FIITJEE

ALL INDIA TEST SERIES

JEE (Advanced)-2025

CONCEPT RECAPITULATION TEST – III

PAPER –2

TEST DATE: 24-04-2025

ANSWERS, HINTS & SOLUTIONS

Physics PART – I

Section – A

1. B

Sol. Let the length of rod is ℓ and co-ordinate of B is (x, y)

$\vec{v}_B = v_x\hat{i} + v_y\hat{j} = \sqrt{3}\hat{i} + v_y\hat{j}$

$x^2 + y^2 = \ell^2 \Rightarrow 2xv_x + 2yv_y = 0 \Rightarrow \sqrt{3} + \frac{y}{x}v_y = 0$

$\Rightarrow \sqrt{3} + \tan 60^o v_y = 0 \quad v_y = -1 \text{ m/s}$

$\vec{v}_B = \sqrt{3}\hat{i} - 1\hat{j}$

$|\vec{v}_B| = \sqrt{3+1} = 2\text{m/s}$

2. B

Sol. Let $\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k} = \frac{dv_x}{dt}\hat{i} + \frac{dv_y}{dt}\hat{j} + \frac{dv_z}{dt}\hat{k}$

As $\vec{a}$ is constant, so its magnitude as well as direction is not changing but v_x, v_y, and v_z all can be varying (any combination of these a_x, a_y, or $a_z = 0$, then corresponding velocity component may be constant)

$|\vec{v}| = v = \sqrt{v_x^2 + v_y^2 + v_z^2}$

$$\frac{d|\vec{v}|}{dt} = \frac{1}{2\sqrt{v_x^2 + v_y^2 + v_z^2}}\left[2v_x\frac{dv_x}{dt} + 2v_y\frac{dv_y}{dt} + 2v_z\frac{dv_z}{dt}\right] = \frac{\vec{v}.\vec{a}}{v}$$

Which is a variable quantity

$\left|\frac{d\vec{v}}{dt}\right| = |\vec{a}|$ which would be a constant

$$\frac{dv^2}{dt^2} = \frac{d\left(v_x^2 + v_y^2 + v_z^2\right)}{dt^2} = 2\vec{v}.\vec{a}$$

[a variable quantity]

$$\frac{d(\vec{v}/v)}{dt} = \frac{d}{dt}\left[\frac{v_x\hat{i}+v_y\hat{j}+v_z\hat{k}}{\sqrt{v_x^2+v_y^2+v_z^2}}\right]$$

[a variable quantity]

3. D
Sol. Apply Snell's law and use geometry.

4. D
Sol. Total energy received by the atom will be 25.2eV. 13.6 eV energy is needed to remove the electron from the attraction of the nucleus rest energy will be almost available in the from K.E. of electron.

5. ABD
Sol. Work done by all force = change in KE

$\vec{v} = \vec{v} + \vec{a}t$

$= \left(8\hat{i} + 8\hat{j}\right)$

$v = 8\sqrt{2}$

$KE = \frac{1}{2}\times 2\times\left(8\sqrt{2}\right) = 128J$

Displacement of the block in the frame of elevator = zero.

6. BD
Sol. The observed reading will be = 10 mm + 1 × 01 mm = 1.01 cm

$\therefore$ density = $\frac{\text{Mass}}{\text{vol}} = \frac{2.7369}{(1.01)^3}$ = 2.65654

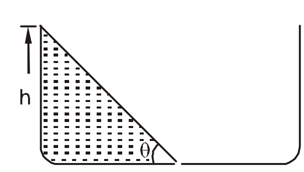
$\approx 2.66\ \text{gm/cm}^3$

7. AC
Sol. The maximum amount of water that can be retained is shown in the fig. If θ is the angle made by the water surface with the horizontal then.

$\tan\theta = \frac{h}{c} = \frac{a}{g}$

$\Rightarrow a = \frac{hg}{c}$

So the maximum volume that can be retained is $\frac{1}{2} \times h \times c \times b$.



And F = $\left[M + \frac{hcb\rho}{2}\right]\frac{hg}{c}$

8. ABCD
Sol. y = 2a cos (ωt + ϕ) cos (Kx) comparison with given equation gives

$$K = \frac{2\pi}{\lambda} = 10\pi \Rightarrow \lambda = \frac{1}{5}m$$

$\omega = 2\pi f = 50\pi \Rightarrow f = 25$ Hz

$\therefore$ v = 5 ms^{-1}

at x = 0.15 m

cos (10 π × 0.15) = cos (1.5π)

= –1 for all t

at x = 0.3

cos (10 π × 0.3) = cos 3π = – 0 for all t

9. ABC

Sol. As $\gamma > 1$

for $TV^{\gamma-1}$ = constant $\frac{dT}{dV} < 0$ $\quad \frac{d^2T}{dV^2} > 0$

and for $T^{\gamma} = KP^{\gamma-1}$

$$\frac{dT}{dP} > 0 \quad \frac{d^2T}{dP^2} < 0$$

10. AB

Sol. $T_A = 2T_B$ and $r_B = 2r_A$

$$\Rightarrow \frac{P_A}{P_B} = 4.$$

Section – B

11. 3

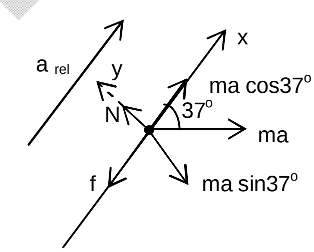
Sol. $f_x = ma_x$

ma cos37° - μN = $ma_{(rel)}$

$F_y = ma_y$

$ma_{(rel)}$ = ma cos37° - μ (ma sin37°)

$$\ell = \frac{1}{2}\left(a\cos 37^o - \mu a \sin 37^o\right)t^2$$

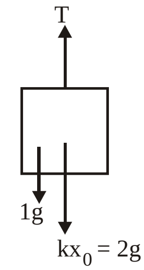


a = 5 m/s^2

$$t = \sqrt{\frac{30.6}{5\left(\frac{4}{5} - \frac{3}{5}(0.2)\right)}} = \sqrt{\frac{30.6}{3.4}} = 3\,\text{sec}$$

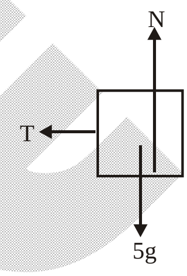
12. 5

Sol. Just after cutting the string 1 the extension of the string will remain same as it was before cutting the string '1'. So, we can take string force on block is equal '2g'. Now making F.B.D of block 'B'.



$3g - T = 1a$… (1)

Making F.B.D of block 'c'



$T = 5a$… (2)

From (1) and (2)

$a = g/2 = 5\ m/s^2$.

13. 3

Sol. $P_o + P = P_o - \rho gh + \frac{1}{2}\rho v^2$ and $V = 2\sqrt{2gh}$

$P = 3\rho gh = 3 \times 10^5 = 3$ atm.

14. 2

Sol. $CRT_o = \frac{R\Delta T}{2} + \frac{3}{2}R\Delta T$

15. 2

Sol. $T = 2\pi\sqrt{\frac{4\ell \sin 37^o}{g}}$

$= 2\pi\frac{4\times 150\times\frac{3}{5}}{10} = 2\pi\times 6$

$= 2 \times 6 \times \pi = 2$.

16. 2

Sol. If the particle hits a plane at its highest point when the plane is vertical then

$eu\cos\theta \times \frac{u\sin\theta}{g} + \frac{2eu\sin\theta}{g}\times eu\cos\theta = u\cos\theta\times\frac{u\sin\theta}{g}$

$\Rightarrow$ e = ½

17. 9

Sol. $l_2' = 4\text{m}$

$S = \frac{1}{2} \times gt^2$

$4 = \frac{1}{2} \times 10t_2^2$

$t_2 = \sqrt{0.8}$

$t_1 : t_2 : t_3 = 1 : 2 : 3$

$t_1 = \frac{1}{2}\sqrt{0.8}$

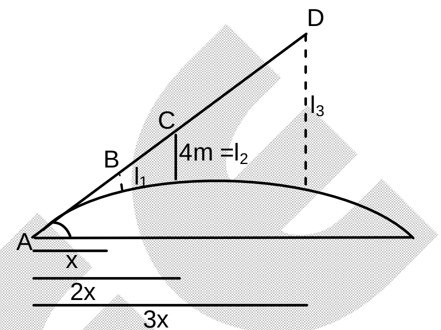
$t_2 = \frac{\sqrt{0.8}}{\sqrt{0.8}}$

$t_3 = \frac{3}{2}\sqrt{0.8}$

$l_3 = \frac{1}{2}gt^2$

$= \frac{1}{2} \times 10 \times \frac{9}{4} \times 0.8$

$l_3 = 9\text{m}$



18. 6

Sol. mc (10 – T) = m 2c (T–5) + 2mC (T-5)
T = 6°C.

Chemistry

PART – II

Section – A

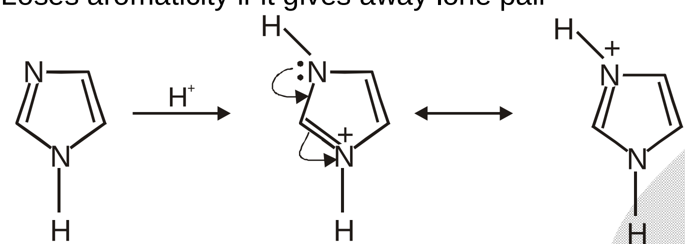
19. B

Sol. $COCl_2 + H_2O \longrightarrow CO_2 + 2HCl$

20. B

Sol. (i) Loses aromaticity if it gives away lone pair

(ii)



Conjugate acid is resonance stabilized but attached to sp^2 carbon atoms, which shows –I effect and destabilize the conjugate acid.

21. A

Sol. The elevation in boiling point is

$\Delta T_b = K_b\, m$: m = molality = $\dfrac{n_2}{w_1}\times 1000$

$2 = 0.76 \times \dfrac{n_2}{100}\times 1000$

$n_2 = \dfrac{5}{19}$

Also, from Raoult's law of lowering of vapour pressure

$\dfrac{-\Delta p}{p^o} = x_2 = \dfrac{n_2}{n_1+n_2} = \dfrac{n_2}{n_1}$

$\Rightarrow -\Delta p = 760 \times \dfrac{5}{19}\times\dfrac{18}{100} = 36$ mm of Hg

$\Rightarrow p = 760 - 36 = 724$ mm of Hg

22. A

Sol. $Ag^+ + NH_3 \rightleftharpoons [Ag(NH_3)]^+$ $\quad K_1 = 3.5\times 10^{-3}$

$[Ag(NH_3)]^+ + NH_3 \rightleftharpoons [Ag(NH_3)_2^+]$ $\quad K_2 = 1.7\times 10^{-3}$

Adding: $Ag^+ + 2NH_3 \rightleftharpoons [Ag(NH_3)_2^+]$

$K = K_1 \times K_2 = 5.95\times 10^{-6}$

23. AC

Sol. (A) $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

$2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$

(B) $MgCl_2.6H_2O \xrightarrow{\Delta} MgCl_2.H_2O + 5H_2O$

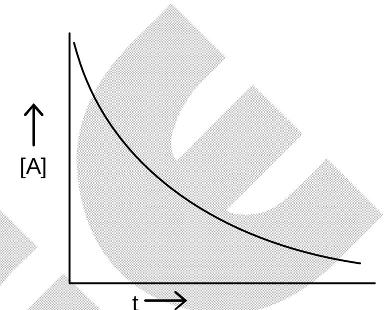
$Na_2SO_4.10H_2O \xrightarrow{\Delta} Na_2SO_4 + 10H_2O$

(C) $2FeSO_4 \xrightarrow{\Delta} Fe_2O_3 + SO_2 + SO_3$

$Fe_2(SO_4)_3 \xrightarrow{\Delta} Fe_2O_3 + 3SO_3$

24. ABD

Sol. (A) For a first order reaction, the concentration of reactant, the concentration of reactant remaining after time t is given by $[A] = [A]_0e^{-kt}$. Therefore, concentration of reactant decreases exponentially with time.



(B) Rise in temperature increases rate constant(k) and therefore decreases half-life($t_{1/2}$) as $t_{1/2} = \dfrac{\ln 2}{k}$

(C) Half-life of first order reaction is independent of initial concentration

(D) For a first order reaction, if 100 moles of reactant is taken initially, after n half-lives, reactant remaining is given by

$$\%A = 100\left(\frac{1}{2}\right)^n = 100\left(\frac{1}{2}\right)^8 = 0.3906$$

$\Rightarrow$ A reacted = 100 – 0.3906 = 99.6%

25. CD

Sol. The bond order of graphite is 1.5 and that of diamond is one. Graphite is more stable than diamond.

26. ABCD

Sol. $CH_3OC_2H_5 \xrightarrow{HI} CH_3OH + C_2H_5I + CH_3I + C_2H_5OH$

All four products are formed.

27. ABC

Sol. Dipole moment of $NH_3 > NF_3$, $SCl_2 > BeCl_2$(zero value)

$SF_4 > CF_4$(zero value)

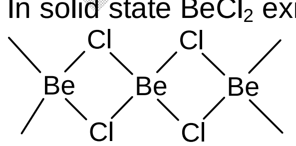
28. AC

Sol. $\mu = 2\mu\cos\frac{\theta}{2}$ [When two diploes are identical]

Section – B

29. 4

Sol. In solid state $BeCl_2$ exists as



30. 3

Sol. $$2X(g) \rightleftharpoons 2Y(g) + Z(g)$$

Initial	1	0	0
At equi	$1 - \propto$	$\propto$	$\propto/2$

$\therefore$ Partial pressure [If total pressure P]

$$p_x = \left[\frac{1-\propto}{1+\propto/2}\right]P \simeq P \qquad p_y = \frac{\propto}{1+\propto/2}P \simeq \propto P$$

$$p_z = \left[\frac{\propto/2}{1+\propto/2}\right]P \simeq \frac{\propto P}{2}$$

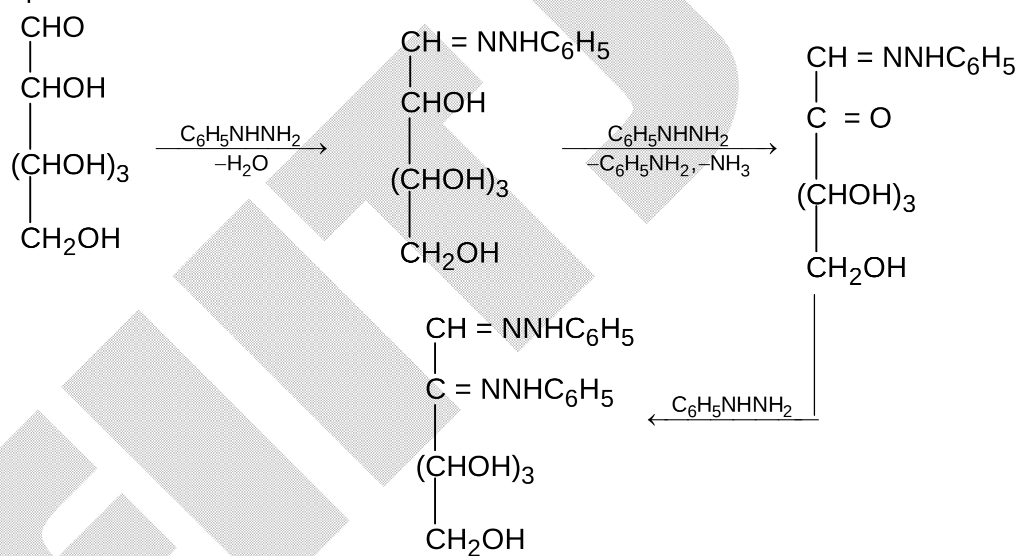
$$\therefore K_p = \frac{[p_y]^2[p_z]}{[p_x]^2} = \frac{[\propto P]^2\left[\frac{\propto P}{2}\right]}{P^2}$$

$$K_p = \frac{\propto^3 P}{2}$$

$$\propto = \left(\frac{2K_p}{P}\right)^{\frac{1}{3}}$$

31. 4

Sol.



32. 5

Sol. $$\frac{\lambda_{(Be^{4+})}}{\lambda_{(He^{2+})}} = \frac{\dfrac{h}{m(Be^{4+})U}}{\dfrac{h}{m(He^{2+})U}} = \frac{m(He^{2+})}{m(Be^{4+})} = \frac{4}{9} = \frac{x}{y}$$

$\therefore$ y – x = 5

33. 5

Sol. The 3p orbitals(n + ℓ = 4) contains five electrons.

34. 3
Sol. Use concept of conformational analysis of given organic compound.

35. 6
Sol. $\Delta H = nC_V\Delta T$

or, $12 = \frac{4.48}{22.4} \times C_V \times 15$

or, $C_V = 4$

$C_P - C_V = R = 2 \Rightarrow C_P = C_V + 2 = 4 + 2 = 6$ cal

36. 6
Sol. For zero order reaction the half-life is directly proportional to the concentration of reactant.

$X \xrightarrow{t_{1/2}=4\,sec} \frac{X}{2} \xrightarrow{t_{1/2}=2\,sec} \frac{X}{4}$

$\therefore$ Total time needed for 75% reaction = 4 + 2 = 6 sec

Mathematics PART – III

Section – A

37. C
Sol. 4 circles touch sides of any given triangle formed by 3 tangents.

38. B
Sol. $(x + iy)^3 = 18 + 26i$
$\Rightarrow x^3 - 3xy^2 = 18$
$3x^2y - y^3 = 26$
Use y = tx and solve

39. C
Sol. Let common root be α and $P(x) = x^2 + bx + c$
Now $P(\alpha) = 0$ and $P(P(P(\alpha))) = 0$
$\therefore$ one of the roots must be 1

40. B
Sol. $|A + B| = 0$

41. AD
Sol. By intermediate value property $\frac{f(0)+f(2)}{2} = f(c),\ 0 < c < 2$
By mean value theorem
$f(1) - f(0) = f'(c_1),\ 0 < c_1 < 1$
$f(2) - f(1) = f'(c_2),\ 1 < c_2 < 2$
By subtraction
$f(0) + f(2) - 2f(1) = f'(c_2) - f'(c_1)$
$= (c_2 - c_1)f''(c),\ c_1 < c < c_2 \Rightarrow f(0) + f(2) - 2f(1) < 0$
$\Rightarrow f(0) + f(2) < 2f(1)$

42. ABCD
Sol. If we could show that $f'''(x) > 0$ then all choices follow since $f(0) = f'(0) = f''(0) = 0$
Indeed $f'(x) = 1 + \frac{8}{3}x^2 - \sec^2 x,\ f'(0) = 0$
$f''(x) = \frac{16}{3}x - 2\sec^2 x \tan x \quad f''(0) = 0$
$f'''(x) = \frac{16}{3} - 2\sec^4 x - 4\sec^2 x \tan^2 x$
$= \frac{16}{3} - 2\sec^2 x\left(\sec^2 x + 2\tan^2 x\right)$
$\because 0 < x < \frac{\pi}{6}$

$\max\left[2\sec^2 x\left(\sec^2 x + 2\tan^2 x\right)\right]$

$= 2\left(\dfrac{2}{\sqrt{3}}\right)^2\left(\dfrac{4}{3}+\dfrac{2}{3}\right) = \dfrac{16}{3}$

$\Rightarrow \quad f'''(x) > 0$

Whence all choices follow.

43. ABC

Sol. $Y = y = m(X - x)$

Put $X = 0$

$Y = y - mx$

$\therefore y - mx = x^2$

$\dfrac{dy}{dx} - \dfrac{1}{x}y = -x$ (linear DE)

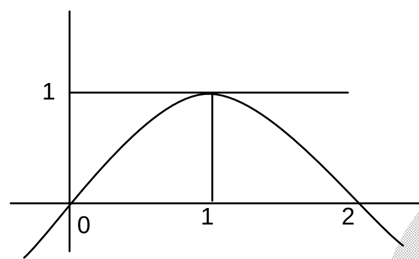
Solving

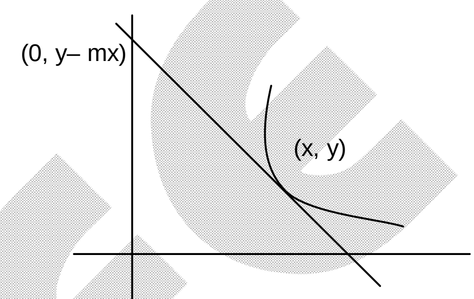
$y = -x^2 + cx$

$x = 1, y = 1$

$\Rightarrow \ c = 2$

$y = 2x - x^2$





44. AD

Sol. $f'(x) = \lim\limits_{n\to 0}\dfrac{f(x+h) - f(x)}{h}$

$= |x|$

Hence, f (x) is differentiable for all $x \in R$ but not twice differentiable at x = 0.

45. AB

Sol. Consider a number system with base 3 and using only the digits 0 or 1.

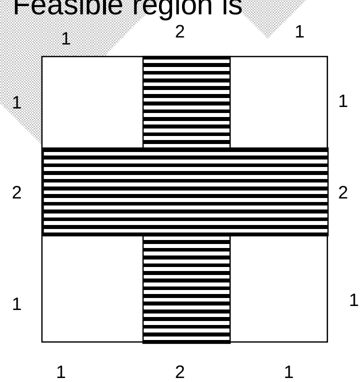
46. AC

Sol. Second diagonal will pass through the centre of the hyperbola.

Section – B

47. 5

Sol. Feasible region is



48. 8

Sol. $x^4 - 7x^2 - 4x + 20 = (x^2 - 4)^2 + (x - 2)^2$

$x^4 + 9x^2 + 16 = (x^2 + 4)^2 + x^2$

Take the curve $y = x^2$. Both square roots can be interpreted as distances.

49. 9

Sol. Given $ar^2 = 8$

$\Rightarrow \quad a = \frac{8}{r^2}$

Sum, $S = \frac{\frac{8}{r^2}}{1-r} = \frac{8}{r^2(1-r)}$

Sum is minimum when $f(r) = r^2 - r^3$ is maximum.

$f'(r) = 2r - 3r^2 = 0$

$\therefore \ r = \frac{2}{3}$ is point of maxima

$\therefore S_{min} = \frac{8}{\frac{4}{9}\left(1 - \frac{2}{3}\right)} = 54$

50. 5

Sol. Since the line $y = mx + 1$ touches $y = -x^4 + 2x^2 + x$,

Curve $-x^4 + 2x^2 + x = mx + 1$ should have coincident solution.

i.e. x_1, x_1 and x_2, x_2

$\therefore x^4 - 2x^2 + (m-1)x + 1 = (x - x_1)^2 (x - x_2)^2$

On comparing, we get

$x_1 = 1, x_2 = -1$

$\therefore y_1 = 2; y_2 = 0$

$\therefore \ \frac{x_1^2 + y_1^2}{x_2^2 + y_2^2} = \frac{1+4}{1+0} = 5$

51. 6

Sol. $P(x) = Q(x)(x^2 + 1) + x^2 - x + 1$

$\therefore \sum P(\alpha) = \sum \alpha^2 - \sum \alpha + 4 = 6$

52. 1

Sol. Here, $f(n) =$ (sum of digits of natural number n)^2

$\therefore \ f(2011) = (2 + 0 + 1 + 1)^2 = 16$

$f^2(2011) = f(f(2011)) = f(16) = (1 + 6)^2 = 49$

$f^3(2011) = f(49) = (4+9)^2 = 169$

$f^4(2011) = f(169) = (1+6+9)^2 = 256$

$f^5(2011) = f(256) = (2+5+6)^2 = 169$

$f^6(2011) = f(169) = (1+6+9)^2 = 256$

$\therefore\ f^{2n}(2011) = 256$ and $f^{2n+1}(2011) = 169$

$$\Rightarrow \frac{f^{2017}(2011) - f^{2016}(2011)}{f^{2017}(2011) - f^{2018}(2011)} = \frac{169-256}{169-256} = 1$$

53. 6

Sol. Diff. both sides

$$f(xy)\{y + xy'\} = y'\int_1^x f(t)dt + yf(x) + \int_1^y f(t)dt + xf(y)y'$$

Put $x = 1$

$$f(y)\{y + y'\} = 3y + \int_1^y f(t)dt + y'f(y)$$

$$yf(\gamma) = 3y + \int_1^y f(t)dt$$

$$xf(x) = 3x + \int_1^x f(t)dx$$

Diff. $\Rightarrow f(x) + xf'(x) = 3 + f(x)$

$$f'(x) = \frac{3}{x}$$

$f(x) = 3\ell nx + c \Rightarrow f(1) = 3 = c$

$f(x) = 3\ell nx + 3 \Rightarrow f(e) = 6$

54. 0

Sol. Let $x = \tan\alpha,\ y = \tan\beta$

$$\therefore \frac{(x+y)(1-xy)}{(1+x^2)(1+y^2)}$$

$$= \frac{(\tan\alpha + \tan\beta)(1 - \tan\alpha\tan\beta)}{\sec^2\alpha\sec^2\beta}$$

$$= \sin(\alpha+\beta)\cos(\alpha+\beta)$$

$$= \frac{1}{2}\sin(2\alpha + 2\beta)$$

$\therefore$ Thus, required range is $\left[\frac{-1}{2}, \frac{1}{2}\right]$.