

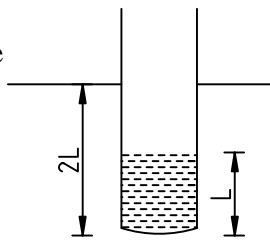
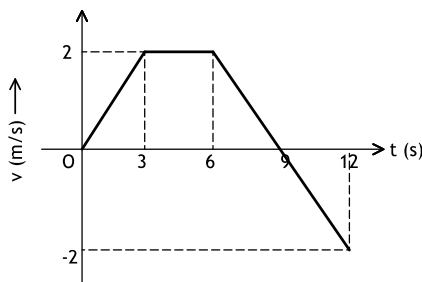
Each question has 4 choices (1), (2), (3) and (4), out of which ONE OR MORE THAN ONE CHOICE IS CORRECT. For each correct answer 4 marks are awarded. No negative marks.

*Use of calculators, slide rule, graph paper and logarithmic, trigonometric and statistical tables is not permitted.*

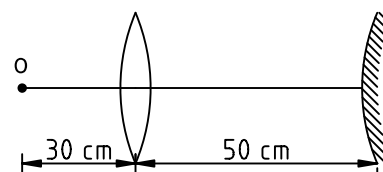
1. In a circle of radius 2018 having centre at O, OPQR is a rectangle with Q on the circumference of the circle. P, R points inside the circle such that PQ = 504. Then PR =  
 A) 2018                                      B) 504                                      C) 252                                      D)  $\sqrt{1008}$
2. The cost of a jug and a glass is Rs.110. If the cost of the jug is Rs. 100 more than that of the glass then the cost of the glass in rupees is  
 A) 10      B) 8                                      C) 9                                      D) 5
3. If  $y = ax^2 + bx + c$ ,  $a \neq 0$ , then  $y = a\left(x + \frac{b}{2a}\right)^2 + \frac{4ac - b^2}{4a}$   
 A) If a is positive then minimum value of y is  $\frac{4ac - b^2}{4a}$   
 B) If a is positive then maximum value of y is  $\frac{4ac - b^2}{4a}$   
 C) If a is negative then minimum value of y is  $\frac{4ac - b^2}{4a}$   
 D) If a is negative then maximum value of y is  $\frac{4ac - b^2}{4a}$
4. In a quadrilateral ABCD, p, q are the lengths of the perpendiculars drawn from the vertices B and D onto the diagonal AC. If AC = r, then the area of the quadrilateral ABCD is  
 A) pqr                                      B) pqr/2                                      C) (p + q)r                                      D) (p + q)r/2
5. Two circles having centers at A(x<sub>1</sub>, y<sub>1</sub>), B(x<sub>2</sub>, y<sub>2</sub>) having radii 5, 3 respectively are touching each other at a point P(x<sub>3</sub>, y<sub>3</sub>). Then  $\left| \sum (x_1 y_2 - x_2 y_1) \right| =$   
 A) 5                                      B) 0                                      C) 3                                      D) 15
6. A factor of  $\sum a^2 b + \sum ab^2 + 3abc$  is (a, b, c are real numbers)  
 A)  $\sum a^2$                                       B)  $\sum a$                                       C)  $\sum ab$                                       D)  $\sum ab^2$
7. D, E, F are the mid points of the sides BC, CA and AB of a triangle ABC.  
 A) DE // AB                                      B) EF = (1/2)BC  
 C) Area of triangle DEF = (1/3)(Area of triangle ABC)  
 D) Area of triangle DEF = (1/4)(Area of triangle ABC)
8. Statement 1: Given any two real numbers p, q there always exist two real numbers a and b such that  $a + b = p$  and  $ab = q$ .  
 Statement 2: There exist two real numbers a, b such that  $a + b = 3$  and  $ab = -400$ .  
 A) Statement 1 is true                                      B) Statement 1 is false  
 C) Statement 2 is true                                      D) Statement 2 is false
9.  $\sqrt{x-a} + \sqrt{x-5} = 0$  then a is a solution of  
 A)  $x^2 - 6x + 5 = 0$                                       B)  $x^2 - 7x + 10 = 0$                                       C)  $x^2 - x + 1 > 0$                                       D)  $x^2 + x + 1 > 0$
10. In a triangle ABC, D, E are points on the line segments AB and AC respectively. DE is parallel to BC. If  $(AB / AC) = 6/7$  and  $(AD / DB) = 3/2$  then  $AC / AE =$   
 A) 3/7                                      B) 3/2                                      C) 7/6                                      D) 5/3

11. The number of integral solutions of the equation  $\left[\frac{k}{1}\right] + \left[\frac{k}{2}\right] + \left[\frac{k}{3}\right] = 100$ , where  $[x]$  is the greatest integer less than or equal to  $x$ , is  
 A) 0                                      B) 55                                      C) 1                                      D) 4
12. If  $x > 2$  then the number of values of  $x$  satisfying  $\sqrt{|x-2|} = |\sqrt{x-2}|$  is  
 A) 0                                      B) less than 3000                                      C) 2018                                      D) not finite
13. In a triangle ABC, D is a point on the side BC such that AD is the internal angle bisector of the angle A. The lengths of the sides AB, BC, AC are 4, 6, 8 respectively. Then the area of triangle ACD is  
 A)  $2\sqrt{15}$                                       B)  $\sqrt{15}$                                       C)  $3\sqrt{15}$                                       D) 2
14. If  $a, b$  are two real numbers such that  $a + 2b^{1/3} = 5$ ,  $a^3 + 8b = 305$  then  
 A)  $ab^{1/3} = -6$                                       B)  $ab^{1/3} = 6$                                       C)  $a^3b = -216$                                       D)  $2ab^{1/3} = 3$
15. The solution set of  $(3x)^{\log 3} = (5x)^{\log 5}$  is  
 A)  $\{1, 3, 5, 15\}$                                       B)  $\{1, 15\}$                                       C)  $\{1/15\}$                                       D)  $\{3, 5\}$
16. In triangle ABC, right angled at A, AD is the altitude on to the side BC. If  $AD = 6$  and  $BD = 9$  then  $CD =$   
 A) 6                                      B) 9                                      C) 4                                      D)  $3/2$
17.  $P(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0 = 0$  is a polynomial equation.  $P(0)$  is a root of the equation  $P(x) = 0$ . Then  
 A)  $P(0) = 0$                                       B)  $P(a_0) = 0$                                       C)  $P(P(0)) = 0$                                       D)  $a_0$  is a root of  $P(x) = 0$
18. Statement 1: A function is possible from a set having 100 elements to a set having 2 elements.  
 Statement 2: A, B are two sets having 3 and 5 elements respectively. Number of functions from A to B such that the range of  $f$  is equal to B is 0.  
 A) Statement 1 is true                                      B) Statement 1 is false                                      C) Statement 2 is true                                      D) Statement 2 is false
19. In a triangle ABC, AD is the altitude onto the side BC. If angle B is acute then  $AC^2 =$   
 A)  $AB^2 + BC^2 + 2BC \cdot BD$                                       B)  $AB^2 + BC^2 - 2BC \cdot BD$                                       C)  $AB^2 + BC^2 + BC \cdot BD$                                       D)  $AB^2 + BC^2$
20.  $x^4 + a_3 x^3 + a_2 x^2 + a_1 x + a_0 = (x-1)(x-2)(x-3)(x-4)$  then  
 A)  $a_3 = -10$                                       B)  $a_2 = 35$                                       C)  $a_1 = -50$                                       D)  $a_0 = 24$
21. If  $\sum_{r=2}^{100} \frac{1}{1+2+3+\dots+r} = \frac{x}{y}$ , where  $x, y$  are positive integers, GCD of  $x, y$  is 1, then  $x + y =$   
 A) 200                                      B) 99                                      C) 101                                      D) 111
22. ABCD is a cyclic quadrilateral inscribed in a circle of radius 5. E is a point on the arc ADC. If angle AEC is  $20^\circ$  then  
 A) angle ABC is  $160^\circ$                                       B) angle ADC is  $20^\circ$                                       C) angle ABC is  $100^\circ$                                       D) angle ADC =  $100^\circ$
23. Given  $\sin(A+B) = \sin A \cos B + \cos A \sin B$ ,  $\sin 75^\circ =$   
 A)  $2/\sqrt{3}$                                       B)  $\frac{\sqrt{3}+1}{2\sqrt{2}}$                                       C)  $\frac{\sqrt{3}+1}{\sqrt{2}}$                                       D)  $\frac{\sqrt{3}-1}{\sqrt{2}}$
24. Three of the vertices of a parallelogram are  $(2, -7)$ ,  $(2, 0)$  and  $(1, 8)$  if the fourth vertex is  
 A)  $(1, 1)$                                       B)  $(1, 15)$                                       C)  $(3, -15)$                                       D)  $(7, -8)$
25. In a rhombus lengths of the diagonals are 12 and 24. A circle C is inscribed in it. Then  
 A) radius of C is  $12/\sqrt{5}$                                       B) radius of C is  $24/\sqrt{5}$   
 C) area of the square inscribed in C is  $12\sqrt{2/5}$                                       D) Area of square inscribed in C is  $6\sqrt{2/5}$

26.  $ax^2 + bx + c = 0$  is a quadratic equation,  $a, b, c$  are rational numbers.  $\Delta = b^2 - 4ac$ .  
 A) Roots of the equation are always real      B) If  $\Delta = k^2$ ,  $k$  is rational, then roots are rational  
 C) If  $\Delta \neq k^2$ ,  $k$  rational, then the roots are rational conjugates  
 D) Roots of the equation are always rational
27. Statement 1: If set  $A$  has  $m$  elements and set  $B$  has  $n$  elements then  $A \times B$  has  $mn$  elements.  
 Statement 2: If  $A$  has 5 elements and  $B$  has 6 elements then the number of one-one functions from  $A$  to  $B$  is 6.  
 A) Statement 1 is true      B) Statement 1 is false      C) Statement 2 is true      D) Statement 2 is false
28. Statement 1: If a chord is drawn through the point of contact of a tangent to a circle, then the angles which this chord makes with the given tangent are equal respectively to the angles formed in the corresponding alternate segments.  
 Statement 2: If a line is drawn through an end point of a chord of a circle so that the angle formed with the chord is equal to the angle subtended by the chord in the alternate segment, then the line is a tangent to the circle.  
 A) Statement 1 is true      B) Statement 1 is false      C) Statement 2 is true      D) Statement 2 is false
29.  $P(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0 = 0$  is a polynomial equation,  $a_0, a_1, \dots, a_n$  are integers. If  $\alpha$  is an integer and  $P(\alpha) = 0$  then  
 A)  $\alpha$  divides  $a_0$       B)  $a_0 = k\alpha$ ,  $k$  is an integer  
 C)  $a_0$  divides  $\alpha$       D)  $\alpha$  divides  $a_n$
30. Number of values of  $x$  such that  $|x| + \sqrt{x} + [x] = x$ , where  $[x]$  denotes the greatest integer less than or equal to  $x$ , is  
 A) 1      B) 0      C) more than 3      D) not finite
31.  $C_1$  and  $C_2$  are two circles such that  $C_1$  lies inside  $C_2$ .  $AB$  is a chord of circle  $C_2$  touching  $C_1$  at  $P$ .  
 A)  $AP = PB$       B)  $AP = (1/2)(AB)$   
 C)  $AP = PB$  if  $C_1$  and  $C_2$  are concentric      D)  $AP = PB$  if  $C_1$  and  $C_2$  touch internally
32. Statement 1: Number of factors of 2018 is 2  
 Statement 2: Sum of the squares of the factors of 2018 is 1018085  
 A) Statement 1 is true      B) Statement 1 is false      C) Statement 2 is true      D) Statement 2 is false
33.  $\alpha, \beta, \gamma, \delta$  are roots of the polynomial equation  $P(x) = a_4 x^4 + a_3 x^3 + a_2 x^2 + a_1 x + a_0 = 0$ . Then  
 A)  $\sum \alpha = a_3$       B)  $\sum \alpha = a_3/a_4$       C)  $\sum \alpha\beta = a_2/a_4$       D)  $\alpha\beta\gamma\delta = a_0/a_4$
34.  $ABCD$  is a rectangle region.  $P$  is a point on the segment  $BC$ .  $PQRC$  is also a rectangle region such that  $A, Q$  lie on the opposite sides of the line  $BC$ .  $AD = 15$ ,  $DR = 18$ . The perimeter of the region  $ABPQRDA$  is  
 A) 66      B) 33      C) 270      D) cannot be determined
35. If  $x, y$  are real numbers such that  $x^2 + y + 8 = 6x^{2/3}y^{1/3}$ ,  $x^{2/3} + y^{1/3} > -2$  then  
 A)  $x^{2/3} = 2$       B)  $y = 8$       C)  $y = 2\sqrt{2}$       D)  $x = 2\sqrt{2}$
36.  $C_1, C_2, C_3, \dots$  are in A.P.  $C_1 = 8, C_2 = 10, C_3 = 12$ . If  $b_1 = 6$  and  $b_n$  be determined by  $b_n = b_{n-1} + C_n$  then  
 A)  $b_4 = 42$       B)  $b_7 = 96$       C)  $b_5 = 58$       D)  $b_6 = 76$
37.  $ABCD$  is a rectangle having area 8051. Its side lengths are integers. Then minimum perimeter possible for such rectangle is  
 A) 8051      B) 16104      C) 180      D) 360
38. For the function  $f(x) = \sqrt{x^2 - 3x + 2} + \sqrt{3x - x^2} - 2$   
 A) domain is  $[1, 2]$       B) domain is  $\{1, 2\}$       C) range is  $\{0\}$       D) Range is  $[0, \infty)$
39. If  $A = (\cos x + \sin x)^2 + (\cos x - \sin x)^2$ ,  $B = 2(\cos^6 x + \sin^6 x) - 3(\cos^4 x + \sin^4 x) + 1$  then  
 A)  $A = B$       B)  $A^2 + B = 4$       C)  $A^2 - B^2 = 4$       D)  $(1 + 2A - 5A^2 + 6A^3)(B^2 - 3B) = 0$

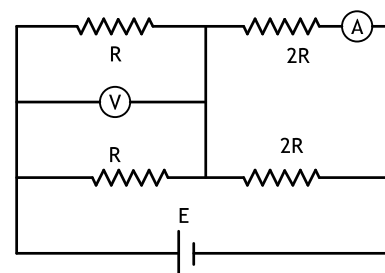
40. Statement 1: If a trapezium is a cyclic quadrilateral, its non parallel sides are equal  
Statement 2: If a quadrilateral is cyclic then it is a trapezium  
A) Statement 1 is true      B) Statement 1 is false      C) Statement 2 is true      D) Statement 2 is false
41. 125 identical spherical drops merge to form one large spherical drop. Ratio of the surface area of the large drop to any one of the individual drops is  
A) 50                      B) 25                      C) 16                      D) 8
42. A solid cube of side 6 cm and density  $2 \text{ g cm}^{-3}$  is floating in a liquid of density  $3 \text{ g cm}^{-3}$ . Volume of the cube seen above the liquid surface is  
A)  $18 \text{ cm}^3$               B)  $36 \text{ cm}^3$               C)  $72 \text{ cm}^3$               D)  $144 \text{ cm}^3$
43. A tube of negligible mass and uniform cross section filled with a liquid of mass 20 g is floating in water as shown. When a lead shot is dropped in to the tube, the length of the submerged portion increases by  $L$ . The buoyant force on the tube after the lead shot is dropped is (Assume acceleration due to gravity =  $10 \text{ ms}^{-2}$ )  
A) 0.1 N                      B) 0.2 N  
C) 0.3 N                      D) 0.4 N
- 
44. A particle moving along a straight line covers 60% of the distance at  $v$ . If the speed averaged for the entire distance is  $5v/4$ , then the speed with which the particle travelled for the remaining distance is  
A)  $v$                       B)  $2v$                       C)  $3v$                       D)  $5v$
45. Figure shows velocity time graph for a particle in motion. Displacement made by the particle in 12 s is  
A) 9 m                      B) 15 m  
C) 12 m                      D) 18 m
- 
46. In the previous question the distance travelled by the particle in 12 s is  
A) 15 m                      B) 12 m                      C) 9 m                      D) 18 m
47. A block A of mass  $m$  moving with a constant velocity  $v$  along a smooth horizontal floor collides with another block B of mass  $2m$  and rebounds with a velocity  $2v/5$ , the velocity of block B after collision is  
A)  $v/3$                       B)  $v/5$                       C)  $2v/5$                       D)  $3v/5$
48. A block of mass  $M$  is displaced through 's' from rest by applying a constant force 'F'. If work done by the force equals increase in kinetic energy of the block, its velocity is  
A)  $2FS/M$                       B)  $\sqrt{2FS/M}$                       C)  $\sqrt{FS/M}$                       D)  $\sqrt{FS/2M}$
49. 'n' samples of same liquid with masses  $m, 2m, 3m, \dots, nm$  at temperatures  $t, 2t, 3t, \dots, nt$  are mixed in an isolated system. The resultant temperature of the mixture is  
A)  $nt$                       B)  $n(n+1)t/2$                       C)  $n(n+1)(2n+1)t/6$                       D)  $(2n+1)t/3$
50. 20 g of ice is dropped in to a calorimeter of water equivalent 10 g containing 90 g of water at  $40^\circ\text{C}$ . The resultant temperature of the mixture is (specific heat of water =  $1 \text{ cal g}^{-1} \text{ }^\circ\text{C}^{-1}$ , Latent heat of ice =  $80 \text{ cal g}^{-1}$ )  
A)  $0^\circ\text{C}$                       B)  $20^\circ\text{C}$                       C)  $10^\circ\text{C}$                       D)  $30^\circ\text{C}$

51. A convex lens of focal length 20 cm and a convex mirror are arranged as shown. A point object is located on the principal axis at a distance of 30 cm to the left of the lens. If the final image coincides with the object, focal length of the mirror must be



- A) 5 cm                      B) 10 cm                      C) 15 cm                      D) 30 cm
52. In the previous question if the convex mirror is removed, the distance of the image from the object would be  
A) 30 cm                      B) 60 cm                      C) 90 cm                      D) 120 cm
53. The image produced by a convex mirror of an extended object is  
A) diminished, virtual B) real, magnified                      C) magnified, virtual                      D) real, diminished
54. A biconvex lens of focal length 20 cm has curved surfaces whose radii are in the ratio 1:2. Refractive index of the material of the lens is 1.5. Smaller of the radii of curvatures is  
A) 30 cm                      B) 15 cm                      C) 10 cm                      D) 20 cm
55. A long horizontal straight conductor carries a current from north to south. Points A and B are to east and west of the conductor and points C, D are vertically above and below the conductor. Direction of magnetic field at  
A) A is downward                      B) B is upward                      C) C is westward                      D) D is westward

56. Readings of ammeter in the circuit shown is  
(Consider ammeter, voltmeter and battery as ideal)



- A)  $E/2R$                       B)  $E/3R$   
C)  $E/R$                       D)  $E/4R$
57. In the previous question the reading of the voltmeter is  
A)  $E$                       B)  $E/2$                       C)  $E/3$                       D)  $E/4$
58. Two resistances of  $6\ \Omega$  and  $3\ \Omega$  are connected in parallel. The ratio of the rate of heat production in the  $6\ \Omega$  and  $3\ \Omega$  resistances is  
A) 2:1                      B) 1:2                      C) 3:1                      D) 1:3
59. In the previous question if the combined current in the two resistors is 3 A, the rate of heat production in the combination is  
A) 18 W                      B) 12 W                      C) 36 W                      D) 24 W
60. An electric bulb rated 60 W at 220 V. If the bulb is used on 110 V supply, its power would be  
A) 60 W                      B) 30 W                      C) 15 W                      D) 240 W
61. A long straight vertical conductor is carrying some current. Magnetic field lines in the neighbourhood of the conductor are  
A) straight lines parallel to the conductor                      B) straight lines perpendicular to the conductor  
C) concentric circles in horizontal plane                      D) concentric circles in vertical plane
62. A charged ion of mass 'm' and charge 'q' is moving in circular path of radius r in a plane at right angles to a magnetic field of strength 'B'. Frequency of revolution of the particle is  
A)  $qB/2\pi m$                       B)  $2\pi m/qB$                       C)  $2qB/\pi m$                       D)  $\pi m/2qB$
63. Nucleus A decays in to nucleus C in a two-step process.  $A \rightarrow B + {}^4_2\text{He}$  and  $B \rightarrow C + 2e^-$ . Then  
A) A and C are isotopes                      B) A and C are isobars  
C) A and B are isotopes                      D) A and B are isobars

64. In a nuclear reactor 94 g of uranium ( $U^{235}$ ) undergoes fission every 160 minutes. Number of reactions occurring every minute is (Avogadro number is  $6 \times 10^{23}$  per mole)  
 A)  $1.5 \times 10^{21}$       B)  $1.5 \times 10^{22}$       C)  $1.5 \times 10^{20}$       D)  $1.5 \times 10^{19}$
65. In the previous question, if the energy released from the fission of one  $U^{235}$  nucleus is 200 MeV, assuming 100% efficiency the power output of the reactor is  
 A) 200 MW      B) 300 MW      C) 400 MW      D) 800 MW
66. The electronic configuration with the highest ionization enthalpy is  
 A)  $[Ne]3s^23p^1$       B)  $[Ne]3s^23p^2$       C)  $[Ne]3s^23p^3$       D)  $[Ne]3d^{10}4s^23p^3$
67. For the following reactions ZnO respectively acting as a/an  
 i)  $ZnO + Na_2O \rightarrow Na_2ZnO_2$       ii)  $ZnO + CO_2 \rightarrow ZnCO_3$   
 A) acid and acid      B) acid and base      C) base and acid      D) base and base
68. The following reaction occurs in the Blast Furnace where iron ore is reduced to iron metal  
 $Fe_2O_3(s) + 3CO(g) \rightleftharpoons 2Fe(l) + 3CO_2(g)$   
 Using the LeChatelier's principle, predict which of the following will disturb the equilibrium?  
 A) removal of CO      B) removal of  $CO_2$       C) addition of  $CO_2$       D) addition of  $Fe_2O_3$
69. The group(s) in which all are not having triangular planar structures is/are  
 A)  $BF_3$ ,  $NF_3$ ,  $CO_3^{2-}$       B)  $CO_3^{2-}$ ,  $NO_3^-$ ,  $SO_3$       C)  $NH_3$ ,  $SO_3$ ,  $CO$       D)  $NCl_3$ ,  $BCl_3$ ,  $SO_3$
70. Assuming ideal behavior the ratio of density of ammonia to that of hydrogen chloride at same temperature and pressure is (Cl=35.5 amu)  
 A) 0.64      B) 1.64      C) 1.46      D) 0.46
71. When  $XO_2$  is fused with an alkali metal hydroxide in the presence of an oxidizing agent such as  $KNO_3$ , a dark green product is formed which disproportionates in acid solution to afford a dark purple solution. X is  
 A) Ti      B) Cr      C) V      D) Mn
72. A group 13 element X reacts with chlorine gas to produce compound  $XCl_3$ .  $XCl_3$  is electron deficient and easily reacts with  $NH_3$  to form  $Cl_3X \leftarrow NH_3$  adduct: However,  $XCl_3$  does not undergo dimerization. X is  
 A) Ga      B) Al      C) In      D) B
73. In which of the following conversions involves change in both shape and hybridization?  
 A)  $BF_3 \rightarrow BF_4^-$       B)  $H_2O \rightarrow H_3O^+$       C)  $CH_4 \rightarrow C_2H_6$       D)  $NH_3 \rightarrow NH_4^+$
74. 1g of a carbonate ( $M_2CO_3$ ) on treatment with excess HCl produces 0.01186 moles of  $CO_2$ . The molar mass of  $M_2CO_3$  in  $g\ mol^{-1}$  is  
 A) 118.6      B) 11.86      C) 1186      D) 84.3
75. Which of the following salts is/are the basic in aq. solution  
 A)  $FeCl_3$       B)  $Pb(NO_3)_2$       C)  $Na_2CO_3$       D)  $CH_3COOK$
76. Metal M is treated with NaOH, a white gelatinous precipitate X is formed. X is soluble in excess of NaOH solution. X when heated strongly gives an oxide, which is also one of the products of aluminothermite process. The metal M is  
 A) Fe      B) Al      C) Zn      D) Ca
77. The compound(s) that produces nitrogen gas by thermal decomposition is/are  
 A)  $NH_4NO_2$       B)  $(NH_4)_2SO_4$       C)  $(NH_4)_2Cr_2O_7$       D)  $NH_4NO_3$
78. Which of the following compounds contain(s) no covalent bond(s)  
 $KCl$ ,  $PH_3$ ,  $O_2$ ,  $B_2H_6$ ,  $H_2SO_4$   
 A) KCl      B) KCl;  $B_2H_6$       C) KCl;  $B_2H_6$ ;  $PH_3$       D) KCl;  $H_2SO_4$

