INJSO 2012 Ans key

Section A: Multiple Choice Questions

Q.No	Option	Q.No	Option
1	c)	31	c)
2	a)	32	c)
3	b)	33	d)
4	c)	34	b)
5	b)	35	c)
6	a)	36	c)
7	d)	37	b)
8	c)	38	c)
9	a)	39	d)
10	b)	40	c)
11	d)	41	a)
12	b)	42	a)
13	d)	43	a)
14	b)	44	b)
15	a)	45	d)
16	c)	46	c)
17	c)	47	c)
18	d)	48	d)
19	a)	49	d)
20	c)	50	d)
21	b)	51	b)
22	b)	52	b)
23	b)	53	b)
24	d)	54	c)
25	b)	55	c)
26	b)	56	c)
27	c)	57	b)
28	a)	58	a)
29	a)	59	a)
30	c)	60	c)

Section B: Long Answer Questions

Ans.61. (a)

i. Calculation of concentration: (mol dm^{-3})
Concentration of milk of magnesia (given) = 29 ppm = 29 mg dm^{-3}
= 0.029 g dm^{-3}

Concentration of milk of magnesia in mol dm^{-3} = 0.029/58 = 0.0005 mol dm^{-3}
Using $N_1V_1 = N_2V_2$,
$0.0005 \times 0.025 = N_2 \times 0.025$
$\therefore N_2 = 0.0005$ mol dm^{-3} (Concentration of acid)

ii. $Mg(OH)_2 + 2HCl$ ----> $MgCl_2 + H_2O$

iii. $A = V \times C = 0.025 \times 0.0005 = 1.25 \times 10^{-4}$

Ans.61. (b) A – Phenolphthalein/base
B – bases/phenolphthalein
C – acid
D – universal indicator.

Ans.62. (a) Initially mass of water = m_1 g,
Mass of ice = m_2 g

Then, $\frac{m_2}{0.8} + \frac{m_1}{1} = 20A$

where A is the area of cross - section of cylindrical vessel.

Let m_{ice} g of ice has melted (this is mass.... not volume!)

Then, $\frac{(m_2 - m_{ice})}{0.8} + \frac{(m_1 + m_{ice})}{1} = 19.5A$

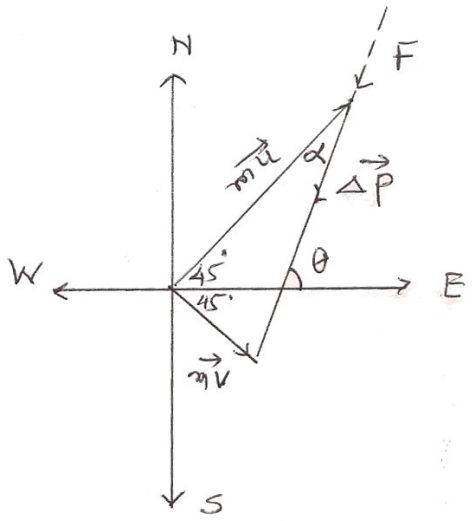
Get $m_{ice} = 2A$ (in grams)
Note that: densities are in g/mL, volume in mL, areas in cm^2, heights in cm

Now, $(0.8 \times 10A) \times 0.5 \times 20 + 2A \times 80 = 10A \times 1 \times x$

Hence, $x = 24°C$

P.T.O

Ans.62. (b)



m = 10 kg, u = 50 ms^{-1}, v = 10 ms^{-1}, t = 10 sec

$(m\vec{v}) = 10\times10 = 100 \text{ kgms}^{-1}$

$(m\vec{u}) = 10\times50 = 500 \text{ kgms}^{-1}$

∴ Change in momentum, $(\vec{\Delta} p) = \sqrt{500^2+100^2} = \sqrt{10000\times26} = \sqrt{2600}$

$$(\vec{\Delta} p) = 100\sqrt{26}$$

$$\text{Force}, (\vec{F}) = \frac{(\vec{\Delta} p)}{t} = \frac{100\sqrt{26}}{10} = 10\sqrt{26}\,N$$

$$\tan\alpha = \frac{(m\vec{v})}{(m\vec{u})} = \frac{100}{500} = 0.2 \text{ or } \alpha = \tan^{-1}(0.2)$$

Let angle between the Force and east direction is θ
So, $\theta = 45 + \tan^{-1}(0.2)$

Hence, angle w.r.t. east is $\left(180 - \tan^{-1}(3/2)\right)$ in clockwise direction.

P.T.O

Ans.63. $ABA \times C = BCC$.
We make a couple of observations.

Observations

(a) $C > 0$

(b) $AC < 9$

Case 1: $A < C$

$A < C \Rightarrow A^2 < AC < 9 \Rightarrow A < 3$. Therefore A is either 1 or 2.

Case 1a: $A = 1$

$1B1 \times C = BCC$ or equivalently $1B \times C = BC$.
As $A = 1$, $B > 1$ and $C > 1$, implying $BC > 1$ and $BC - C > 1$. Note that $BC - C$ is divisible by 10.
Therefore, $BC = 10y + C$ for some positive integer y.
Also, $C + y = B$. But then $B - C = y (> 0)$ and $BC = 10(B - C) + C$,
implying $C = 10B/(B + 9) = 10 - 90/(B + 9)$.
As C is an integer, $90/(B + 9)$ must be an integer.
Now $1 < B <= 9$ i.e $10 < B + 9 <= 18$.
So we need to find out those divisors of 90 which are between 11 and 18 (both inclusive).

There are only two such, namely, 15 and 18, and the corresponding values of B are $6 (= 15 - 9)$, $9 (= 18 - 9)$.
So the numbers are 161 and 191, and the corresponding values of C are 4 and 5.

Case 1b: $A = 2$

2B2 x C = BCC. 2C = 10y + C for some positive integer y. Impossible.

Case 2: A > C

In this case $C^2 < AC < 9$, or $C < 3$.
$C = 1$ or $C = 2$.
$C = 1$ is evidently impossible.
If $C = 2$ then $ABA \times 2 = B22$.
As $A > C$, it has to be 6 but then $2A = 12 > B$, absurd.
No solution is possible.

Final solution: 161 x 4 = 644; 191 x 5 = 955.

Ans. 64. i. The distance between two successive bases in the DNA is 3.4 nm
Hence 34 cm DNA will have 10^8 bases
Mass will be 660×10^8 Da (since one base pair has 2 nucleotides)

ii. 10^8 bases. (Since the length of DNA and RNA remains same)

iii. 34 cm

iv. 110×10^8 Da. (3 nucleotides are designated as a codon and they code for one amino acid.)

Ans.65.

$$\underset{\textbf{A}}{\text{Orange solid}} \xrightarrow{\Delta} \underset{\textbf{B}}{\text{green residue}} + \underset{\textbf{C}}{\text{colourless gas}} + H_2O\,(g)$$

$(NH_4)_2Cr_2O_7$ $\quad$ Cr_2O_3 $\quad$ N_2

$$\textbf{C} + Mg \xrightarrow{\Delta} \underset{\textbf{D}}{\text{white solid}} \rightarrow \underset{\textbf{E}}{\text{pungent smelling gas}}$$

Mg_3N_2 $\quad$ NH_3

$$\textbf{E} + HCl \rightarrow \text{dense white fumes}$$

NH_4Cl

$$(NH_4)_2Cr_2O_7 \rightarrow Cr_2O_3 + N_2\uparrow + 4\,H_2O\uparrow$$
$$Mg + N_2 \rightarrow Mg_3N_2$$
$$Mg_3N_2 + 6\,H_2O \rightarrow Mg(OH)_2 + 2\,NH_3\uparrow$$
$$NH_3 + HCl \rightarrow NH_4Cl$$

Thus, **A = $(NH_4)_2Cr_2O_7$** (ammonium dichromate)/(potassium dichromate),
B = Cr_2O_3
C = N_2
D = Mg_3N_2
E = NH_3

Ans.66.
i. $f_o = 1$ cm, $f_e = 5$ cm, $u_o = 1.5$ cm

Now, using the formula, $\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$ we get, $\frac{1}{1} = \frac{1}{v_o} - \frac{1}{-1.5}$

$\therefore\ v_o = 3$ cm

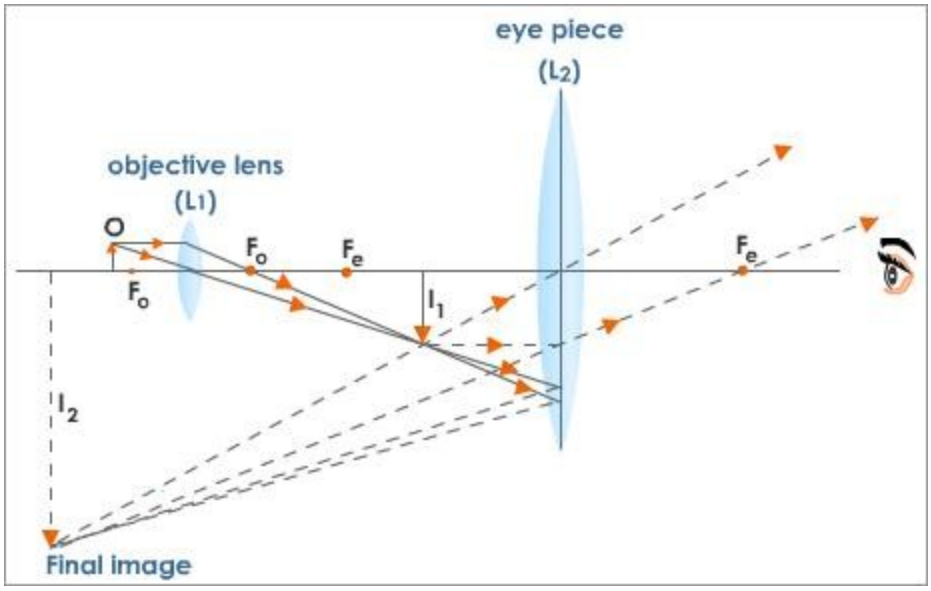
Also, $\frac{1}{f_e} = \frac{1}{v_e} - \frac{1}{u_e}$ or $\frac{1}{5} = \frac{1}{-25} - \frac{1}{u_e}$

$\therefore\ u_e = 4.17$ cm

This is the distance between the first image and the eye piece.

ii. Maximum possible angular magnification is $\left(1+\frac{D}{f}\right)$ where D = 25 cm. Hence maximum possible angular magnification = 6.

iii. From diagram it is clear that distance between the lenses is 3.00 cm + 4.17 cm = 7.17 cm.



In the above figure distance between the objective and first image, L_1I_1 = 3.00 cm, distance between the objective and the first image, L_2I_1 = 4.17 cm, distance between the eyepiece and the final image, L_2I_2 = 25 cm . Hence distance between the two lenses = $L_1I_1 + L_2I_1$ = 3.00 + 4.17 = 7.17 cm.
Note distances are measured along principal axis.

Ans.67 i. Cladogenesis or branching evolution

ii. a) and c) both.

iii. True

iv. a) Behavioural isolation b) Habitat isolation

Ans.68. Observe that $38^2 = 1444$. Look at numbers of the form $(500n + 38)^2$, where 'n' is a non- negative integer (i.e n = 0, 1, 2, 3, . . .). These numbers always end in 444 and there are infinitely many of them as the set of non-negative integers is infinite.

For instance $538^2 = 289444$, $1038^2 = 1077444$.