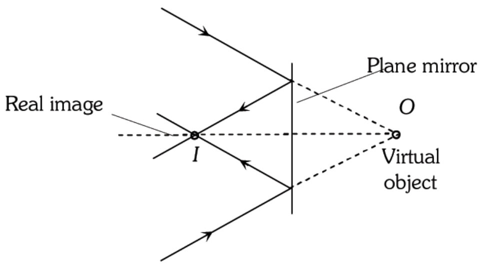
WEEKLY TEST OYJ TEST - 22 R & B
SOLUTION Date 15-09-2019

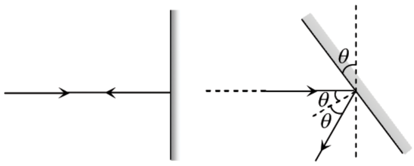
[PHYSICS]

1. (d) $\delta = (360 - 2\theta) = (360 - 2 \times 60) = 240^o$

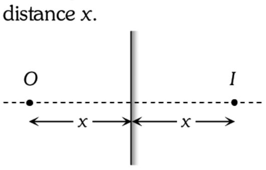
2. (b) When converging beam incident on plane mirror, real image is formed as shown



3. (c, d) By keeping the incident ray is fixed, if plane mirror rotates through an angle θ reflected ray rotates through an angle 2θ.

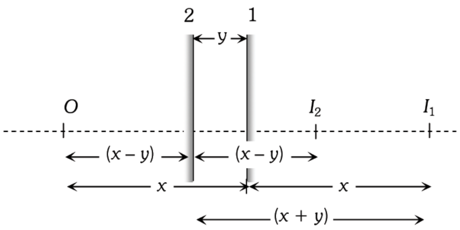


4. (c) Suppose at any instant, plane mirror lies at a distance x from object. Image will be formed behind the mirror at the same distance x.

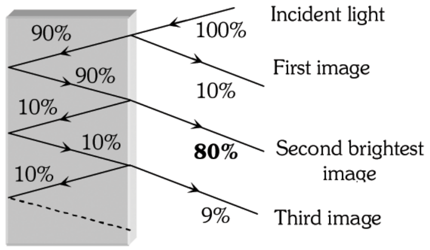


When the mirror shifts towards the object by distance 'y' the image shifts $= x + y - (x - y) = 2y$

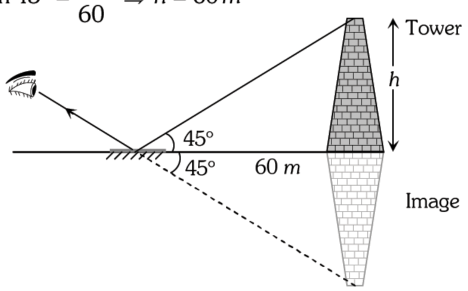
So speed of image $= 2 \times$ speed of mirror



5. (b) Several images will be formed but second image will be brightest



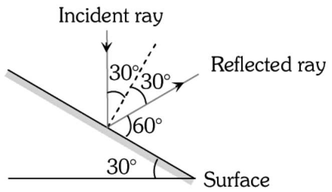
6. (b) $\tan 45° = \frac{h}{60} \Rightarrow h = 60\,m$



7. (b) In two images man will see himself using left hand.

8. (b) Size of image formed by a plane mirror is same as that of the object. Hence its magnification will be 1.

9. (c)



10. b

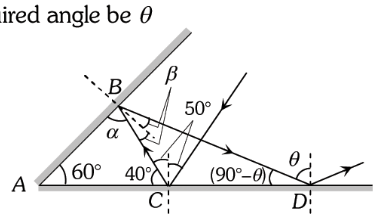
11. (c) $n = \left(\frac{360}{\theta} - 1\right) \Rightarrow n = \left(\frac{360}{72} - 1\right) = 4$

12. (c) $n = \left(\frac{360}{\theta} - 1\right) \Rightarrow 3 = \left(\frac{360}{\theta} - 1\right) \Rightarrow \theta = 90°$

13. (c) $n = \frac{360}{45} - 1 = 7$

14. (b) Diminished, erect image is formed by convex mirror.

15. (c) Let required angle be θ



From geometry of figure

In ΔABC; $\alpha = 180° - (60° + 40°) = 80°$

$\Rightarrow \beta = 90° - 80° = 10°$

In ΔABD; $\angle A = 60°$, $\angle B = (\alpha + 2\beta)$

$= (80 + 2 \times 10) = 100°$ and $\angle D = (90° - \theta)$

$\because \angle A + \angle B + \angle D = 180° \Rightarrow 60° + 100° + (90° - \theta)$

$= 180° \Rightarrow \theta = 70°$

[CHEMISTRY]

16.

17. Octahedral complex has 6 centres for coordination to the central metal ion. EDTA has 6 centres for coordination. Hence, only **one** molecule is required.

18.

19.

20.

21.

22. CO is a strong ligand. 6 electrons of $3d^5\ 4s^1$ form pairs and no unpaired electron is left.

23. Though NH_3 and CN^- both are strong ligands yet NH_3 cannot vacate two d-orbitals from

Ni^{2+} : $[Ar]3d^8$ | ↑↓ | ↑↓ | ↑↓ | ↑ | ↑ |. Here hybridisation is sp^3d^2.

24. $[Ni(CN)_4]^{4-}$: $x - 4 = -4 \Rightarrow x = \mathbf{0}$

25. In $[MnCl_4]^{2-}$, Mn^{2+} : $[Ar]3d^5$ has 5 unpaired electrons.

In $[CoCl_4]^{2-}$, Co^{2+} : $[Ar]3d^7$ has 3 unpaired electrons.

In both Cl^- is a weak ligand.

In $[Fe(CN)_6]^{4-}$, CN^- is a strong ligand. Fe^{2+} : $[Ar]3d^6$ will have no unpaired electron.

26. Mn^{2+}, $3d^5$ will have **five** unpaired electrons because H_2O is a weak ligand.

27. $[Cr(NH_3)_6]Cl_3$ gives four ions in water.

28.

29. $2Cl^-$ of ionic sphere out of total $3Cl^-$ *i.e.*, **2/3rd** will be precipitated as AgCl.

30. (i) $[Cu^{II}(NH_3)_4]^{2+}[Pt^{II}Cl_4]^{2-}$

(ii) $[Cu^{II}Cl(NH_3)_3]^{1+}\ [Pt^{II}Cl_3(NH_3)]^{1-}$

(iii) $[Cu^{II}Cl_2(NH_3)_2]^0\ [Pt^{II}Cl_2(NH_3)_2]^0$ not possible

(iv) $[Pt^{II}Cl(NH_3)_3]^{1+}[Cu^{II}Cl_3(NH_3)]^{1-}$

(v) $[Pt^{II}(NH_3)_4]^{2+}[Cu^{II}Cl_4]^{2-}$

[MATHEMATICS]

31. (b) $3\frac{d^2y}{dx^2} = \left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{3/2}$

On squaring, we get $9\left(\frac{d^2y}{dx^2}\right)^2 = \left\{1+\left(\frac{dy}{dx}\right)^2\right\}^3$

Obviously the highest derivative $\frac{d^2y}{dx^2}$ contains a degree 2.

32. (a) Given curve is $y^2 = 2c(x+\sqrt{c})$.

Differentiate *w.r.t.* x, $2y\frac{dy}{dx} = 2c \Rightarrow c = y\frac{dy}{dx}$

Hence differential equation is

$y^2 = 2y\frac{dy}{dx}\left(x+\sqrt{y\frac{dy}{dx}}\right) \Rightarrow \frac{y}{2dy/dx} - x = \sqrt{y\frac{dy}{dx}}$

Squaring and multiplying by $\left(\frac{dy}{dx}\right)^2$

$y\left(\frac{dy}{dx}\right)^3 - x^2\left(\frac{dy}{dx}\right)^2 + xy\left(\frac{dy}{dx}\right) - \frac{y^2}{4} = 0$

33. (b) $y = C_1e^{2x+C_2} + C_3e^x + C_4\sin(x+C_5)$

$= C_1.e^{C_2}e^{2x} + C_3e^x + C_4(\sin x\cos C_5 + \cos x\sin C_5)$

$= Ae^{2x} + C_3e^x + B\sin x + D\cos x$

Here, $A = C_1e^{C_2}$, $B = C_4\cos C_5$, $D = C_4\sin C_5$

(Since equation consists of four arbitrary constants)

$\therefore$ order of differential equation = 4.

34. (b) $y = Ae^{3x} + Be^{5x}$

$\Rightarrow \frac{dy}{dx} = 3Ae^{3x} + 5Be^{5x} \Rightarrow \frac{d^2y}{dx^2} = 9Ae^{3x} + 25Be^{5x}$

$\Rightarrow \frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 15y = 0$ (By inspection)

35. (a) Here $\frac{dy}{dx} = \frac{y}{x}\left(\log\frac{y}{x}+1\right)$ .....(i)

It is homogeneous equation

So now put $y = vx$ and $\frac{dy}{dx} = v + x\frac{dv}{dx}$, then the equation (i) reduces to $\frac{dv}{v\log v} = \frac{dx}{x}$

On integrating, we get $\log(\log v) = \log x + \log c$

$\Rightarrow \log\left(\frac{y}{x}\right) = cx \Rightarrow y = xe^{cx}$.

36. (a) $\frac{dx}{dy}+\frac{x^2-xy+y^2}{y^2}=0$

$\frac{dx}{dy}+\left(\frac{x}{y}\right)^2-\left(\frac{x}{y}\right)+1=0$

Put $v=x/y \Rightarrow x=vy \Rightarrow \frac{dx}{dy}=v+y\frac{dv}{dy}$

$v+y\frac{dv}{dy}+v^2-v+1=0 \Rightarrow \frac{dv}{v^2+1}+\frac{dy}{y}=0$

$\Rightarrow \int\frac{dv}{v^2+1}+\int\frac{dy}{y}=0 \Rightarrow \tan^{-1}(v)+\log y+C=0$

$\Rightarrow \tan^{-1}(x/y)+\log y+c=0$.

37. (a) $\frac{dy}{dx}=\frac{1}{x+y+1} \Rightarrow \frac{dx}{dy}=x+y+1 \Rightarrow \frac{dx}{dy}-x=y+1$

It is linear equation, therefore I.F. $=e^{\int -1dy}=e^{-y}$

Hence the solution of the equation is

$x.e^{-y}=\int(y+1)e^{-y}dy+c \Rightarrow x=ce^{y}-y-2$.

38. (c) We have $\frac{dy}{dx}=\frac{y}{x}-\cos^2\left(\frac{y}{x}\right)$

Putting $y=vx$ so that $\frac{dy}{dx}=v+x\frac{dv}{dx}$, we get

$v+x\frac{dv}{dx}=v-\cos^2 v$ or $\frac{dv}{\cos^2 v}=-\frac{dx}{x}$

On integrating, we get $\tan v=-\log x+\log c$

$\Rightarrow \tan\left(\frac{y}{x}\right)=-\log x+\log C$

This passes through $\left(1,\frac{\pi}{4}\right)$, therefore $1=\log c$

$\Rightarrow \tan\left(\frac{y}{x}\right)=-\log x+\log e \Rightarrow y=x\tan^{-1}\left[\log\left(\frac{e}{x}\right)\right]$.

39. (d) $\frac{dy}{dx}=1+y^2 \Rightarrow \frac{dy}{1+y^2}=dx$

Integrating both sides,

$\int\frac{dy}{1+y^2}=\int dx \Rightarrow \tan^{-1}y=x+c$

At $x=0,\ y=0,$ then $c=0$

At $x=\pi,\ y=0,$ then $\tan^{-1}0=\pi+c \Rightarrow c=-\pi$

$\therefore \tan^{-1}y=x \Rightarrow y=\tan x=\phi(x)$

Therefore, solution is $y=\tan x$

But $\tan x$ is not continuous function in $(0,\pi)$

Hence, $\phi(x)$ is not possible in $(0,\pi)$.

40. (d) $\frac{d^2y}{dx^2} = \frac{\log x}{x^2} \Rightarrow \frac{dy}{dx} = \frac{-(\log x + 1)}{x} + c$

At $\frac{dy}{dx} = -1$, $x = 1, y = 0, \therefore c = 0$

$\Rightarrow y = -\int \frac{\log x + 1}{x} dx = -\frac{1}{2}(\log x)^2 - \log x$.

41. (b) $\frac{dy}{dx} = 1 + x + y + xy$

$\Rightarrow \frac{dy}{dx} = (1+x) + y(1+x)$

$\Rightarrow \frac{dy}{dx} = (1+x)(1+y)$

$\Rightarrow \frac{dy}{(1+y)} = dx(1+x)$

Integrating both sides, $\int \frac{dy}{(1+y)} = \int dx(1+x)$

$\log(1+y) = x + \frac{x^2}{2} + \log c$

$y = ce^{x+(x^2/2)} - 1$

$\Rightarrow y(-1) = ce^{-1+(1/2)} - 1 = 0$

$\therefore ce^{-1/2} = 1 \Rightarrow c = e^{1/2}$

$\therefore y = e^{1/2}e^{x+\frac{x^2}{2}} - 1$, $y = e^{\frac{(x+1)^2}{2}} - 1$.

42. (a) Rearranging the terms, $\frac{dy}{dt} - \frac{t}{1+t}y = \frac{1}{1+t}$

I.F. $= e^{\int -\frac{t}{1+t}dt} = e^{-t}.(1+t)$

$\therefore$ Solution is $ye^{-t}.(1+t) = \int (1+t).e^{-t}\frac{1}{(1+t)} + c$

$ye^{-t}(1+t) = -e^{-t} + c$

Also, $y(0) = -1 \Rightarrow c = 0 \Rightarrow y(1) = \frac{-1}{2}$.

43. (a) The equation is $\frac{dy}{dx} - \frac{y}{x} = \frac{\log x}{x}$

I.F. $= e^{\int -\frac{1}{x}dx} = e^{-\log x} = \frac{1}{x}$

Hence solution is $y.\frac{1}{x} = \int \frac{\log x}{x} \times \frac{1}{x} dx$

$\Rightarrow \frac{y}{x} = -\frac{\log x}{x} - \frac{1}{x} + c$

$\Rightarrow y = cx - (1 + \log x)$.

44. (d) $y' = y\tan x - 2\sin x \Rightarrow \frac{dy}{dx} - y\tan x = -2\sin x$

$\text{I.F.} = e^{-\int \tan x\,dx} = e^{\log\cos x} = \cos x$

$\therefore\ y\cos x = \int(-2\sin x)(\cos x)dx + c$

$\Rightarrow\ y\cos x = -\int \sin 2x\,dx + c$

$\Rightarrow\ 2y\cos x = \cos 2x + c$.

45. (b) $(1+y^2)+(x-e^{\tan^{-1}y})\frac{dy}{dx} = 0$

$(1+y^2)\frac{dx}{dy} + x = e^{\tan^{-1}y}$

$\frac{dx}{dy} + \frac{x}{(1+y^2)} = \frac{e^{\tan^{-1}y}}{(1+y^2)}$

$\text{I.F.} = e^{\int\frac{1}{1+y^2}dy} = e^{\tan^{-1}y}$

$\Rightarrow\ x\left(e^{\tan^{-1}y}\right) = \int \frac{e^{\tan^{-1}y}}{1+y^2} e^{\tan^{-1}y} dy$

$\Rightarrow\ x\left(e^{\tan^{-1}y}\right) = \frac{e^{2\tan^{-1}y}}{2} + c$,

$\therefore\ 2xe^{\tan^{-1}y} = e^{2\tan^{-1}y} + k$.