PACE-IIT & MEDICAL

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FOR 2018 ASPIRANTS **Medical Droppers - Part Test - 7** **DATE: 18-03-2018**

SOLUTIONS
PHYSICS

1. [3]

According to the problem, combination of L_1 and L_2 act a simple glass plate. Hence according to formula

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1 f_2}$$

$$\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1 f_2}=0 \Rightarrow \frac{1}{f_1}+\frac{1}{f_2}=\frac{d}{f_1 f_2}$$

$$\Rightarrow \frac{1}{30}-\frac{1}{10}=\frac{d}{30\times -10} \Rightarrow \frac{-20}{30\times 10}=-\frac{d}{30\times 10}$$

$$\Rightarrow d = 20\,cm$$

2. [4]

From the figure for real image formation

$x + x' + 2f \geq 4f \Rightarrow x + x' \geq 2f.$

3. [4]

Apparent distance of fish from lens $u = 0.2+\frac{h}{\mu} = 0.2+\frac{0.4}{4/3} = 0.5\,m$

From $\frac{1}{f}=\frac{1}{v}-\frac{1}{u} \Rightarrow \frac{1}{(+3)}=\frac{1}{v}-\frac{1}{(-0.5)}$ $v = -0.6\,m$

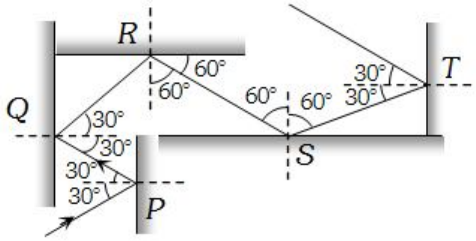
The image of the fish is still where the fish is 0.4 *m* below the water surface.

4. [1]

When light ray goes from denser to rarer medium (*i.e.* more μ to less μ) it deviates away from the normal while if light ray goes from rarer to denser medium (*i.e.* less μ more μ) it bend towards the normal.

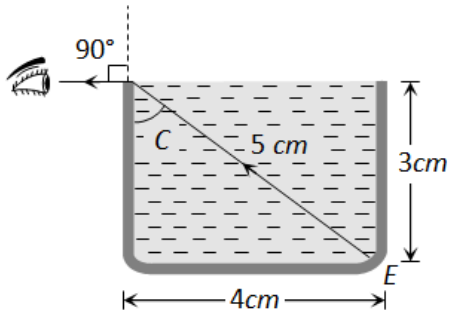
This property is satisfying by the ray diagram (i) only.

5. [3]



6. [1]

Light ray is going from liquid (Denser) to air (Rarer) and angle of refraction is 90^o, so angle of incidence must be equal to critical angle from figure



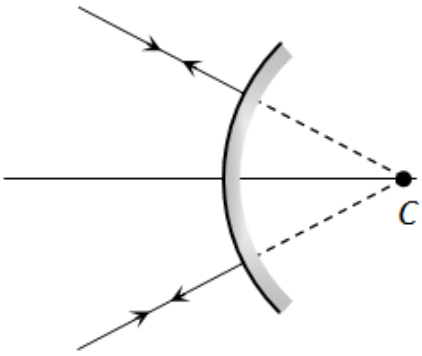
$\sin C = \frac{4}{5}$

Also $\mu = \frac{1}{\sin C} = \frac{5}{4} = 1.2$

7. [2]

8. [3]

Here object and image are at the same position so this position must be centre of curvature



$\therefore \; R = 12\ cm$

$\Rightarrow f = \frac{R}{2}$

9. [3]

$_1\mu_2 = \frac{1}{\sin C} \Rightarrow \frac{\mu_2}{\mu_1} = \frac{\lambda_1}{\lambda_2} = \frac{1}{\sin C}$

$\Rightarrow \frac{6000}{4000} = \frac{1}{\sin C} \Rightarrow C = \sin^{-1}\left(\frac{2}{3}\right)$

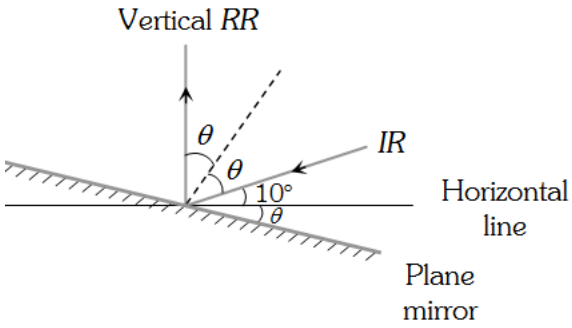
10. [3]

Two plano-convex lens of focal length *f*, when combined will give rise to a convex lens of focal length $f/2$.

The image will be of same size if object is placed at 2*f i.e.* at a distance *f* from optical centre.

11. [1]

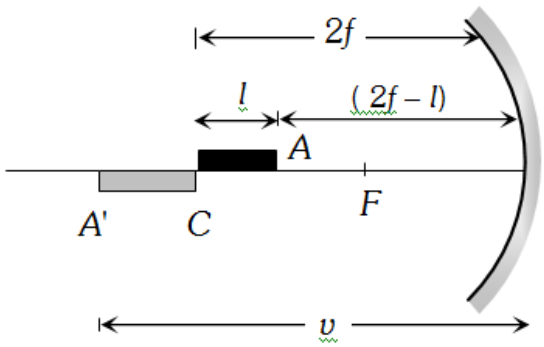
From figure



$\theta + \theta + 10 = 90$

$\Rightarrow \ \theta = 40^o$

12. [2]



End A of the rod acts as an object for mirror and A' will be its image so $u = 2f - l = 20 - 5 = 15\ cm$

$\because \ \frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{-10} = \frac{1}{v} - \frac{1}{15} \Rightarrow v = -30\ cm$.

Now $m = \frac{\text{Length of image}}{\text{Length of object}} = \frac{(30-20)}{5} = 2$

13. [3]

If path difference $\Delta = (SS_1 + S_1O) - (SS_2 + S_2O) = n\lambda$ n = 0, 1, 2, 3, ... the central fringe at O is a bright fringe and if the path difference $\Delta = \left(n - \frac{1}{2}\right)\lambda$, n = 1, 2, 3, ... the central bright fringe will be a dark fringe.

14. [2]

15. [2]

Position of n^{th} maxima from central maxima is given by $x_n = \frac{n\lambda D}{d}$

$\Rightarrow \ x_n \propto n\lambda \ \Rightarrow \ \frac{d_1}{d_2} = \frac{n_1\lambda_1}{n_2\lambda_2} = \frac{8\lambda_1}{6\lambda_2} = \frac{4}{3}\left(\frac{\lambda_1}{\lambda_2}\right)$

16. [3]

Path difference at point $P = \frac{xd}{D}$

Phase difference at point $P = \frac{2\pi}{\lambda}\frac{xd}{D} = \frac{2\pi x}{\beta}$

$I_0 = 4I_1$, intensity at point P

$I = I_1 + I_1 + 2I_1\cos\frac{2\pi x}{\beta} = 2I_1\left[1+\cos\frac{2\pi x}{\beta}\right] = I_0\cos^2\frac{\pi x}{\beta}$

17. [2]

Position of n^{th} minima $y_n = \frac{n\lambda D}{d}$

$\Rightarrow (y_3 - y_1) = \frac{\lambda D}{d}(3-1) = \frac{2\lambda D}{d}$

$\Rightarrow 3\times10^{-3} = \frac{2\times6000\times10^{-10}\times0.5}{d}$

$\Rightarrow d = 0.2\times10^{-3}m = 0.2\,mm$

18. [3]

$n_1\lambda_1 = n_2\lambda_2 \Rightarrow 60\times4000 = n_2\times6000 \Rightarrow n_2 = 40$

19. [3]

$\lambda = \frac{h}{mv}$. Since v is increasing in case (i), but it is not changing in case (ii). Hence, in the first case de-Broglie wavelength will change, but it second case, it remain the same

20. [3]

$E = W_0 + K_{\max} \Rightarrow \frac{hc}{\lambda_1} = W_0 + E_1$ and $\frac{hc}{\lambda_2} = W_0 + E_2$

$\Rightarrow hc = W_0\lambda_1 + E_1\lambda_1$ and $hc = W_0\lambda_2 + E_2\lambda_2$

$\Rightarrow W_0\lambda_1 + E_1\lambda_1 = W_0\lambda_2 + E_2\lambda_2 \Rightarrow W_0 = \frac{E_1\lambda_1 - E_2\lambda_2}{(\lambda_2 - \lambda_1)}$.

21. [3]

$\lambda = \frac{h}{p} \Rightarrow \lambda - \frac{0.5}{100}\lambda = \frac{h}{p+\Delta p} \Rightarrow \frac{199\lambda}{200} = \frac{h}{p+\Delta p} = \frac{199}{200}\frac{h}{p}$

$\Rightarrow p + \Delta p = \frac{200}{199}p \Rightarrow p = 199\,\Delta p$

22. [2]

$\frac{n}{t} = \frac{IA\lambda}{hc} = \frac{150\times10^{-3}\times4\times10^{-4}\times3\times10^{-7}}{6.6\times10^{-34}\times3\times10^{8}} = 9\times10^{13}\frac{1}{sec}$

23. [4]

Peaks on the graph represent characteristic *X*-ray spectrum. Every peak has a certain wavelength, which depends upon the transition of electron inside the atom of the target. While λ_{min} depends upon the accelerating voltage (As. $\lambda_{min} \propto 1/V$).

24. [2]

25. [1]

$${}_{Z}X^{A} \xrightarrow{9\alpha,} {}_{Z-18}X^{A-36} \xrightarrow{5\beta} {}_{Z-13}X^{A-36}$$

Number of protons = $(Z = 13)$

Number of neutrons = $(A - 36) - (Z - 13) = (A - Z - 23)$

$\therefore \quad \frac{P}{N} = \frac{(Z-13)}{(A-Z-23)}$

26. [2]

The electrostatic *P.E.* is zero when the electron and proton are far apart from each other. Work done in pulling electron and proton far away from each other

$$W = E_f - E_i = 0 - E_i = -\left(-\frac{13.6}{n^2}eV\right)$$

$$\Rightarrow W = \frac{13.6}{(2)^2} \times 1.6 \times 10^{-19} J = 3.4 \times 1.6 \times 10^{-19} J.$$

27. [1]

Activity depends upon mass, but λ doesn't change.

28. [2]

From conservation of momentum, two identical photons must travel in opposite directions with equal magnitude of momentum and energy $\frac{hc}{\lambda}$

from conservation of energy $\frac{hc}{\lambda} + \frac{hc}{\lambda} = m_0c^2 + m_0c^2$

$\Rightarrow \lambda = \frac{h}{m_0 c}$.

29. [2]

Acceleration $a \propto \frac{v^2}{r}$

where $v \propto \frac{Z}{n}$ and $r \propto \frac{n^2}{Z} \Rightarrow a \propto \frac{Z^3}{n^4}$

Since both are in ground state *i.e.*, $n = 1$

so $a \propto Z^3 \Rightarrow \frac{a_{He^+}}{a_H} = \left(\frac{Z_{He^+}}{Z_H}\right)^3 = \left(\frac{2}{1}\right)^3 = \frac{8}{1}$.

30. [2]

Transition from $4E$ to E

$(4E - E) = \frac{hc}{\lambda_1} \Rightarrow \lambda_1 = \frac{hc}{3E}$ ..... (i)

Transition from $\frac{7}{3}E$ to E

$\left(\frac{7}{3}E - E\right) = \frac{hc}{\lambda_2} \Rightarrow \lambda_2 = \frac{3hc}{4E}$ ..... (i)

From equation (i) and (ii) $\frac{\lambda_1}{\lambda_2} = \frac{4}{9}$

31. [1]

(1 = high, 0 = low)

Input to A is in the sequence, 1,0,1,0.

Input to B is in the sequence, 1, 0, 0, 1.

Sequence is inverted by NOT gate.

Thus inputs to OR gate becomes 0, 1, 0, 1 and output of OR gate becomes 0, 1, 1, 1

Since for OR gate 0 + 1 = 1. Hence choice [1] is correct.

32. [2]

Time $t = CR$ is known as time constant. It is time in which charge on the capacitor decreases to $\frac{1}{e}$ times of it's initial charge (steady state charge).

In figure (i) PN junction diode is in forward bias, so current will flow the circuit *i.e.*, charge on the capacitor decrease and in time t it becomes $Q = \frac{1}{e}(Q_o)$; where $Q_o = CV \Rightarrow Q = \frac{CV}{e}$

In figure (ii) P-N junction diode is in reverse bias, so no current will flow through the circuit hence change on capacitor will not decay and it remains same *i.e.* CV after time t.

33. [1]

Use $V_0 = AV_s$

Now $A = \frac{24 \times 10k}{10k + 10k} = \frac{24 \times 10}{20} = 12$

Therefore, $V_0 = 12 \times 0.4 = 4.8\ volt\ (r.m.s.)$

34. [1]

Charge carriers inside the P-type semiconductor are holes (mainly). Inside the conductor charge carriers are electrons and for cell ions are the charge carriers.

35. [1]

36. [1]

1% of 10 GHz = $10\times10^{9}\times\frac{1}{100}=10^{8}\,Hz$

Number of channels $=\frac{10^{8}}{5\times10^{3}}=2\times10^{4}$

37. [1]

$\lambda=\frac{hc}{E}=\frac{6.6\times10^{-34}\times3\times10^{8}}{1.5\times1.6\times10^{-19}}=8.25\times10^{-7}m=8250\text{Å}$

The photon having wavelength equal to 8250Å or more than this will not able to overcome the energy gap of silicon.

38. [1]

Using $Z=\sqrt{\frac{L}{C}}$ we get $Z=\sqrt{\frac{0.40\times10^{-6}}{10^{-11}}}=2\times10^{2}\Omega$

39. [1]

Carrier swing $=\frac{\text{Frequency deviation}}{\text{Modulating frequency}}=\frac{50}{7}=7.143$

40. [1]

$I_{Carrier}=\frac{I_{rms}}{\sqrt{1+\frac{m_a^2}{2}}}=\frac{11}{\sqrt{1+\frac{(0.5)^2}{2}}}=10.35\,A$

41. [4]

42. [4]

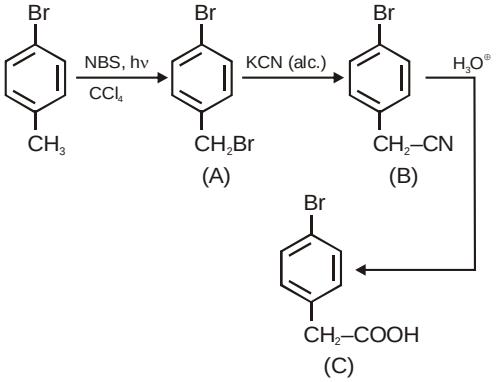
43. [3]

44. [2]

45. [4]

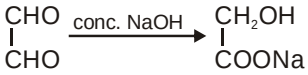
CHEMISTRY

46. [2]

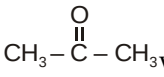


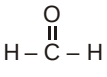
47. [2]

Intramolecular, Cannizzaro reaction



48. [3]

 will give iodoform test.

 will give Tollen's reagent test.

49. [2]

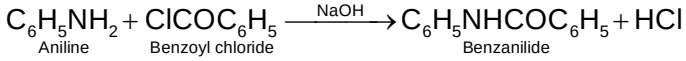
Polarity increases the B.P.

50. [1]

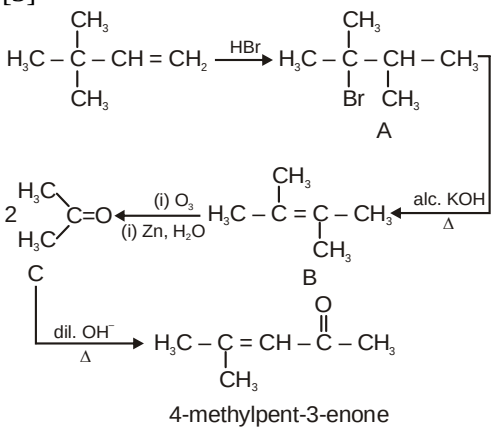
Wittig reaction.

51. [3]

It is known as Schotten Baumann reaction.



52. [3]



4-methylpent-3-enone

53. [2]

The strength of an acid refers to its ability or tendency to lose a proton (H^+). So the correct order is I > II > III > IV.

54. [2]

From pK_b value.

55. [1]

Hydroboration then mild oxidation.

56. [1]
In maltose the two glucose molecules are linked by (C-1, C-4) α - link

57. [3]

$$C_2H_5NH_2 + HNO_2 \rightarrow \underset{(A)}{C_2H_5OH} + N_2 + H_2O$$

$$C_2H_5OH + PCl_5 \rightarrow \underset{(B)}{C_2H_5Cl} + POCl_3 + HCl$$

$$C_2H_5Cl + KCN \rightarrow \underset{\text{(C)Propane nitrile}}{C_2H_5CN} + KCl$$

58. [2]
It has $CH_3-\overset{\overset{O}{\|}}{C}-$ group.

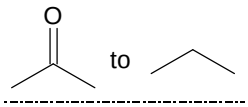
59. [4]

$$CH_3COONH_4 \xrightarrow{\Delta} CH_3CONH_2 \xrightarrow{\Delta} CH_3CN + H_2O$$

60. [1]
Methyl salicylate also known as oil of wintergreen is used as medicine iodex in treatment of rheumatic pains are remedy for aches, sprains and bruises.

61. [1]
The attacking species in diazotisation reaction is NO^+

62. [3]
Wolff–Kishner reduction involves (NH_2NH_2/KOH) a very strong base so, along with the reduction of



group, it also undergo E2 elimination in presence of strong base.

63. [4]
64. [3]
65. [2]

$$CH_3NH_2 \xrightarrow{CH_3I\ (excess)} (CH_3)_3\overset{+}{N}I^- \xrightarrow{AgOH} (CH_3)_4\overset{+}{N}-OH^- \xrightarrow{\Delta} (CH_3)_3N + CH_3OH$$

66. [2]
67. [3]
68. [1]
69. [4]
70 [3]
$LiAlH_4$ reduces Aldehyde, Ketone, Ester and Carboxylic acid in upto alcohol

71. [3]
Aldehyde will be more reactive towards nucleophilic addition than ketone.

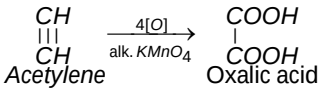
72. [4]
73. [4]
74. [4]
75. [1]
76. [3]
77. [4]
78. [3]
79. [3]
80. [2]
81. [2]
82. [2]
83. [3]
84. [2]
85. [2]

86. [1]

It is true that benzene diazonium chloride does not respond Lassaigne test of nitrogen because benzene diazonium chloride losses N_2 on Slight heat and thus it can't react with sodium metal.

87. [4]

Acetylene, on treatment with alkaline $KMnO_4$ is oxidised to produce oxalic acid.



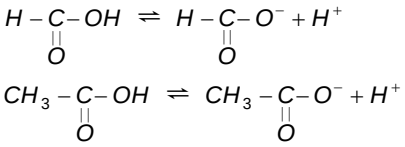
Therefore, both assertion and reason are false.

88. [2]

Both carbanions (formed in presence of base) and enol form (formed in presence of an acid) act as nucleophiles and hence add on the carbonyl group of aldehydes and ketones to give aldols.

89. [1]

Formic acid is stronger than acetic acid



Presence of CH_3 group in acetate ion shows +*I.E,* and there by intensifying charge on O^- of acetate ion than formate ion or acetate ion is destabilized. Thus formate ion is more stable than acetate ion or $HCOOH$ loses proton more easily than CH_3COOH.

90. [2]