# SOLUTIONS

# PROGRESS TEST-4

# GRA

## JEE MAIN PATTERN

## Test Date: 22-07-2017

Corporate Office: Paruslok, Boring Road Crossing, Patna-01
Kankarbagh Office: A-10, 1st Floor, Patrakar Nagar, Patna-20
Bazar Samiti Office : Rainbow Tower, Sai Complex, Rampur Rd.,
Bazar Samiti Patna-06
Call : 9569668800 | 7544015993/4/6/7

# PHYSICS

**1. (C)**

$$\mu mg = m\left(\frac{mg}{4m}\right) \Rightarrow \mu = \frac{1}{4}$$

**2. (C)**

If acceleration of block *A* is *a* upward along the incline, then acceleration of block *B* is 2*a* downward.

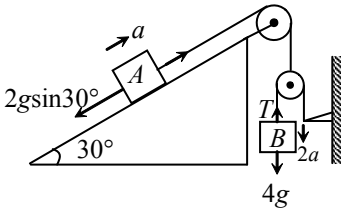
For block *B*,

$$4g - T = 8a \qquad \ldots(i)$$

For block *A*,

$$2T - 2g\sin 30° = 2a$$

$$\Rightarrow \quad T - \frac{g}{2} = a \qquad \ldots(ii)$$




From (i) and (ii)

$$9a = \frac{7g}{2}$$

$$a = \frac{70}{18}\ m/s^2 = \frac{35}{9}\ m/s^2$$

**3. (A)**

This is the situation similar to elastic collision of ball impinging on floor and bouncing back.

**4. (B)**

$$v_{avg} = \frac{\frac{1}{2}\times\frac{t}{2}\times v + \frac{t}{2}\times v}{t} = \frac{3v}{4}$$

**5. (A)**

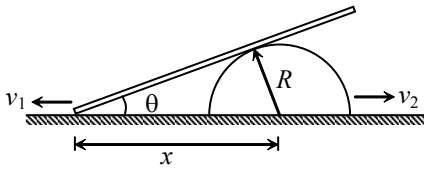
$$\frac{dx}{dt} = v_1 + v_2$$

$$\sin\theta = \frac{R}{x}$$

$x = R\ \text{cosec}\ \theta$

$$\frac{dx}{dt} = -R\ \text{cosec}\ \theta\ \cot\theta\ \frac{d\theta}{dt}$$

$$\frac{d\theta}{dt} = \frac{-(v_1 + v_2)\sin^2\theta}{R\cos\theta}$$ (–ve sign shows that $\theta$ decreasing with time)



**6. (B)**

$a_c = k^2rt^2$ or $\frac{v^2}{r} = k^2rt^2$ or $v = krt$

Therefore, tangential acceleration, $a = \frac{dv}{dt} = kr$

or tangential force,

Only tangential force does work, $F_t = ma_t = mkr$

Power = $F_t v = (mkr)(krt)$ or Power = $mk^2r^2t$

**7. (B)**

Let $x$ be the extension in the spring when 2 kg block leaves the contact with ground. Then,

$kx = 2g$

or $x = \frac{2g}{k} = \frac{2 \times 10}{40} = \frac{1}{2}\text{m}$

Now, from conservation of mechanical energy

$$mgx = \frac{1}{2}kx^2 + \frac{1}{2}mv^2 \quad (m = 5 \text{ kg})$$

or $v = \sqrt{2gx - \frac{kx^2}{m}}$

Substituting the values $v = \sqrt{2 \times 10 \times \frac{1}{2} - \frac{(40)}{4 \times 5}} = 2\sqrt{2}$ m/s

**8. (A)**

If block M moves a distance of x the extension in spring increases by $2x$.

By work energy theorem,

$$\frac{1}{2}k[x_0^2 - (x_0 + 2x)^2] + Mgx = O$$

$$-\frac{1}{2}k(4x^2 + 4xx_0) + Mgx = O$$

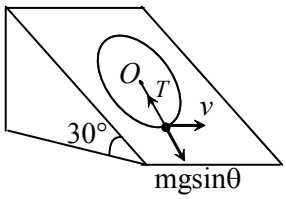
$$\frac{1}{2}k(4x + 4x_0) = Mg$$

$$x + x_0 = \frac{Mg}{2k}$$

$$x = \frac{Mg}{2k} - x_0$$

**9. (B)**

$$T - mg\sin\theta = \frac{mv^2}{r}$$




$$T = mg\sin\theta + \frac{mv^2}{r}$$

$$= 2 \times 10 \times \frac{1}{2} + \frac{2\times 36}{0.5}$$

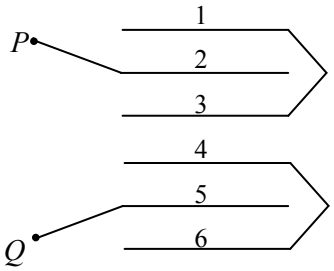
$$= 10 + 144$$

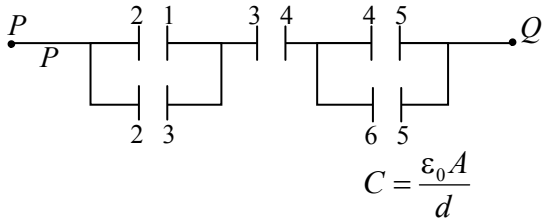
$$= 154 \text{ N}$$

**10. (D)**

$$\frac{1}{C_{eff}} = \frac{1}{3C} + \frac{1}{C} \Rightarrow C_{eff} = \frac{3C}{4}$$

**11. (C)**




$$C = \frac{\varepsilon_0 A}{d}$$

$$\frac{1}{C_{eq}} = \frac{1}{2C} + \frac{1}{C} + \frac{1}{2C} = \frac{4}{2C}$$

$$C_{eq} = \frac{C}{2} = \frac{\varepsilon_0 A}{2d}$$

**12. (C)**

By Guass theorem, $\oint EdS = \frac{1}{\varepsilon_0}\int dq$

$$\Rightarrow \quad E = \frac{\rho}{\varepsilon_0}\left(\frac{r}{2} - \frac{r^2}{9}\right)$$

for max. electric field, $\frac{dE}{dr} = 0$

$\Rightarrow \quad \frac{1}{2} - \frac{2r}{9} = 0 \qquad \Rightarrow \quad r = \frac{9}{4}$

**13. (C)**

Centripetal force on electron at distance *r* from centre of disc.

$$m\omega^2 r = eE \Rightarrow E = \frac{m\omega^2 r}{e}$$

$$Q = \int_O^R \rho dV = \int_O^R \frac{2\varepsilon_0 m\omega^2}{e} \times 2\pi r \ell \, dr$$

$$= \frac{2\pi\varepsilon_0 m\omega^2 R^2 \ell}{\varepsilon_0}.$$

**14. (B)**

Work done on innermost shell

$$W_1 = \Delta U_1 + \Delta U_{12} + \Delta U_{13}$$

$$= \frac{KQ^2}{12r}$$

Work done on middle shell

$$W_2 = \Delta U_2 + \Delta U_{21} + \Delta U_{23}$$

$$= \frac{KQ^2}{3r}$$

$\therefore \quad \frac{W_1}{W_2} = \frac{1}{4}.$

**15. (A)**

Electrostatic field is always conservative.

**16. (D)**

$C_{final} = C_1 + C_2, \; V_{common} = \left( \frac{C_1 V_0}{C_1 + C_2} \right)$

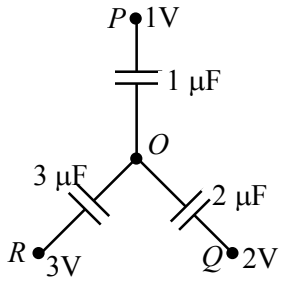
$$E_{final} = \frac{1}{2}(C_1 + C_2)\left(\frac{C_1 V_0}{C_1 + C_2}\right)^2 = \frac{C_1^2 V_0^2}{2(C_1 + C_2)} = \frac{C_1 U_0}{C_1 + C_2}$$

$$E_{initial} = \frac{1}{2} C_1 V_0^2 = U_0, \qquad E_{loss} = E_{initial} - E_{final} = \frac{C_2 U_0}{C_1 + C_2}.$$

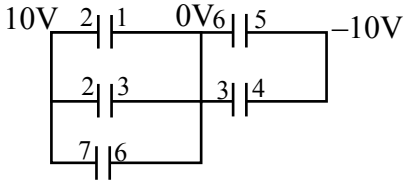
**17. (D)**

$$1(v-1) + 2(v-2) + 3(v-3) = 0$$

$$v = \frac{7}{6}\text{V}$$




**18. (C)**




Circuit can be redrawn as

$$C_{eq} = \frac{6C}{5} = \frac{6\varepsilon_0 A}{5L}$$

**19. (A)**

The equivalent capacitance

$$C = \frac{4\pi\varepsilon_0(3a \times 4a)}{(4a - 3a)} + 4\pi\varepsilon_0(4a)$$

$$= 64\pi\varepsilon_0 a\,.$$

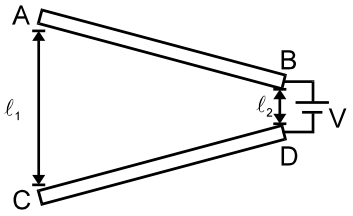
**20. (B)**

The potential in both the plates are same.

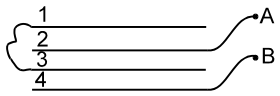
i.e. $V_{AC} = V_{BD}$ $\Rightarrow$ $E_{AC} \times \lambda_1 = E_{BD} \times \lambda_2$

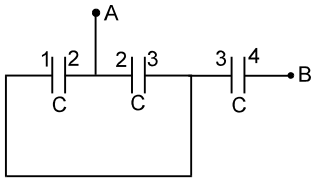
$\Rightarrow$ $E_{AC} < E_{BD}$ (as $\lambda_1 > \lambda_2$)

$\Rightarrow$ $\sigma_A < \sigma_B$ (since, $E \alpha \sigma$)

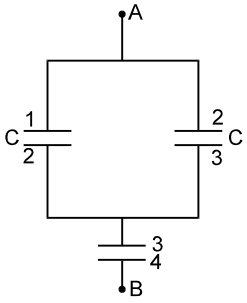


**21. (C)**

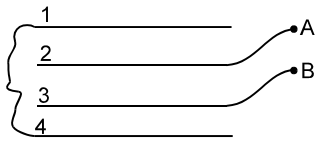
(i) 

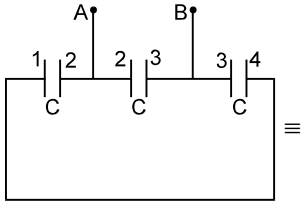

This is equivalent to 


Let capacitance of each capacitor be C, then $C = \frac{\varepsilon_0 S}{d}$

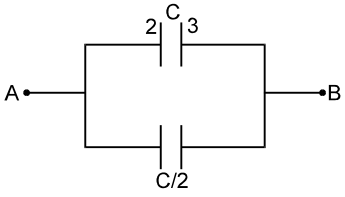



$\equiv C_{eq} \frac{2C \times C}{2C + C} = \frac{2}{3}C = \frac{2}{3} \frac{\varepsilon_0 A}{d}$

(ii) 


This is equivalent to 

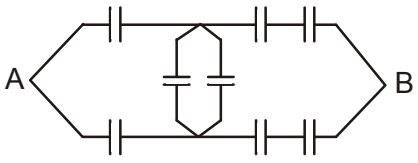
≡




$\therefore \quad C_{eq} = C + \frac{C}{2} = \frac{3C}{2} = \frac{3}{2} \frac{\varepsilon_0 S}{d}$

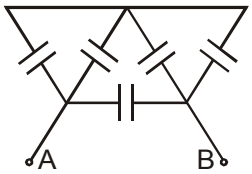
**22. (C)**

Circuit can be redrawn as



**23. (B)**

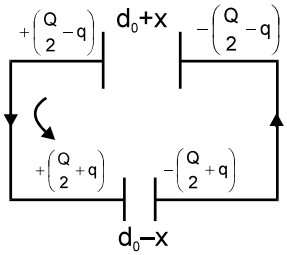
The equivalent circuit is




$C_{AB}$ = 60 $\mu$F

**24. (A)**

Let each plate moves a distance 'x' from its initial position.




Let q charge flows in the loop. using KVL

$$\frac{\left(\frac{Q}{2}-q\right)(d+x)}{\epsilon_0 A}-\frac{\left(\frac{Q}{2}+q\right)(d-x)}{\epsilon_0 A}=0$$

$$\therefore \quad q=\frac{Qx}{2d_0} \; ; \quad I=\frac{dq}{dt}=\frac{Q}{2d_0}\left(\frac{dx}{dt}\right) ;$$

**25. (D)**

When switch $S_2$ is closed, due to symmetry no charge will flow through $S_2$.

**Alternate solution :**

Current through $S_2$ will be zero. $\because$ top point of $S_2$ is also connected to zero potential.

**Alternate solution :**

After closing and before closing the switch there is no change in potential of any point.

**26. (D)**

**27. (C)**

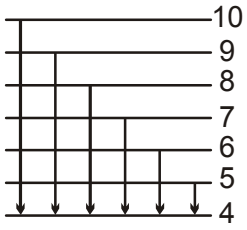
**28. (B)**

**29. (D)**

**30. (C)**

# CHEMISTRY

**31. (B)**




6 spectral lines in bracket series.

**32. (B)**

For $Zn + 2Fe^{+2} \rightarrow Zn^{+2} + 2Fe$ $E^{o}_{cell} = -0.44 + 0.76 = +ve$ and hence, the reaction is spontaneous.

**33. (A)**

A gas does not liquifies above $T_C$.

**34. (B)**

$Cl_2 + 2e^- \longrightarrow 2Cl^-$

$(P_2)$

$2Cl^- \longrightarrow Cl_2 + 2e^-$

$(P_2) \qquad (P_1)$

$Cl_2 \longrightarrow Cl_2$

$(P_2) \qquad (P_1)$

$$E = \frac{-0.0591}{2}\log\frac{P_1}{P_2}$$

For the cell to be spontaneous

$\Delta G = -nFE = -ve$ and $E = +ve$ i.e. $\mathbf{P_2 > P_1}$.

**35. (B)**

Ni reacts with CO, So [CO] decreases so, second reaction moves backward i.e $[Cl_2]$ increases so, first reaction also moves backward so, $[PCl_3]$ decreases and $[PCl_5]$ increases.

**36. (B)**

$$Kt = 2.303\log_{10}\frac{C_0}{Ct}$$

$$K \times 138.6 = 2.303\log_{10}\frac{1}{0.25}$$

or $K = \frac{2.303 \times 2 \times 0.301}{138.6} = \frac{2 \times 0.693}{138.6} = 0.01\,min^{-1}$

rate = $K[R]^1 = 0.01 \times 0.1 = 10^{-3}\,Mmin^{-1}$.

**37. (B)**

For 1 F 1g.eq metal is deposited i.e, 1 mole Ag, $\frac{1}{2}$ mole Cu and $\frac{1}{3}$ mole Al

So, mole ratio $1 : \frac{1}{2} : \frac{1}{3} = 6 : 3 : 2$

**38. (A)**

$2H^+(aq.) + 2e^- \longrightarrow H_2(g)$

$E_1 = -\frac{0.059}{2}\log_{10}\frac{P_{H_2}}{[H^+]^2}$ (i)

$E_2 = -\frac{0.059}{2}\log_{10}\frac{100P_{H_2}}{[H^+]^2}$ (ii)

$E_2 - E_1 = \frac{0.059}{2}\log_{10}10^{-2} = -0.059$ decreases

**39. (C)**

$$H_2(0.4\ atm) \longrightarrow 2H^+(10^{-1}M) + 2e^-$$

$$\frac{2H^+(10^{-2}M) + 2e^- \longrightarrow H_2(0.1atm)}{H_2(0.4\ atm) + 2H^+(10^{-2}M) \longrightarrow 2H^+(10^{-1}M) + H_2(0.1\,atm)}$$

$E_{cell} = 0 - \frac{0.059}{2}\log_{10}\frac{(10^{-1})^2 \times 0.1}{(10^{-2})^2 \times 0.4}$

$= -0.059\log_{10}5$

**40. (B)**

$i = 10 \times 10^{-3}A = 10^{-2}A$

t = ?

mass of $H_2 = 0.01 \times 2$

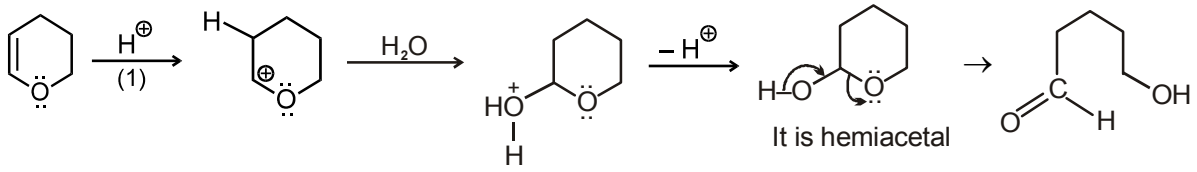
$w = \frac{i \times t}{F}E$

$$0.01\times 2=\frac{10^{-2}\times t}{96500}\times 1$$

$$\text{or}_1\ \ t=\frac{0.01\times 2\times 96500}{10^{-2}}$$

$$=19.3\times 10^{4}\ s$$

**41. (D)**




**42. (B)**

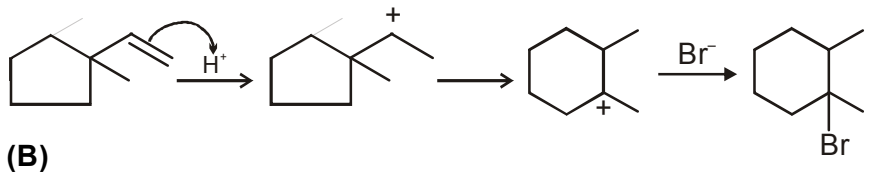
Ring contraction take place.

**43. (B)**

In this reaction carbocations are formed as intermediate and rearrangement also takes place.

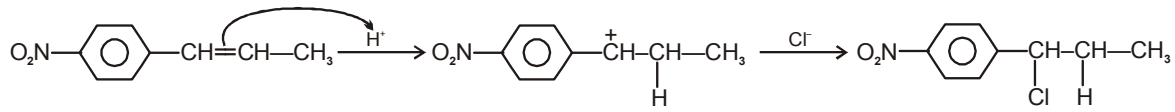
**44. (A)** **45. (D)** **46. (D)**

**47. (A)**

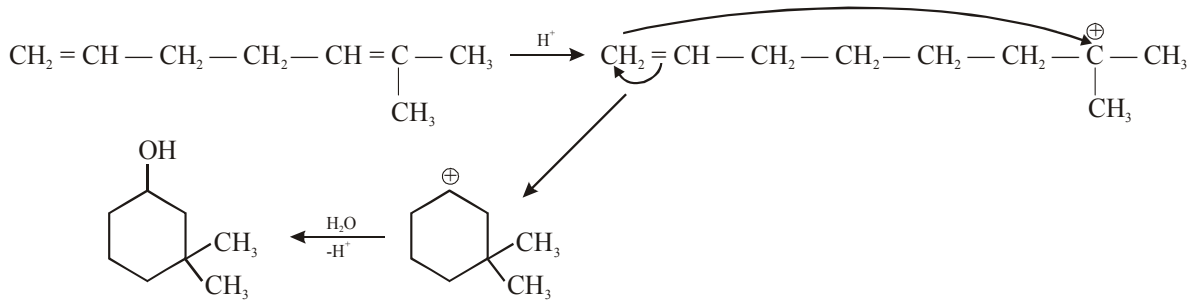


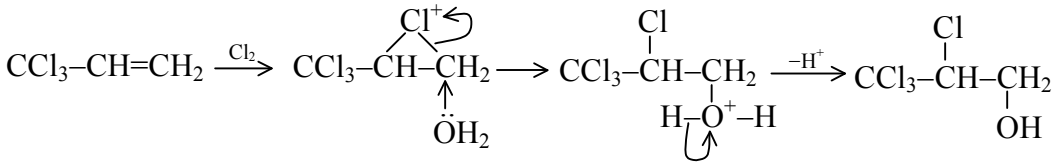

**48. (B)**

**49. (B)**




**50. (D)**





**51. (A)**

**52. (B)**

**53. (B)**

**54. (A)**

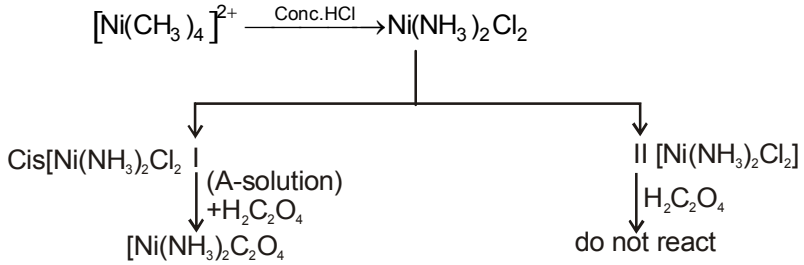
**55. (B)**

Argentite is a sulphide ore.

**56. (D)**

The anode mud in the electrolytic refining of silver contains Au.

**57. (B)**



I = Cis $[Ni(NH_3)_2Cl_2]$

II = Trans $[Ni(NH_3)_2Cl_2]$

**58. (A)** **59. (D)** **60. (C)**

# MATHEMATICS

**61. (C)**

$$\tan^{-1}1+\tan^{-1}\frac{1}{2}+\tan^{-1}\frac{1}{3}$$

$$\tan^{-1}1+\tan^{-1}\left(\frac{\frac{1}{2}+\frac{1}{3}}{1-\frac{1}{6}}\right)=\frac{\pi}{2}$$

**62. (D)**

$-1 \le \sin x \le 1$

$-2 \le 2\sin x \le 2$

Range [cos2, 1]

**63. (A)**

**64. (A)**

$$\frac{\tan\theta}{\tan\theta - \tan 3\theta} + \frac{\cot\theta}{\cot\theta - \cot 3\theta} = 1$$

**65. (D)**

$\log_2\left(x^2 + 12\right) = 4$

$x^2 = 4$

$x = \pm 2$

$x = \pm 1$

$x = 0$

**66. (B)**

At x = 0

**67. (C)**

**68. (A)**

$y' = 0$ at x = 5

$bx^{\frac{3}{2}} - 5a = 0$

$\frac{a}{b} = \sqrt{5}$

**69. (A)**

f(–1) = f(1)

**70 (A)** **71. (A)** **72. (B)** **73. (D)**

**74. (B)** **75. (B)** **76. (D)** **77. (A)**

**78. (B)**

**79. (D)**

$4 = t^2$ ; $2 = t^3 - 3t \quad \Rightarrow t = 2$

$\frac{dy}{dx} = \frac{3t^2 - 3}{2t} = \frac{9}{4}$

**80. (D)** **81. (C)** **82. (A)** **83. (C)**

**84. (D)** **85. (C)** **86. (D)**

**87. (A)**

Let a, and b be two number then a, $A_1$, $A_2$, b where $A_1$, $A_2$ are AM's

$\therefore$ $A_1 + A_2 = a + b$ ....(1)

a, $G_1$, $G_2$ b where $G_1$, $G_2$ are G.M's then

$G_1G_2 = ab$ ....(2)

a, $H_1$, $H_2$, b where $H_1$, $H_2$ are Hm's

$$\frac{1}{H_1}+\frac{1}{H_2}=\frac{1}{a}+\frac{1}{b}=\frac{a+b}{ab}$$

$$\therefore \quad \frac{H_1+H_2}{H_1H_2}=\frac{a+b}{ab} \qquad .....(3)$$

$$\frac{H_1+H_2}{H_1H_2}=\frac{A_1+A_2}{G_1G_2}$$

$$\frac{G_1G_2}{H_1H_2}=\frac{A_1+A_2}{H_1+H_2}$$

**88. (A)**

**89. (A)**

$$S = \frac{5}{2}+\frac{7}{4}+\frac{11}{8}+\frac{19}{16}+.....+t_n$$

$$= \left(1+\frac{3}{2}\right) + \left(1+\frac{3}{4}\right) + \left(1+\frac{3}{8}\right) + \left(1+\frac{3}{16}\right) + \text{upto n term}$$

$$= n + \left(\frac{3}{2}+\frac{3}{4}+\frac{3}{8}+.....\text{upto n term}\right) = n + \frac{\frac{3}{2}\left(1-\frac{1}{2^n}\right)}{1-\frac{1}{2}} = n + 3 - \frac{3}{2^n}$$

**90. (A)**

$$\cos x = \frac{2\cos(x-y)\cos(x+y)}{\cos(x+y)+\cos(x-y)}$$

$\Rightarrow$ $2\cos x \cos x \cos y = 2(\cos^2 x - \sin^2 y)$ $\Rightarrow$ $\cos^2x \cos y = \cos^2x - \sin^2y$

$\Rightarrow$ $\cos^2x(1 - \cos y) = \sin^2y$ $\Rightarrow$ $2\cos^2x \times \sin^2\left(\frac{y}{2}\right) = \sin^2y$

$$\Rightarrow \quad 2\cos^2 x \sin^2\left(\frac{y}{2}\right) = 4\sin^2\left(\frac{y}{2}\right)\cos^2\left(\frac{y}{2}\right) \quad \Rightarrow \cos x \ \sec\frac{y}{2} = \pm\sqrt{2}$$