balance and gave 16 kg of wheat at 30 Rs per kg to a customer. Customer had a doubt and asked the grocer to put the wheat bag in the other pan and weights in the first pan. Now it weighed only 9 kg. The grocer apologized and charged for the average $12.5 (= \frac{16+9}{2})\text{kg}$.

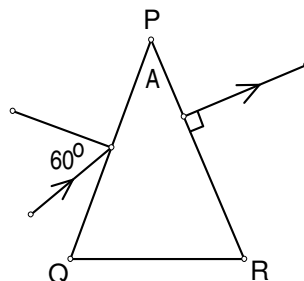
How much extra money customer had to pay than that of actual weight of wheat he got? Express your answer in rupees.

21. On a linear 50 meter scale, two particles A and B are at rest at 12m and 24m marks respectively. At a certain instant, both start moving simultaneously, towards each other. Particle A is given instantaneous velocity 2 m/s and no force acts on it. While particle B is pulled with such a force which imparts a constant acceleration of 0.5 m/s^2 to it. Find the position marker of B when they meet. Express your answer in meter.

22. Consider a circuit consisting of 3 light bulbs as shown. Bulb A (24W), Bulb B(60W) and Bulb C(40W) are all rated at 240V. When switch s is closed, find out the power dissipated in bulb C in Watts. Multiply your answer by 10 and mark it in the bubble sheet.



23. Consider a prism made of glass of refractive index n and angle $A = 30^\circ$ as shown in the figure. It is observed that a ray of light incident on the face PQ at angle $\theta = 60^\circ$ emerges from the face PR at 90° . Calculate the value of n . Square the number and multiply it by 4. mark this value in the bubble sheet.



24. In a hydrogen atom 1 electron revolves around proton. Let F_e and F_g by the electrostatic force (Coulomb force) and gravitational force respectively. Find ratio F_e/F_g . If it is expressed as $N.M \times 10^X$, where N is single digit integer, mark value of X in the bubble sheet.

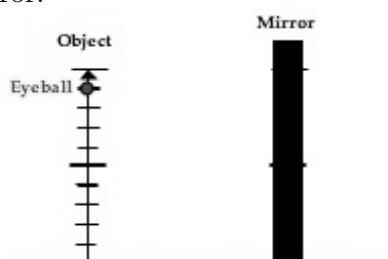
Mass of e = 9×10^{-31} kg

Mass of P = 1.6×10^{-27} kg

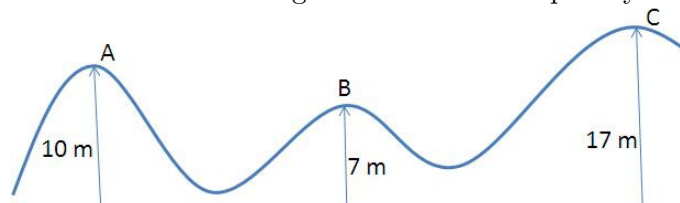
Charge on p and e = 1.6×10^{-19} C

Size of Hydrogen atom = $0.1nm$

25. A robot of height 1 m is standing in front of a mirror mounted on a wall. Its eyeball is placed at 10 cm from top. Calculate the minimum length of the mirror needed so that the robot can see his image completely. Mirror can be mounted at any height on the wall (it need not necessarily touch the ground level). You will also observe that the result is independent of the distance between robot and mirror.



26. Consider a frictionless curved path as shown. An object is given velocity v m/s at point A such that it just reaches the maximum height on the path. If same velocity is given to another object at point B, calculate maximum height it will reach. Express your answer in meters.



Mathematics

27. In square $ABCD$, M and N are on \overline{AB} and \overline{BC} respectively such that $m\angle MDN = 45^\circ$. \overline{AC} intersects \overline{MD} at R and \overline{ND} at Q . P is midpoint of MN . If $m\angle NRQ = 8^\circ$ then $m\angle PRN$ equals.

28. $\square ABCD$ is cyclic with $\overline{AC} \perp \overline{BD}$. If radius of circumcircle is 4 and $AC = 7$ and $BD = 6$ then $(AB^2 + BC^2 + CD^2 + DA^2)/2 =$.

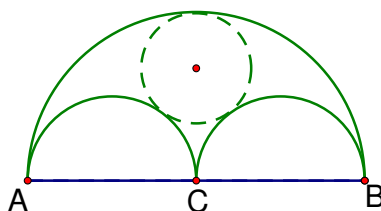
29. In $\triangle ABC$, D is a point on BC such that AD is the internal angle bisector of $\angle A$. Suppose $\angle B = 2\angle C$ and $AB = CD$. Then $m\angle BAC$ equals.

30. In $\triangle ABC$, $AB = AC$. Let I be incenter.

If $BC = AB + AI$ then find $\angle BAC$.

31. $\square ABCD$ is parallelogram. X and Y are mid points of \overline{BC} and \overline{CD} respectively. If area of $\square ABCD = 64$ then area of $\triangle AXY$ equals.

32. \overline{AB} is a line segment of length 48. C is mid point. On \overline{AB} , \overline{AC} , \overline{CB} semi circles are drawn on one side of \overline{AB} . Find radius of circle drawn tangent to these semicircles.



- 33.** A tailor cuts a piece of cloth into 10 pieces. Then he picks up any one and cuts it into 10 pieces. He continues to do this (picking a piece and cutting it into 10 peices) N number of times till he gets total number of pieces between 621 to 630. Then N equals.
- 34.** Let x, y be non zero integers. If $\frac{1}{x^2} + \frac{1}{y^2} = \frac{13}{36}$ and $\frac{1}{x^3} + \frac{1}{y^3} = \frac{19}{216}$ then $y^3 - x^3$ equals.
- 35.** Product of roots of $\sqrt{x+3} - \sqrt{x-\sqrt{x-2}} = 1$ is K . Find $3K$.
Note that: \sqrt{K} represents the non negative square root of non negative real number K .
- 36.** If x, y, z are positive real numbers.
 $x(y+z) = 98$, $y(z+x) = 54$, $z(x+y) = 110$. Then $x+y+z$ equals.
- 37.** $3x^2 - x + 1$ is a factor of $ax^4 + bx^3 + 12x^2 - 6x + 1$. Then $a - b$ equals
- 38.** $\triangle ABC$ is right angled at $\angle C$. Let the measure of $\angle ABC = 2\theta$. If $2 \sec 2\theta = \sqrt{13}$ find value of $(3 \tan \theta + 2)^2$.
- 39.** If A and B work together, they will complete a job in 7.5 days. However if A works alone and completes half the job and then B takes over and completes the remaining half alone, they will be able to complete the job in 20 days. How long will B alone take to do the job if A is more efficient than B ?
- 40.** Area of regular octagon inscribed in a circle is A . Area of regular hexagon inscribed in the same circle is B . Then $27(A/B)^2$ equals.