



MasterJEE

IIT-JEE | Medical | Foundations

Master JEE CLASSES Kukatpally, Hyderabad.

IIT-JEE-2012-P1-Model

Max. Marks: 210

2012_PAPER-I

IMPORTANT INSTRUCTIONS:

- 1) This booklet is your Question Paper.
- 2) Use the Optical Response Sheet (ORS) provided separately for answering the questions
- 3) Blank spaces are provided within this booklet for rough work.
- 4) Write your name, roll number and sign in the space provided on the back cover of this booklet.
- 5) You are allowed to take away the Question Paper at the end of the examination.

OPTICAL RESPONSE SHEET:

- 6) Darken the appropriate bubbles on the ORS by applying sufficient pressure. This will leave an impression at the corresponding place on the Candidate's sheet.
- 7) The ORS will be collected by the invigilator at the end of the examination.
- 8) Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work.**
- 9) Write your name, roll number and code of the examination center, and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else** on the ORS. Darken the appropriate bubble under each digit of your roll number.

DARKENING THE BUBBLES ON THE ORS

- 10) Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
- 11) Darken the bubble **COMPLETELY**.
- 12) The correct way of darkening a bubble is as:
- 13) The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
- 14) Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.

IIT-JEE-2012-P1-Model**IMPORTANT INSTRUCTIONS****Max Marks: 210****PHYSICS:**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 10)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 11 – 15)	Questions with Multiple Correct Choice	4	0	5	20
Sec – III(Q.N : 16 – 20)	Questions with Integer Answer Type	4	0	5	20
Total				20	70

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 – 30)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 31 – 35)	Questions with Multiple Correct Choice	4	0	5	20
Sec – III(Q.N : 36 – 40)	Questions with Integer Answer Type	4	0	5	20
Total				20	70

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 41 – 50)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 51 – 55)	Questions with Multiple Correct Choice	4	0	5	20
Sec – III(Q.N : 56 – 60)	Questions with Integer Answer Type	4	0	5	20
Total				20	70

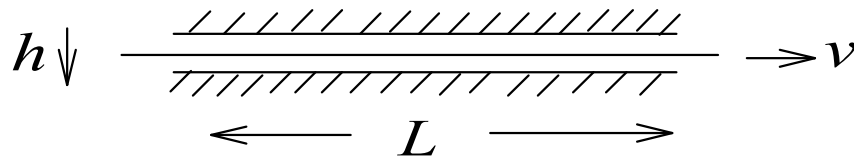
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Page 2

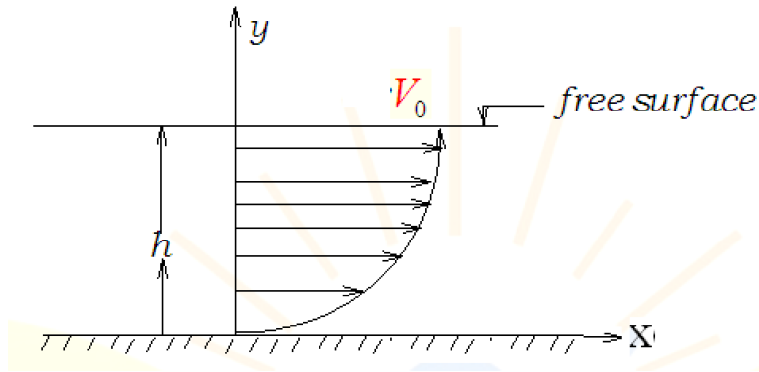
SECTION I
Single Correct Answer Type

This section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. During a painting process, a thin, flat tape of width b [dimension perpendicular to the plane of the figure] is pulled through a paint filled channel of length L . The density and viscosity of the paint liquid is ρ and η respectively. The tape is pulled at constant speed v and width of the channel is h . Find the minimum force needed to pull the tape.



- A) $\frac{2\eta bLv}{h}$ B) $\frac{4\eta bLv}{h}$ C) $\frac{8\eta bLv}{h}$ D) None of these
2. A liquid is flowing through a horizontal channel. The speed of the flow (V) depends on height (y) from the floor as $V = V_0 \left[2\left(\frac{y}{h}\right) - \left(\frac{y}{h}\right)^2 \right]$ where V_0 is the speed of the top layer. Co efficient of viscosity is η . Find the shear stress that liquid exerts on the floor.

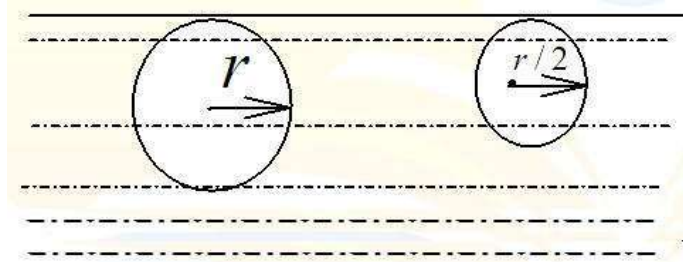


- A) Zero B) $\frac{3\eta V_0}{2h}$ C) $\frac{2\eta V_0}{h}$ D) None of these

3. A car having cross-sectional area of its front equal to A is travelling on a highway at a speed V . The viscous drag force acting on the car is known to be given by $F_v = CA\rho V^2$, where ρ is density of air and C is a constant which depends on the shape of the car. The petrol used by the car produces E joules of energy per kg of its burnt. Calculate the mileage (in km/kg) of the car if the combined efficiency of its engine and transmission is f .

- A) $\frac{fE}{CA\rho V}$ B) $\frac{fE}{CA\rho V^2}$ C) $\frac{CV^2}{A\rho f}$ D) $\frac{C\rho}{AV^2E}$

4. Two balls of radii r and $\frac{r}{2}$ are released inside a deep water tank. Their initial accelerations are found to be $\frac{g}{2}$ and $\frac{g}{4}$ respectively. Find the velocity of smaller ball relative to the larger ball, a long time after the two balls are released. Coefficient of viscosity is η and density of water is ρ .



- A) $\frac{11}{54} \frac{r^2 \rho g}{\eta}$ downwards B) $\frac{11}{54} \frac{r^2 \rho g}{\eta}$ upwards
 C) $\frac{5}{27} \frac{r^2 \rho g}{\eta}$ downwards D) $\frac{5}{27} \frac{r^2 \rho g}{\eta}$ upwards
5. A ball of mass 'm' and density ρ is being released inside a fluid of density $\frac{\rho}{2}$ and coefficient of viscosity η . Find the net force on the ball when speed achieved by ball is 60% of the terminal speed.
- A) $0.6 mg$ B) mg C) $0.4 mg$ D) $0.2 mg$

6. A marble of mass x and diameter $2r$ is gently released in a tall cylinder containing honey. If the marble displaces mass $y (< x)$ of the liquid, the terminal velocity is proportional to

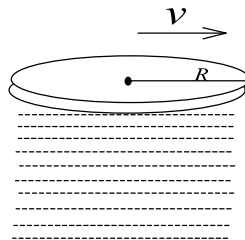
- A) $x+y$ B) $x-y$ C) $\frac{x+y}{r}$ D) $\frac{x-y}{r}$

7. The rising smoke of a cigarette in the still air of a room illustrates which type of flow?

- A) Stream line near cigarette
B) Vortices indicating onset of a turbulence at 0.3m or above the cigarette
C) Both a and b
D) only turbulent flow

PARAGRAPH (8, 9 & 10):-

Consider a disk of mass M , radius R lying on a liquid layer of thickness T and coefficient of viscosity η as shown in figure.



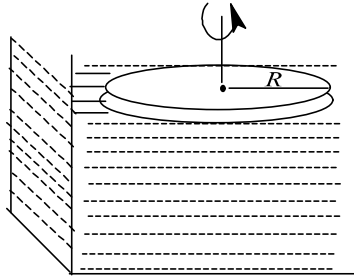
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8. The coefficient of viscosity varies as $\eta = \eta_0 x$ (x is measured along velocity line from centre of the disk). At the given instant the disk is floating towards right with a velocity v as shown. Find the force required to move the disk slowly at the given instant.

- A) $\frac{4\eta_0 R^3 v}{3T}$ B) $\frac{2\eta_0 R^3 v}{3T}$ C) $\frac{2}{3} \frac{\pi \eta_0 R^3 v}{T}$ D) $\frac{16\eta_0 R^3 v}{T}$

9. Find the torque required to rotate the disk at a constant angular velocity ω , given the viscosity is uniformly η .



- A) $\frac{4\pi\omega\eta R^4}{T}$ B) $\frac{\pi\omega\eta R^4}{2T}$ C) $\frac{2\pi\omega\eta R^4}{T}$ D) $16\pi\omega\eta R^4$

10. A disk rotating with angular velocity ω_0 is placed on the viscous liquid. Find the angle rotated by the disc before it comes to rest. (Viscosity= η , mass of disc= M , radius of disc = R)

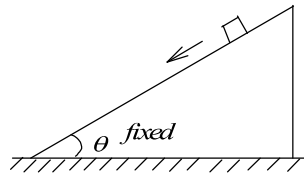
- A) $\frac{4\omega_0 TM}{\eta\pi R^2}$ B) $\frac{2\omega_0 TM}{\eta\pi R^2}$ C) $\frac{\omega_0 TM}{\eta\pi R^2}$ D) $\frac{\omega_0 TM}{2\eta\pi R^2}$

SECTION II

Multiple Correct Answer(s) Type

This section contains **5 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct**.

11. An oil drop falls through air with a terminal velocity of $5 \times 10^{-4} \text{ m/s}$. Viscosity of air is $1.8 \times 10^{-5} \text{ N s/m}^2$ and density of oil is 900 kg/m^3 . Neglect density of air as compared to that of oil.
- A) The radius of drop is $4.18 \times 10^{-6} \text{ m}$
B) The radius of drop is $2.14 \times 10^{-6} \text{ m}$
C) Terminal velocity of a drop of half of this radius is $1.25 \times 10^{-4} \text{ m}$
D) Terminal velocity of a drop of half of this radius is $2.5 \times 10^{-4} \text{ m}$
12. A cubical block of side a and density ρ slides over a fixed inclined plane with constant velocity v . There is thin film of viscous fluid of thickness t between the plane and the block. Then, the coefficient of viscosity of the thin film cannot be



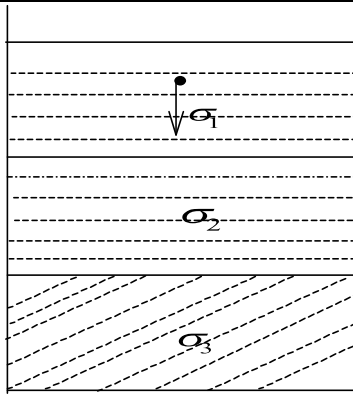
A) $\frac{\rho a g t \sin \theta}{v}$

B) $\frac{\rho a g t}{v \sin \theta}$

C) $\frac{\rho a g t \sin \theta}{\sqrt{2} v}$

D) $\frac{\rho a g t}{\sqrt{2} v \sin \theta}$

13. A tube of length l and radius R carries a steady flow of fluid whose density is ρ and viscosity η . The velocity v of flow is given by $v = v_0(1 - r^2/R^2)$, Where r is the distance of flowing fluid from the axis.
- A) The volume of fluid, flowing across the section of the tube, in unit time $2\pi v_0(R^2/4)$
- B) The Kinetic energy of the fluid within the volume of the tube is $K.E = \pi\rho l v_0^2(R^2/6)$
- C) The frictional force exerted on the tube by the fluid is $F = 4\pi\eta l v_0$
- D) The pressure difference at the ends of tube is $p = \frac{4\eta l v_0}{R^2}$
14. viscous force is somewhat like friction as it opposes the relative motion and is non-conservative but not exactly so, because;
- A) It is velocity dependent while friction not
- B) It is velocity independent while friction is not
- C) It is dependent on area of contact while friction is not
- D) It is independent of area like surface tension while friction depends.
15. A ball moves successively through three liquids, at rest as shown, of densities σ_1, σ_2 and σ_3 and viscosity coefficient η_1, η_2, η_3 and respectively with the same terminal velocity. Then



A) $\eta_3 > \eta_2 < \eta_1$

B) $\frac{\sigma_1}{\eta_1} = \frac{\sigma_2}{\eta_2} = \frac{\sigma_3}{\eta_3}$

C) $\frac{\eta_1}{\eta_3} > \frac{\eta_3}{\eta_2}$

D) $\frac{\eta_2\sigma_1 - \eta_1\sigma_2}{\eta_3\sigma_1 - \eta_1\sigma_3} = \frac{\eta_2 - \eta_1}{\eta_3 - \eta_1}$

SECTION- III
Integer Answer Type

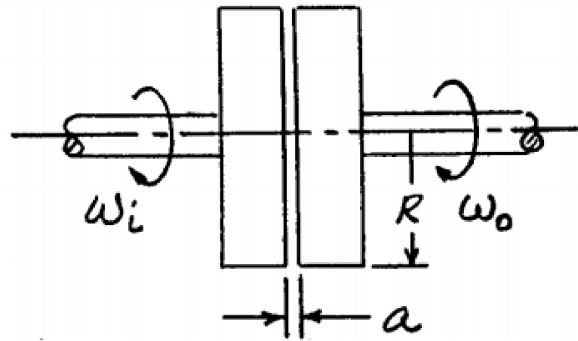
This section contains **5 questions**. The answer to each question is single digit integer, ranging from 0 to 9 (both inclusive).

16. A spherical ball of radius r and density d is dropped from rest in a viscous, fluid having density ρ and coefficient of viscosity is η . Then the power of gravitational

force acting on the ball at a time t after it is dropped is $\frac{x\pi}{27} \frac{d(d-\rho)}{\eta} g^2 r^5 \left[1 - e^{-\frac{9\eta t}{2dr^2}} \right]$.

Find x .

17. A plate of area $2m^2$ is made to move horizontally with a speed of $2ms^{-1}$ by applying a horizontal tangential force over the free surface of a liquid .The depth of the liquid is 1 m and the liquid in contact with the bed is stationary. Coefficient of viscosity of liquid =0.01poise.The tangential force needed to move the plate is $\alpha \times 10^{-3}$ N find the value of α
18. A viscous clutch as shown in figure transmits torque. Radius of each clutch plate is R and separation between the plates is a and is completely filled with liquid of coefficient of viscosity μ , If ω_i and ω_o are angular velocities of plates connected to input and output respectively. The torque transmitted is $\frac{\pi \mu (\omega_i - \omega_o) R^4}{xa}$ find x?

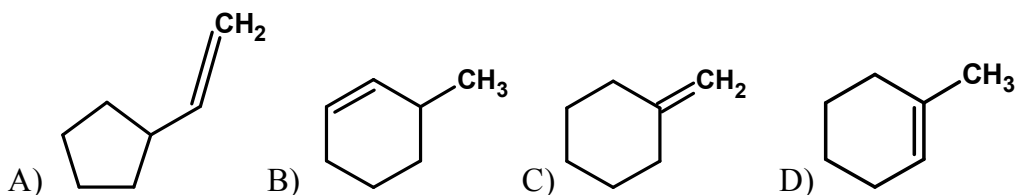
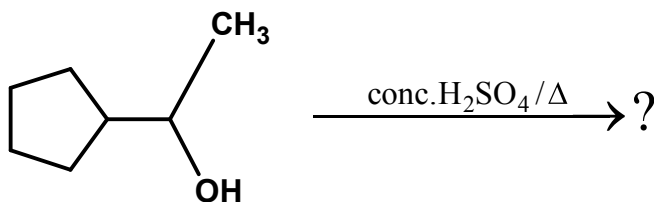


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19. Eight equal drops of water each of radius $r=2\text{mm}$ are falling through air with the terminal velocity of 16cm/s . The eight drops combine to form a big drop. The terminal velocity of the big drop is $16 \times N \text{ cm/s}$, find N .
20. A small spherical ball falling under gravity in a viscous medium heat the medium due to viscous drage force. The rate of heating is proportional to r^n . (r =radius of the sphere). Find n .

SECTION I
Single Correct Answer Type

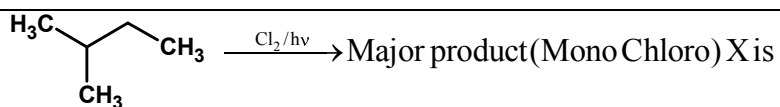
This section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

21. The major product of the following reaction is

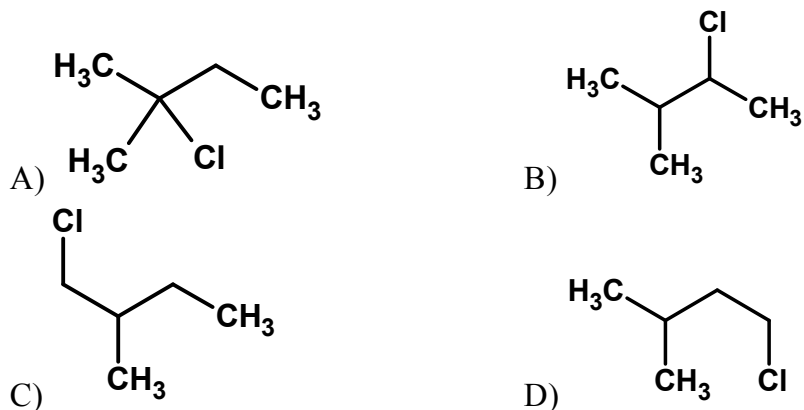


22. Amongst the isomeric pentanes the decreasing order of boiling points is

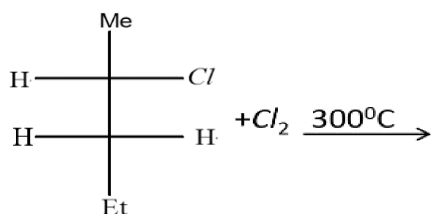
- A) Neopentane > n-pentane > isopentane
B) isopentane > neopentane > n-pentane
C) n-pentane > isopentane > neopentane
D) n-pentane > neopentane > isopentane



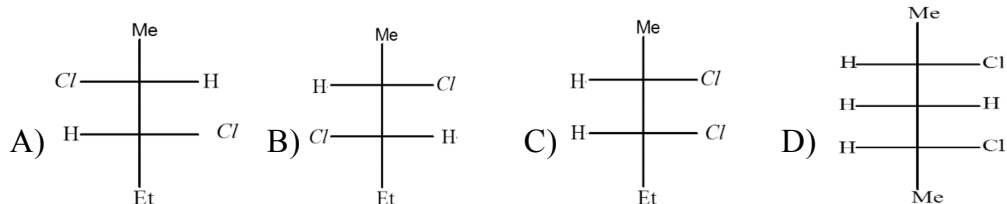
23.



24.

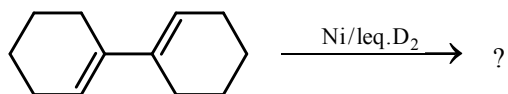


Which of the following compounds will not be obtained in the above reaction?

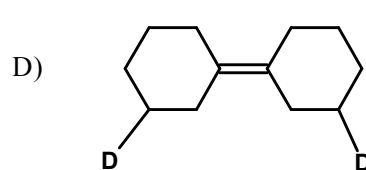
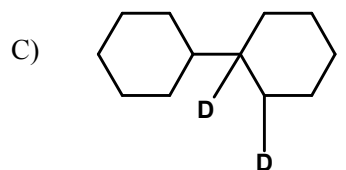
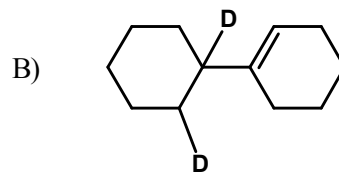
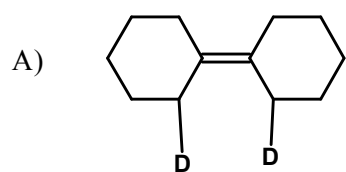


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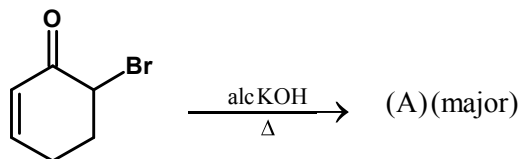
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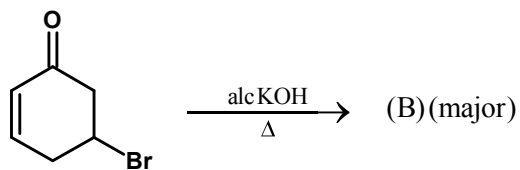
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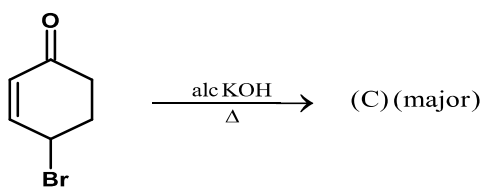
26. Reaction (1)



Reaction (2)



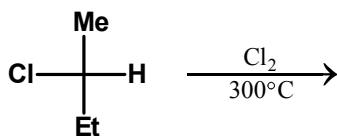
Reaction (3)



Product obtained in above reactions (1) (2) and (3) is-

- A) A = B but C is different
- B) A = B but B is different
- C) B = C but A is different
- D) A = B = C all products are identical

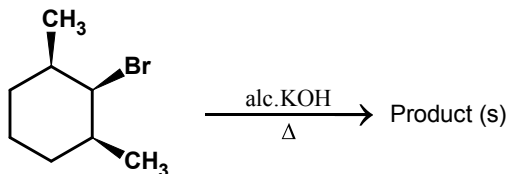
27. Pick the correct statement for monochlorination of R-2-chlorobutane-



- A) There are four possible products; three are optically active, one is optically inactive
- B) There are five possible products; three are optically inactive & two are optically active.
- C) There are five possible products; two are optically inactive & three are optically active.
- D) There are four possible products; two are optically active & two are optically inactive.

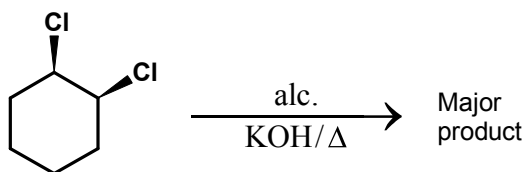
28. $\text{Ph}-\text{CH}_2-\text{CH}_2\text{Br}$ on treatment with $\text{C}_2\text{H}_5\text{OD}/\text{C}_2\text{H}_5\text{O}^-$ gives $\text{Ph}-\text{CD}=\text{CH}_2$ as the product. Which of the following is the most appropriate mechanism for this reaction.

- A) E_1 B) E_2 C) $\text{E}_{1\text{cb}}$ D) E_i

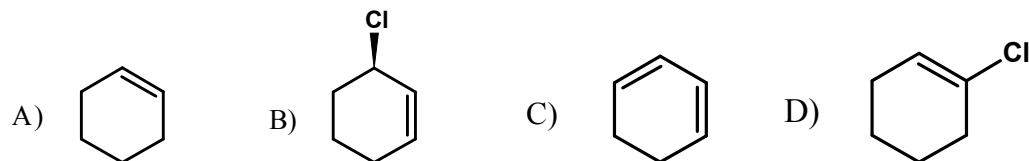


29. Number of E_2 alkene products (including stereoisomers) is/are-

- A) 1 B) 2 C) 3 D) 4



30. Will be



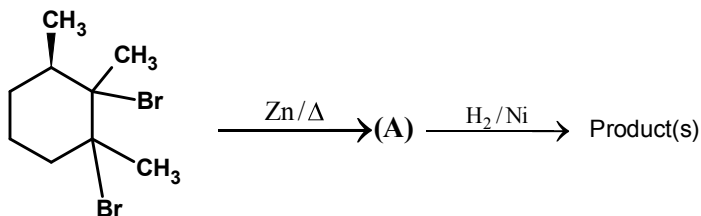
SECTION II

Multiple Correct Answer(s) Type

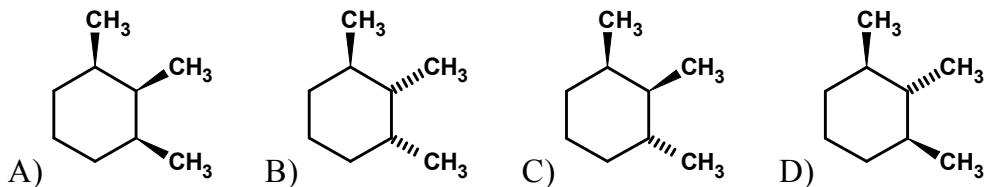
This section contains **5 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct**.

31. Photochemical fluorination is explosive while iodination is too slow to occur. The reason for this is

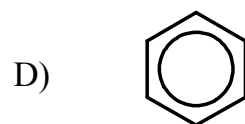
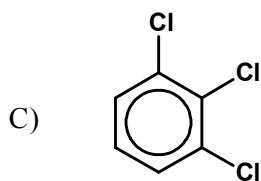
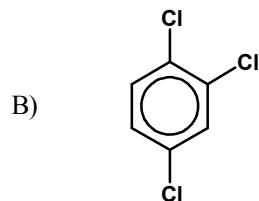
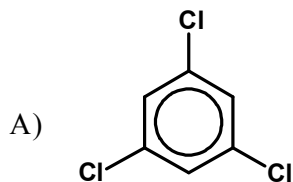
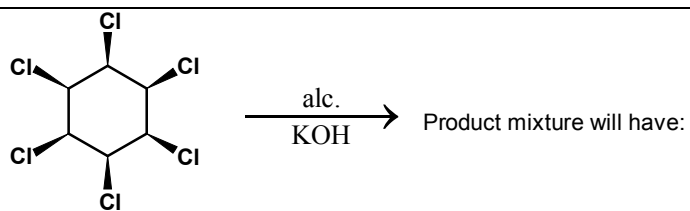
- A) Bond dissociation energy of I_2 is high
- B) Formation of $CH_3 - F$ is most exothermic
- C) Formation of $H - F$ is most exothermic while formation of $H - I$ is endothermic
- D) F_2 has lower bond dissociation energy than Cl_2 or Br_2



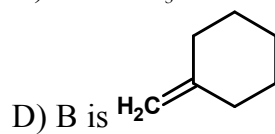
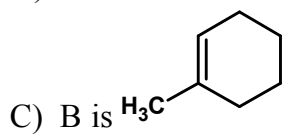
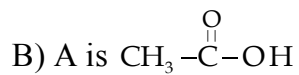
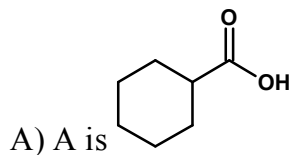
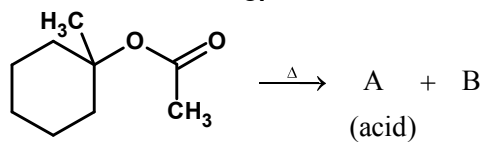
32. Identify the products



33.



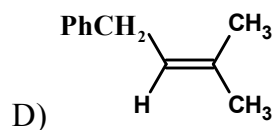
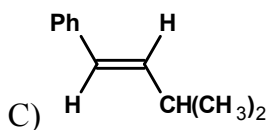
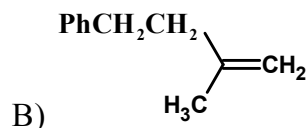
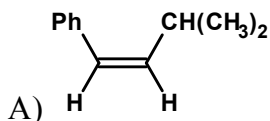
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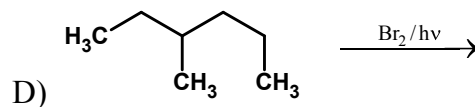
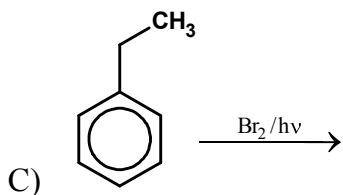
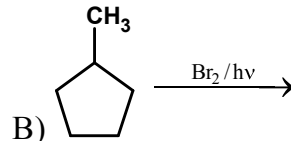
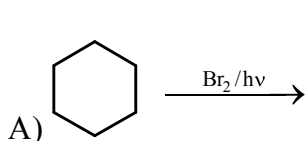
35. The main (formed in maximum percentage) product of the following reaction is



SECTION III
Integer Answer Type

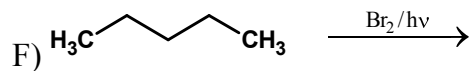
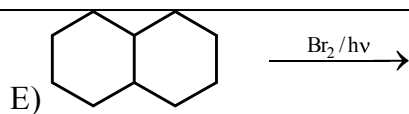
This section contains **5 questions**. The answer to each question is single digit integer, ranging from 0 to 9 (both inclusive).

36. Among the following reactions select those in which 2° halide is the major product?

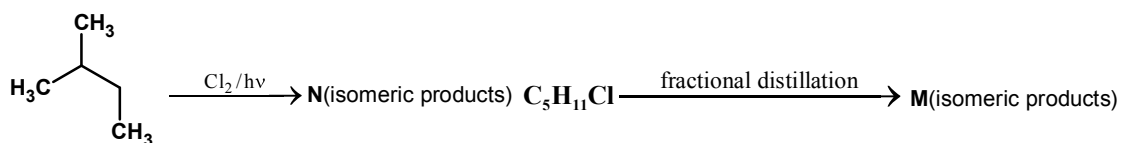
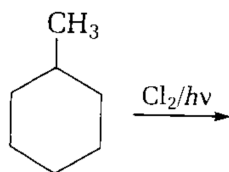


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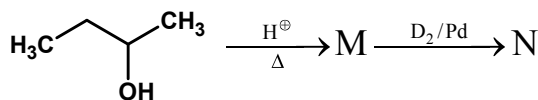
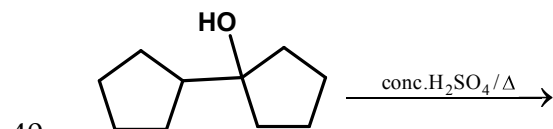


37. Find the total number of isomeric products X in the following reaction and mark (X-5) in your response sheet



38. Find the value of M

39. How many transition states are involved in the following dehydration of alcohol.



Find the value of M+N?

SECTION I
Single Correct Answer Type

This section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

41. The plane $4x+7y+4z+81=0$ is rotated through a right angle about its line of intersection with the plane $5x+3y+10z=25$. The equation of the plane in its new position is $x-4y+6z=K$ where K is
- A) 106 B) -89 C) 73 D) 37
42. Let P be the image of the point (3,1,7) with respect to the plane $x-y+z=3$, then the equation of the plane passing through P and containing the straight line $\frac{x}{1}=\frac{y}{2}=\frac{z}{1}$ is
- A) $x+y-3z=0$ B) $3x+z=0$ C) $x-4y+7z=0$ D) $2x-y=0$
43. The length of the projection of the line segment joining the points (1,-1,0) and (-1,0,1) on to the plane $2x+y+6z=1$ is equal to
- A) $\frac{\sqrt{255}}{41}$ B) $\sqrt{\frac{237}{41}}$ C) $\frac{\sqrt{137}}{41}$ D) $\frac{\sqrt{155}}{41}$
44. The three planes $4y+6z=5$, $2x+3y+5z=5$, $6x+5y+9z=10$ are such that they
- A) meet in a point B) have a line in common
C) form a triangular prism D) none

45. The volume of the tetrahedron included between the plane $5x+3y+4z-30=0$ and the three coordinate planes is
 A) 150 B) 225 C) 75 D) 600
46. Perpendiculars are drawn from points on the line $\frac{x+2}{2} = \frac{y+1}{-1} = \frac{z}{3}$ to the plane $x+y+z=3$. The feet of the perpendiculars lie on the line
 A) $\frac{x}{5} = \frac{y-1}{8} = \frac{z-2}{-13}$ B) $\frac{x}{2} = \frac{y-1}{3} = \frac{z-2}{-5}$ C) $\frac{x}{4} = \frac{y-1}{3} = \frac{z-2}{-7}$ D) $\frac{x}{2} = \frac{y-1}{-7} = \frac{z-2}{5}$
47. The distance of the point $(1,-2,3)$ from the plane $x-y+z-5=0$ measured parallel to the line $\frac{x}{2} = \frac{y}{3} = \frac{z-1}{-6}$ is
 A) 1 B) 2 C) 4 D) 10
48. Which one of the following is best condition for the plane $ax+by+cz+d=0$ to intersect the x and y axes at equal angles is
 A) $|a|=|b|$ B) $a=-b$ C) $a=b$ D) $a^2+b^2=1$
49. The projection of the line $\frac{x+1}{-1} = \frac{y}{2} = \frac{z-1}{3}$ on the plane $x-2y+z=6$ is the line of intersection of the given plane with the plane whose possible equation is
 A) $2x+y+2=0$ B) $3x+y-z=2$ C) $2x-3y+8z=3$ D) $x-3y+8z=2$

50. The perpendicular distance from origin to the line of intersection of the planes $\bar{r} \cdot \bar{a} = 1, \bar{r} \cdot \bar{b} = 1$ is

- A) $\left| \frac{\bar{a} + \bar{b}}{\bar{a} \times \bar{b}} \right|$ B) $\left| \frac{\bar{a} - \bar{b}}{(\bar{a} \times \bar{b})^2} \right|$ C) $\sqrt{\left| \frac{\bar{a} - \bar{b}}{\bar{a} \times \bar{b}} \right|}$ D) $\left| \frac{\bar{a} - \bar{b}}{\bar{a} \times \bar{b}} \right|$

SECTION - II

Multiple Correct Answer(s) Type

This section contains **5 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct**.

51. In R^3 space consider the planes $P_1: y = 0$ and $P_2: x + z = 1$. Let P_3 be a plane different from P_1 and P_2 which passes through the intersection of P_1 and P_2 . If the distance of the point $(0, 1, 0)$ from P_3 is 1 and the distance of a point (α, β, γ) from P_3 is 2, then which of the following relation (s) is / are true ?

- A) $2\alpha + \beta + 2\gamma + 2 = 0$ B) $2\alpha - \beta + 2\gamma + 4 = 0$
 C) $2\alpha + \beta - 2\gamma - 10 = 0$ D) $2\alpha - \beta + 2\gamma - 8 = 0$

52. Projection of the line $\frac{x+1}{2} = \frac{y+1}{-1} = \frac{z+3}{4}$ on the plane $x + 2y + z = 6$ has the possible equation is

- A) $x + 2y + z - 6 = 0 = 9x - 2y - 5z - 8$ B) $x + 2y + z + 6 = 0 = 9x - 2y + 5z - 8$
 C) $\frac{x-1}{4} = \frac{y-3}{-7} = \frac{z+1}{10}$ D) $\frac{x+3}{4} = \frac{y-2}{4} = \frac{z-7}{-10}$

53. A ray is sent along the line $\frac{x-0}{2} = \frac{y-2}{2} = \frac{z-1}{0}$ and is reflected by the plane $x=0$ at a point A. The reflected ray is again reflected by the plane $x+2y=0$ at point B. The initial ray and final reflected ray meets at point J then which of the following is/are true
- A) The coordinates of the point B is (4, -2, 1)
B) The coordinates of the point J is (-3, -1, 1)
C) The centroid of $\triangle ABJ$ is (0,0,0)
D) The coordinates of J is (2, -1, 1)
54. The equation of the plane(s) through the origin which are parallel to the line $\frac{x-1}{2} = \frac{y+3}{-1} = \frac{z+1}{-2}$ and at a distance $5/3$ from is/are
- A) $2x+2y+z=0$ B) $x+2y+2z=0$ C) $x-2y+z=0$ D) $x-2y+2z=0$
55. A rod of length 2 units whose one end is (1, 0, -1) and other end touches the plane $x-2y+2z+4=0$ then which of the following is/are true
- A) The rod sweeps the figure with the given plane whose volume is π cubic units
B) The area of the region which the rod traces on the plane is 2π
C) The length of projection of the rod on the plane is $\sqrt{3}$ units
D) The centre of the region which the rod traces on the plane is $\left(\frac{2}{3}, \frac{2}{3}, \frac{-5}{3}\right)$

SECTION III
Integer Answer Type

This section contains **5 questions**. The answer to each question is single digit integer, ranging from 0 to 9 (both inclusive).

56. Let $P(a,b,c)$ be any point on the plane $3x+2y+z=7$ then the least value of $2(a^2+b^2+c^2)$ is
57. The distance of z-axis from the image of the point $(2,-3,3)$ in the plane $x-2y-z+1=0$ is
58. The position vectors of four angular points of a tetrahedron OABC are $(0,0,0), (0,0,2), (0,4,0)$ and $(6,0,0)$ respectively. A point P inside the tetrahedron is at the same distance r from the four plane faces of the tetrahedron. The value of $9r$ is
59. If the line $3x-2y+z+3=0=4x-3y+4z+1$ is parallel to the plane $2x-y+mz-2=0$ then the value of $|m|$ is
60. A square ABCD of diagonal $2a$ is folded along the diagonal AC so that planes DAC, BAC are at right angles. If the shortest distance between DC and AB is $\frac{Ka}{\sqrt{3}}$ then K is equal to

Master JEE CLASSES

Kukatpally, Hyderabad.

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KEY SHEET

PHYSICS

1	B	2	C	3	B	4	B	5	D
6	D	7	C	8	A	9	B	10	C
11	BC	12	BCD	13	ABCD	14	AC	15	CD
16	8	17	4	18	2	19	4	20	5

CHEMISTRY

21	D	22	C	23	B	24	A	25	A
26	D	27	C	28	C	29	B	30	C
31	BC	32	ABC	33	AB	34	BD	35	C
36	3	37	7	38	4	39	5	40	8

MATHS

41	A	42	C	43	B	44	B	45	C
46	D	47	A	48	A	49	A	50	D
51	BD	52	AC	53	AB	54	AD	55	ACD
56	7	57	1	58	6	59	2	60	2

SOLUTIONS PHYSICS

1. $F_{\text{viscous}} = \eta b L v \left[\frac{h}{x(h-x)} \right]$ (force is minimum at $x = \frac{h}{2}$)

$$F_{\text{viscous}} = \frac{4\eta b L v}{h}$$

2. viscous force per unit area = $\eta \frac{dv}{dy}$

3. Conceptual

4. $u_{01} = \frac{2}{9} \frac{r^2 \rho g}{\eta}$ $u_{02} = \frac{r^2 \rho g}{54\eta}$

5. Conceptual

6. Conceptual

7. Conceptual

8. Conceptual

9. Conceptual

10. Conceptual

11. Conceptual

12. viscous force = $mg \sin \theta$

$$\eta a^2 \frac{v}{t} = a^3 \rho g \sin \theta$$

13. The value of fluid flowing through this section per second

$$dV = (2\pi r dr) v_0 \left(1 - \frac{r^2}{R^2}\right)$$

$$\text{Total volume } V = \int_0^R (2\pi r dr) v_0 \left(1 - \frac{r^2}{R^2}\right)$$

$$= 2\pi v_0 \left(\frac{R^2}{4}\right)$$

ii) The Kinetic energy of the fluid within the volume element of thickness dr

K.E of fluid within the tube is

$$= \frac{1}{2} (2\pi l) \rho v_0^2 \int_0^R \left(1 - \frac{r^2}{R^2}\right)$$

$$\text{We get K.E } \pi \rho l v_0^2 \left(\frac{R^2}{6}\right)$$

iii) The viscous drag exerts a force on the tube

$$F = -\eta A \left(\frac{dv}{dr} \right)_{r=R}$$

$$\text{Here } \left(\frac{dv}{dr} \right)_{r=R} = V_0 \left(-2r / R^2 \right)_{r=R} = -2F = V_0 / R$$

$$\therefore F = 4\pi\eta l v_0$$

$$\Delta P = P_2 - P_1 = P$$

iv) where $P_1 = 0$ & $P_2 = P$

$$P = \frac{\text{force}(F)}{\text{area}(\pi R^2)} = \frac{4\eta l v_0}{R^2}$$

14. Conceptual

$$\frac{p - \sigma_1}{\eta_1} = \frac{p - \sigma_2}{\eta_2} = \frac{p - \sigma_3}{\eta_3}$$

15. $\sigma_1 < \sigma_2 < \sigma_3 \Rightarrow \eta_1 > \eta_2 > \eta_3$

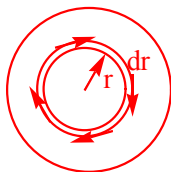
$$\text{Also } \frac{\eta_1}{\eta_3} = \frac{p - \sigma_1}{p - \sigma_3} > \frac{\eta_3}{\eta_2} = \frac{p - \sigma_3}{p - \sigma_2} < 1 \Rightarrow (C)$$

Eliminating P gives (D)

16. Conceptual

17. velocity gradient=2

$$F = 2\eta A \frac{dv}{dy} = 0.004N$$



18.

$$d\tau = r \cdot (v \cdot F)$$

$$= r \left[\frac{\mu \cdot 2\pi r dr \cdot r (\omega_i - \omega_o)}{a} \right]$$

19. $v_{bigger} = n^{\frac{2}{3}} v_{small}$ Conceptual

20. Rate of heating = \dot{Q} so F_v proportional to r^3 hence rate of heating is proportional to r^5

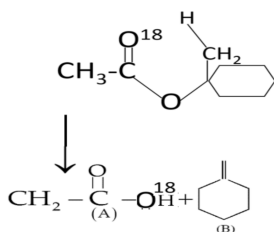
CHEMISTRY

21. Carbocation rearrangement then saytzeff elimination.

22. With increase in branching boiling point decreases

23. $\%(2^\circ) = \frac{7.6}{21.6} \times 100 \approx 35\%$ (major)

24. Conceptual
25. 1,4 Addition of D_2 takes place
26. Dehydrohalogenation followed by tautomerism
27. Conceptual
28. β H exchange with D indicates E_1cb
29. Conceptual
30. Due to antiperiplanar requirement conjugated diene is form
31. Iodination is reversible reaction
- $$R-H + I_2 \rightleftharpoons R-I + HI$$
32. Conceptual
33. Conceptual
34. (B, D)



35. Trans alkene is formed in highest percentage
36. A, C, F reactions will have 2^0 halide as major product
37. Value of X is 12 So ans: 7
38. Value of N is 6, that includes two enantiomeric pairs. On fractional distillation four fraction will be obtained. So answer is 4
39. Conceptual
40. M is 3: 1-butene, cis-2-butene, trans-2-butene
Value of N is 5, so $M+N=8$

MATHS

41. The plane is $(4x + 7y + 4z + 81) + \lambda(5x + 3y + 10z - 25) = 0$
 $\Rightarrow x(4 + 5\lambda) + y(7 + 3\lambda) + z(4 + 10\lambda) + 81 - 25\lambda = 0$
 But it is perpendicular to given plane $\Rightarrow 4(4 + 5\lambda) + 7(7 + 3\lambda) + 4(4 + 10\lambda) = 0$
 $\Rightarrow 81 + 81\lambda = 0 \Rightarrow \lambda = -1$

$$\therefore \text{the plane is } -x+4y-6z+106=0 \Rightarrow x-4y+6z=106$$

$$\Rightarrow K=106$$

42. Image of $(3,1,7)$ is $(-1,5,3)$

$$\text{Equation of the plane is } \begin{vmatrix} x & y & z \\ 1 & 2 & 1 \\ -1 & 5 & 3 \end{vmatrix} = 0 \Rightarrow x-4y+7z=0$$

43. Let A be the acute angle between the normal of the plane and the line segment joining the points

$$\therefore \cos A = \frac{3}{\sqrt{6}\sqrt{41}} \Rightarrow \text{length of projection} = \sqrt{6} \sin A$$

$$= \sqrt{6} \sqrt{1 - \frac{9}{246}}$$

$$= \sqrt{6 \cdot \frac{237}{246}} = \sqrt{\frac{237}{41}}$$

$$44. \begin{vmatrix} 0 & 4 & 6 \\ 2 & 3 & 5 \\ 6 & 5 & 9 \end{vmatrix} = -4(-12) + 6(-8) = 0$$

$$\text{And } \Delta_1 = \begin{vmatrix} 5 & 4 & 6 \\ 5 & 3 & 5 \\ 10 & 5 & 9 \end{vmatrix} = 0$$

$$45. \frac{x}{6} + \frac{y}{10} + \frac{z}{15/2} = 1$$

$$\therefore \text{Volume} = \frac{1}{6} \times 6 \times 10 \times \frac{15}{2} = 75$$

46. Any point P on line is $(2\lambda - 2, -\lambda - 1, 3\lambda)$. Point P lies on the plane

$$\Rightarrow \lambda = \frac{3}{2} \Rightarrow P = \left(1, -\frac{5}{2}, \frac{9}{2}\right)$$

The foot of the perpendicular from $(-2, -1, 0)$ on the plane is $(0, 1, 2)$

$$\therefore \text{the line is } \frac{x}{2} = \frac{y-1}{-7} = \frac{z-2}{5}$$

47. Equation of line passing through $(1, -2, 3)$ and parallel to the given line is

$\frac{x-1}{2} = \frac{y+2}{3} = \frac{z-3}{-6}$ any point on the line is $(2\lambda + 1, 3\lambda - 2, -6\lambda + 3)$. It lies on the plane

$$\Rightarrow \lambda = \frac{1}{7} \therefore \text{the point is } \left(\frac{9}{7}, \frac{-11}{7}, \frac{15}{7} \right)$$

$$\therefore \text{distance} = \sqrt{\left(1 - \frac{9}{7}\right)^2 + \left(-2 + \frac{11}{7}\right)^2 + \left(3 - \frac{15}{7}\right)^2} = 1$$

48. Let α be the angle between x-axis and plane

$\Rightarrow \cos(90^\circ - \alpha) = \frac{|a|}{\sqrt{a^2 + b^2 + c^2}}$ similarly angle between y-axis and plane is

$$\alpha \Rightarrow \sin \alpha = \frac{|b|}{\sqrt{a^2 + b^2 + c^2}} \Rightarrow |a| = |b|$$

49. Equation of the plane containing the given line and perpendicular to the plane

$$x - 2y + z - 6 = 0 \text{ is } \begin{vmatrix} x+1 & y & z-1 \\ -1 & 2 & 3 \\ 1 & -2 & 1 \end{vmatrix} = 0$$

$$\Rightarrow (x+1)(8) - y(-4) + (z-1)(0) = 0$$

$$\Rightarrow 2x + y + 2 = 0$$

50. Conceptual

51. Here P_3 is $(x + z - 1) + \lambda y = 0$ Distance from $(0, 1, 0)$ is 1

$$\therefore |\lambda - 1| = \sqrt{\lambda^2 + 2} \Rightarrow \lambda = \frac{-1}{2}$$

$$\therefore \text{Equation of } P_3 \text{ is } 2x - y + 2z - 2 = 0$$

$$\Rightarrow |2\alpha - \beta + 2\gamma - 2| = 6 \Rightarrow 2\alpha - \beta + 2\gamma - 2 = \pm 6$$

52. It is the line of intersection of the given plane and a plane perpendicular to given plane and containing the given line

53. $A = (0, 2, 1)$

54. We can easily get it from options

55. The rod sweeps out the figure which is a cone. The distance of the point $A(1, 0, -1)$ from the plane is 1 unit. The slant height of the cone is 2 units. The radius of base is $\sqrt{3}$

$$\therefore \text{volume of the cone is } \frac{\pi}{3} (\sqrt{3})^2 \cdot 1 = \pi \text{ C.C}$$

\therefore Area of the circle on the plane which the rod traces is 3π

56. Clearly minimum value of $a^2 + b^2 + c^2 = \left(\frac{|-7|}{\sqrt{14}}\right)^2 = \frac{49}{14} = \frac{7}{2}$

\therefore minimum value of $2(a^2 + b^2 + c^2) = 7$

57. $\frac{a-2}{1} = \frac{b+3}{-2} = \frac{c-3}{-1} = -2 \Rightarrow$ the image is $(0,1,5)$

58. Let $P(r,r,r)$ be the point which is equidistant from the four faces. Its distance is r from the plane $2x+3y+6z=12$ also

$\therefore |11r-12| = 7r \Rightarrow r = \frac{2}{3}$ or 3 but $r < 2 \Rightarrow r = 2/3$

59. Dr's of the line are $5,8,1$. It is perpendicular to the normal to the plane

$\therefore 10-8+m=0 \Rightarrow m=-2$