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IIB

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NEET FRESH 2023-24

Mark 720	Group PCB	PCB EXAM - 61	Date : 30/12/2023 Time : 3:20 Hours

Answer Key Version - R (NEET FRESH All Batches)

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PHYSICS

SECTION - A (35 Questions)

01. **(4)** Resolve the 90N, 80N and 70N force into x and y components. The line of action of 90N, 50N, and x-components of the 80N and 70N forces pass through the pivot point A, therefore they cause on rotation.

$\therefore$ The total torque about point A is

$$=(80\sin 30°)\left(\frac{L}{2}\right)-(60)\left(\frac{L}{2}\right)+(70\cos 60°)(L)$$

$$=(80)\left(\frac{1}{2}\right)\left(\frac{3}{2}\right)-(60)\left(\frac{3}{2}\right)+(70)\left(\frac{1}{2}\right)(3)$$

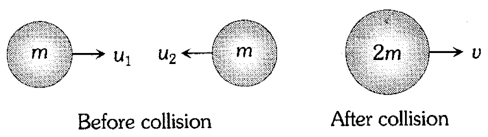
$$=75Nm.$$

02. **(3)** According to conservation of angular momentum

$$I_1\omega_1=I_2\omega_2\Rightarrow\frac{1}{2}MR^2\omega=\left(\frac{1}{2}MR^2+\frac{1}{2}\left(\frac{M}{4}\right)R^2\right)\omega_2$$

$$\therefore \omega_2=\frac{4}{5}\omega.$$

03. **(3)**



Here, $m = 0.25$ kg, $u_1 = 3$ m/s, $u_2 = -1$ m/s

It is an inelastic collision.

According to conservation of momentum

$mu_1 + mu_1 = (m + m)u$

$$\Rightarrow \upsilon=\frac{mu_1+mu_2}{2m}=\frac{u_1+u_2}{2}=\frac{3-1}{2}=1m/s.$$

04. **(1)** Given, $r = 0.4$m, $\alpha = 8$ rad/s^2, $m = 4$ kg, $I = ?$

Torque, $\tau = I\alpha = mgr \Rightarrow 4\times10\times0.4 = I\times8$

$$\Rightarrow I=\frac{16}{8}=2kg-m^2.$$

05. **(2)** $KE=\frac{L^2}{2I}\Rightarrow KE\propto\frac{1}{I}$ for same L

06. **(2)** When target is very light and at rest then after head on elastic collision it moves with double speed of projectile i.e. the velocity of body of mass m will be 2v.

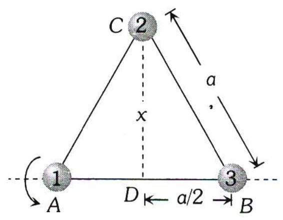
07. **(1)** $U_1 = mgh_1$ and $U_2 = mgh_2$

$$\%\text{ energy lost}=\frac{U_1-U_2}{U_1}\times100$$

$$\frac{mgh_1-mgh_2}{mgh_1}\times100=\left(\frac{h_1-h_2}{h_1}\right)\times100$$

$$=\frac{2-1.5}{2}\times100=25\%.$$

08. **(3)** From the triangle BCD



$$CD^2=BC^2-BD^2=a^2-\left(\frac{a}{2}\right)^2$$

$$x^2=\frac{3a^2}{4}\Rightarrow x=\frac{\sqrt{3}a}{2}$$

Moment of inertia of system along the side AB

$$I_{system}=I_1+I_2+I_2=m\times(0)^2+m\times(x)^2+m\times(0)^2$$

$$=mx^2=m\left(\frac{\sqrt{3}a}{2}\right)^2=\frac{3ma^2}{4}.$$

09. **(2)**

10. **(2)** Here, R = 2m, M = 100 kg, $v = 200$ cm s^{-1} $= 20\times10^{-2}$ ms^{-1}

Total kinetic of the loop = $K_T + K_R$

$$=\frac{1}{2}Mv^2+\frac{1}{2}I\omega^2\ [\because \text{ For a hoop, } I=MR^2]$$

$$=\frac{1}{2}Mv^2+\frac{1}{2}MR^2\omega^2$$

$$=\frac{1}{2}Mv^2+\frac{1}{2}Mv^2\qquad[\because v=R\omega]$$

$= Mv^2$

Work required to stop the hoop = Total kinetic energy of the hoop.

$$Mv^2=(100kg)(20\times10^{-2}\text{ ms}^{-1})^2=4J$$

11. **(3)** $2u+m\times O=\frac{2u}{3}+mv$

$$\frac{4u}{3} = mv \qquad .....(1)$$

$$e = 1 = \frac{V - \frac{u}{3}}{u - 0}$$

$$V = \frac{4u}{3} \qquad .....(2)$$

On solving (1) and (2)

$$\frac{4u}{3} = m \times \frac{4u}{3}$$

$\Rightarrow \quad m = 1$ kg.

12. **(4)** $L = \sqrt{2IE}$. If E are equal then

$$\frac{L_1}{L_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{I}{2I}} = \frac{1}{\sqrt{2}}.$$

13. **(4)** M.I. decreases and angular velocity increases.

14. **(3)** Force of friction

= K.E. of translation + K.E. of rotation

$$= \frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2$$

$$= \frac{1}{2}Mv^2 + \frac{1}{2}Mk^2\frac{v^2}{R^2}$$

$(\because I = Mk^2 \text{ and } v = \omega R)$

$$= \frac{1}{2}Mv^2\left(1 + \frac{k^2}{R^2}\right)$$

$$\frac{\text{K.E. of rotation}}{\text{Total K.E.}} = \frac{\frac{1}{2}Mk^2\frac{v^2}{R^2}}{\frac{1}{2}Mv^2\left(1 + \frac{k^2}{R^2}\right)}$$

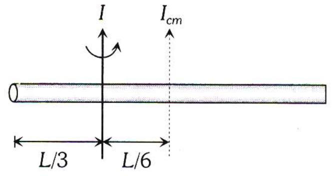
$$= \frac{\frac{k^2}{R^2}}{1 + \frac{k^2}{R^2}} = \frac{k^2}{k^2 + R^2}$$

15. **(2)** Velocity interchange when mass are equal

So K.E. = mgL.

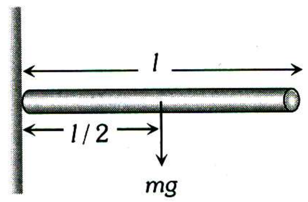
16. **(1)** Conceptual

17. **(2)** $I_{cm} = \frac{ML^2}{12}$ (about middle point)



$$\therefore I = I_{cm} + Mx^2 = \frac{ML^2}{12} + M\left(\frac{L}{6}\right)^2 = \frac{ML^2}{9}.$$

18. **(4)**



Weight of the rod will produce the torque.

$$\tau = I\alpha \Rightarrow mg \times \frac{l}{2} = \frac{ml^2}{3} \times \alpha$$

Angular acceleration $\alpha = \frac{3g}{2l}$.

19. **(1)** Angular momentum of system remains constant

$$I \propto \frac{1}{\omega} \Rightarrow \frac{I_2}{I_1} = \frac{\omega_1}{\omega_2} = \frac{20}{10} \Rightarrow I_2 = 2I_1 = 2I.$$

20. **(2)** Rotational kinetic energy $= \frac{1}{2}I\omega^2 = 1500$

$$\Rightarrow \frac{1}{2} \times 1.2 \times \omega^2 = 1500$$

$$\Rightarrow \omega^2 = \frac{3000}{1.2} \Rightarrow \omega = 50 \, rad/s$$

Initially the body was at rest and after t sec its angular velocity becomes 50 rad/s.

$$\omega = \omega_0 + \alpha t \Rightarrow 50 = 0 + 25 \times t$$

$$\Rightarrow t = 2s.$$

21. **(4)** $f = \frac{KE_t}{KE_t + KE_r} = \frac{\frac{1}{2}mv^2}{\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2} = \frac{5}{7}$

$$\left[\because \omega = \frac{v}{R}, I = \frac{2}{5}mR^2\right]$$

22. **(4)**

23. **(2)** $E=\frac{L^2}{2I}\therefore E\propto L^2\Rightarrow\frac{E_2}{E_1}=\left(\frac{L_2}{L_1}\right)^2$

$$\frac{E_2}{E_1}=\left(\frac{L_1+200\%\text{ of }L_1}{L_1}\right)^2=\left(\frac{L_1+2L_1}{L_1}\right)^2=(3)^2$$

$\Rightarrow E_2=9E_1$

Increment in kinetic energy

$\Delta E=E_2-E_1=9E_1-E_1$

$\Delta E=8E_1$ $\Delta E=8E_1$ $\therefore\frac{\Delta E}{E_1}=8$ or percentage increase $=800\%$.

24. **(2)** $a=\frac{g\sin\theta}{1+\frac{K^2}{R^2}}$

For disc $\frac{K^2}{R^2}=\frac{1}{2}=0.5$

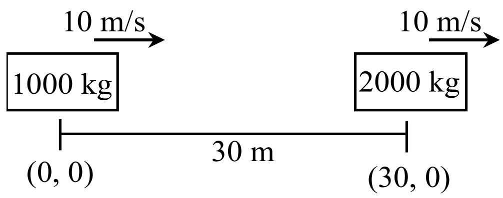
For sphere $\frac{K^2}{R^2}=\frac{2}{5}=0.4$

a (sphere) $>a$(disc)

$\therefore$ sphere reaches first

25. **(2)**

26. **(3)**



$$X_{com}=\frac{2000\times30}{2000+1000}=\frac{2000\times30}{3000}=20\text{m.}$$

27. **(3)** A-2 ; B-1 ; C-4 ; D-3

Rolling motion $\rightarrow$ combination of translatory and rotatory motion

Rate of change of angular momentum $\rightarrow$ torque

$\frac{dL}{dt}=\tau$

Moment of inertia of a hollow cylinder about axis $=MR^2$

Theorem of parallel axis

$I=I_{com}+Mr^2$.

28. **(1)** $X_{cm}=\frac{m_1x_1+m_2x_2+m_3x_3}{m_1+m_2+m_3}$

$$X_{cm}=\frac{300(0)+500(40)+400(70)}{300+500+400}$$

$$X_{cm}=\frac{500\times40+400\times70}{1200}\Rightarrow X_{cm}=40cm.$$

29. **(2)** $X=\frac{m_1x_1+m_2x_2+m_3x_3+m_4x_4}{m_1+m_2+m_3+m_4}$

$$X=\frac{0+40x_4}{100}\Rightarrow3=\frac{40x_4}{100}\Rightarrow x_4=\frac{300}{40}=7.5$$

Similarly $y_4=7.5$ and $z_4=7.5$.

30. **(3)** According to law of conservation of linear momentum both pieces should possess equal momentum after explosion. As their masses are equal therefore they will possess equal speed in opposite direction.

31. **(4)** In the given situation, projectile could be considered as rigid body before explosion and after explosion, as its fragments are considered as system of particles. Thus, the concept of COM is applicable to both.

Since, the explosion is due to internal forces, so the motion of COM after explosion will follow the same parabolic path as it would have followed if there was no explosion.

Thus, statement given in option (4) is correct, rest are incorrect.

32. **(4)** $E_{sphere}=\frac{1}{2}I_s\omega^2=\frac{1}{2}\times\frac{2}{5}MR^2\times\omega^2$

$$E_{Cylinder}=\frac{1}{2}I_c(2\omega)^2=\frac{1}{2}\times\frac{MR^2}{2}\times4\omega^2$$

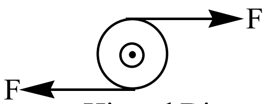
$$\frac{E_{sphere}}{E_{cylinder}}=\frac{1}{5}$$

33. **(2)** According to the equation of motion of the centre of mass. $M\vec{a}_{CM}=\vec{F}_{ext.}$.

If $\vec{F}_{ext.}=0$, $\vec{a}_{CM}=0$

i.e., $\vec{v}_{CM}=$ constant

i.e., if no external force acts on a system (or resultant external force acting on a system is zero) the velocity of its centre of mass remains constant (i.e., velocity of the centre of mass is unaffected by internal forces).



Here, $F_{net} = 0$ but Kinetic energy will increase.

34. **(4)**

35. **(4)** Change in momentum

$$= m\vec{\upsilon}_2 - m\vec{\upsilon}_1 = -m\upsilon - m\upsilon = -2m\upsilon.$$

Section - B (Attempt Any 10 Questions)

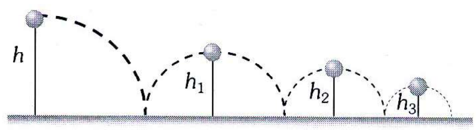
36. **(1)** Angular momentum can be conserved about lowest point.

$$mv_0 r + \frac{2}{5}mr^2\frac{v_0}{2r} = mv'r + \frac{2}{5}mr^2\frac{v'}{r}$$

$$\frac{10mv_0 r + 2mv_0 r}{10} = \frac{7mv''r}{5}$$

$$v'' = \frac{6v_0}{7}$$

37. **(1)**



Particle falls from height h then formula for height covered by it in nth rebound is given by

$$h_n = e^{2n}h$$

where e = coefficient of restitution, n = No. of rebound Total distance travelled by particle before rebounding has stopped

$$H = h + 2h_1 + 2h_2 + 2h_3 + 2h_4 + ...$$

$$= h + 2he^2 + 2he^4 + 2he^6 + 2he^8 + ...$$

$$= h + 2h(e^2 + e^4 + e^6 + e^8 + ...)$$

$$= h + 2h\left[\frac{e^2}{1-e^2}\right] = h\left[1 + \frac{2e^2}{1-e^2}\right] = h\left(\frac{1+e^2}{1-e^2}\right).$$

38. **(2)** $m = 2$kg, $V_1 = 0$, $V_2 = ?$, $t = 5$, J = Area

$$m(V_2 - V_1) = \frac{1}{2}\times 5\times 10$$

$$2(V_2 - 0) = 25$$

$$V_2 = 12.5 \text{ m/s}.$$

39. **(4)** Apply conservation of angular momentum about the hinge.

$$mvR = \frac{m}{2}R^2\omega + m(R\omega)R$$

$$R\omega = \frac{2v}{3} = \frac{2\times 5}{3} = \frac{10}{3}\text{m/s}.$$

40. **(4)** Rotational kinetic energy is

$$K_R = \frac{1}{2}I\omega^2 = \frac{1}{2}Mk^2\left(\frac{v}{R}\right)^2$$

($\because$ I = Mk^2 and $v = R\omega$)

$$\frac{1}{2}Mv^2\left(\frac{k^2}{R^2}\right)$$

Translational kinetic energy is

$$K_T = \frac{1}{2}Mv^2$$

As per question, $K_R = 40\%\ K_T$

$$\therefore \frac{1}{2}Mv^2\left(\frac{k^2}{R^2}\right) = 40\%\ \frac{1}{2}Mv^2$$

or $\frac{k^2}{R^2} = \frac{40}{100} = \frac{2}{5}$

For a solid sphere, $\frac{k^2}{R^2} = \frac{2}{5}$

Hence, the body is solid ball.

41. **(4)** According to parallel axes theorem

$$I = \frac{2}{5}mR^2 + mx^2$$

Hence graph (4) correctly depicts I vs x.

42. **(1)** By conservation of momentum,

$$m\upsilon + M\times 0 = (m+M)V$$

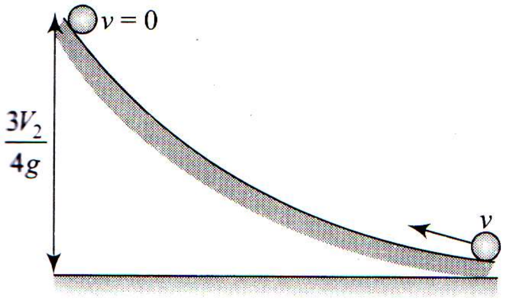
Velocity of composite block $V = \left(\frac{m}{m+M}\right)\upsilon$

K.E. of composite block $= \frac{1}{2}(M+m)V^2$

$$= \frac{1}{2}(M+m)\left(\frac{m}{M+m}\right)^2\upsilon^2 = \frac{1}{2}m\upsilon^2\left(\frac{m}{M+m}\right).$$

43. **(4)** From law of conservation of mechanical energy

$$\Delta K + \Delta U = 0$$



$$\left[0-\left(\frac{1}{2}I\omega^2+\frac{1}{2}mv^2\right)\right]+\left(mg\times\frac{3v^2}{4g}\right)=0$$

$$\Rightarrow \frac{1}{2}I\omega^2=\frac{3}{4}mv^2-\frac{1}{2}mv^2=\frac{mv^2}{2}\left(\frac{3}{2}-1\right)=\frac{mv^2}{4}$$

As cylinder is rolling $\omega=\frac{v}{R}$

or $\frac{1}{2}I\frac{v^2}{R^2}=\frac{mv^2}{4}$

or $I=\frac{1}{2}mR^2$

Hence, object is disc.

44. **(4)** Conceptual.

45. **(1)** $a=\frac{(3m-m)}{3m+m}g=\frac{g}{2}$

$$\vec{a}_{cm}=\frac{3m\vec{a}_1+m\vec{a}_2}{3m+m}$$

Both mass have same magnitude of acceleration but in opposite direction $\vec{a}_1=-\vec{a}_2=a\,(\text{Let})$

$$a_{cm}=\left(\frac{3m-m}{4m}\right)\times\frac{g}{2}=\frac{g}{4}$$

46. **(2)** As there is no external torque about the axis of rotation on the system of platform and tortoise, angular momentum will remain unchanged. As the tortoise moves moment of inertia of system will first decrease and then increase.

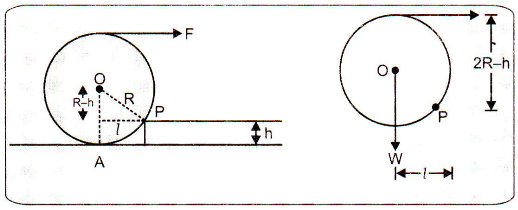
Hence angular velocity will first increase and then decrease. Also variation will not be linear.

47. **(1)** *Mass of smaller circle = M*

$$I=\frac{9MR^2}{2}-\left(\frac{1}{2}M\left(\frac{R}{3}\right)^2+M\left(\frac{2R}{3}\right)^2\right)$$

$= 4MR^2$.

48. **(1)**



When the cylinder is about to be raised, reaction at A vanishes. Taking torque about P.

$$F(2R-h)\ge Wl$$

$$l=\sqrt{R^2-(R-h)^2}$$

$$=\sqrt{R^2-\left(R-\frac{R}{3}\right)^2}$$

$$\Rightarrow \sqrt{R^2-\frac{4R^2}{9}}=\frac{\sqrt{5}R}{3}$$

$$2R-h=2R-\frac{R}{3}=\frac{5R}{3}$$

$$F\times\frac{5R}{3}\ge W\times\frac{\sqrt{5}R}{3}$$

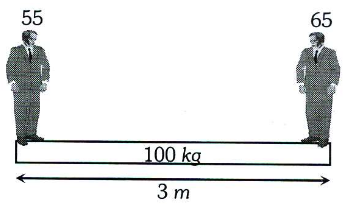
$$F\ge\frac{W}{\sqrt{5}}\ \Rightarrow F_{min}=\frac{W}{\sqrt{5}}.$$

49. **(3)** $h=e^{2n}h_0$

here, $n=2$, so $\frac{h}{2}=e^4h$

$$\Rightarrow e=\left(\frac{1}{2}\right)^{1/4}.$$

50. **(3)**



There is no external force so centre of mass will not shift.

CHEMISTRY

SECTION - A (35 Questions)

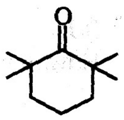
51. **(1)**

A – (p), B – (r), C – (q), D – (s)

52. **(2)**

A – (p), B – (p), C – (q)

53. **(4)**



54. **(3)**

Infinite

55. **(2)**

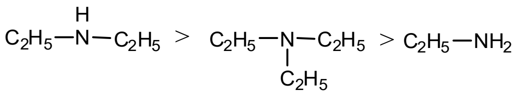
The compound contains longest chain of 5C - atoms and e of ene is retained as the suffix name starts with constant

56. **(4)**

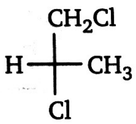
$-NO_2$ group, being strong electron-withdrawing, disperses the –ve charge, hence stabilizes the concerned carbanion.

57. **(3)**

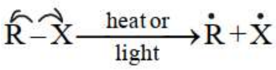
In aqueous phase the decreasing order of basicity as



58. **(2)**



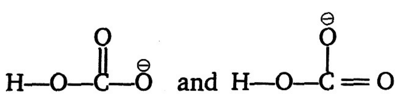
59. **(1)**



60. **(3)**

CN^-, RCH_2^-, ROH

61. **(1)**

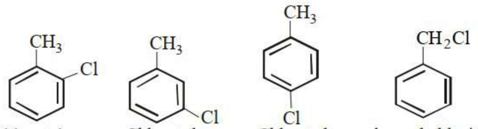


62. **(1)**

Cyclohexylamine

63. **(3)**

C_7H_7Cl has 4 isomers



o-Chlorotoluene *m*-Chlorotoluene *p*-Chlorotoluene benzyl chloride

64. **(2)**

The compound is a derivative of benzoic acid. The positions of substituents attached to benzene nucleus are represented by number of C-atoms and not by ortho, meta and para.

65. **(2)**

(a) > (d) > (b) > (c)

Due to S.I.P. effect (ortho effect) ortho methyl aniline is less basic than aniline.

66. **(3)**

b > a > c

67. **(3)**

2–ethyl–3–methylpentanal

68. **(2)**

Stability order of different alkyl carbocations on the basis of hyperconjugation is : 3° > 2° > 1° > methyl In t-butyl cation, the C-atom bearing the positive charge is attached to three methyl groups therefore it possess nine α-hydrogens. It will give maximum nine hyperconjugative structures leading to maximum stability.

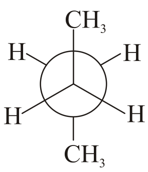
69. **(3)**

a, b, d

70. **(3)**

sp^3, sp^2, sp

71. **(2)**



Antiform of butane is most stable conformer because of least steric and torsinal strain.

72. **(2)**

Electromeric effect is purely a temporary effect and is brought into play only at the requirement of attacking reagent, it vanishes out as soon as the attacking reagent is removed from reaction mixture.

73. **(4)**

All of these

74. **(2)**

$-OH$ shows $+R$ effect while $>C=O$ shows $-R$ effect.

75. **(1)**

A – (q), B – (p), C – (r), D – (s)

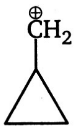
76. **(4)**

CH_3OH, CH_3CH_2OH

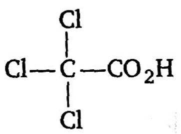
77. **(2)**

7

78. **(4)**



79. **(3)**



80. **(3)**

(c) > (b) > (d) > (a)

Because of ortho effect O-Toluic acid is more acidic than benzoic acid.

81. **(4)**

n-propyl propanoate

82. **(1)**

Diethyl ketone and methyl propyl ketone are position isomers

83. **(1)**

Molecular symmetry

84. **(4)**

Both (1) and (2)

85. **(2)**

2

SECTION - B (Attempt Any 10 Questions)

86. **(4)**

Assertion is incorrect, reason is correct

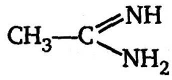
87. **(3)**

1, 1

88. **(4)**

IV > III > I > II

89. **(1)**



90. **(2)**

91. **(2)**

3, 4, 6-trimethyl octane

92. **(1)**

$$Br-\underset{sp^2}{\overset{1}{C}H}=\underset{sp^2}{\overset{2}{C}H}-Br \xrightarrow[\text{Catalyst}]{H_2} Br-\underset{sp^3}{\overset{3}{C}H_2}-\underset{sp^3}{\overset{4}{C}H_2}-Br$$

93. **(1)**

If both assertion and reason are true and the reason is the correct explanation of the assertion.

94. **(1)**

3-methyl-1-hexen-5-yne

95. **(1)**

If both assertion and reason are true and the reason is the correct explanation of the assertion.

96. **(3)**

$Cl_2C=CH-CH_2-CH_2-CH_2$. It can't show geometrical isomerism due to unsymmetrical alkene.

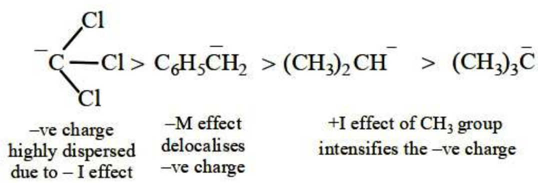
97. **(3)**

All resonating structures should have same number of electron pairs

98. **(4)**

Has two dissimilar groups attached to both ends of double bond

99. **(2)**



100. **(2)**

3