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

Let x g of ice has melted (this is mass.... not volume!)

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

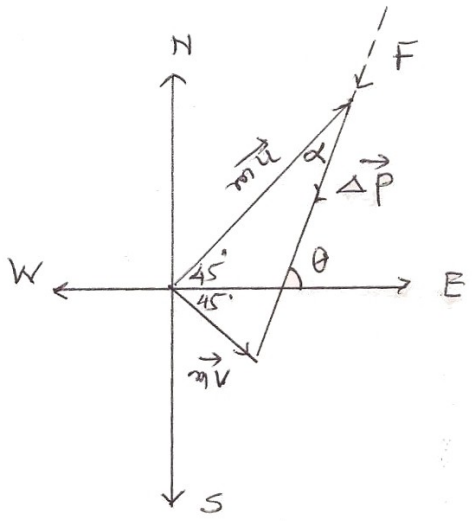
Get $x = 2A$ (in grams)
Note that: densities are in g/mL, volume in mL, areas in cm^2, heights in cm

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

Hence, $\theta = 24°C$

P.T.O

Ans.62. (b)



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

$|m\vec{v}| = 10\times10 = 100\ \text{kg m s}^{-1}$

$|m\vec{u}| = 10\times50 = 500\ \text{kg m s}^{-1}$

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

$$|\vec{\Delta p}| = 100\sqrt{26}$$

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

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

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

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

P.T.O

Ans.63. ABA x $C = BCC$.
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: $A = 1$

$1B1$ x $C = BCC$ or equivalently $1B$ x $C = BC$.
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 x 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.

$$\text{Orange solid} \xrightarrow{\Delta} \underset{\mathbf{B}\ Cr_2O_3}{\text{green residue}} + \underset{\mathbf{C}\ N_2}{\text{colourless gas}} + H_2O\ (g)$$
$$\mathbf{A}\ (NH_4)_2Cr_2O_7$$

$$\mathbf{C} + Mg \xrightarrow{\Delta} \underset{\mathbf{D}\ Mg_3N_2}{\text{white solid}} \rightarrow \underset{\mathbf{E}\ NH_3}{\text{pungent smelling gas}}$$

$$\mathbf{E} + HCl \rightarrow \underset{NH_4Cl}{\text{dense white fumes}}$$

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

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

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

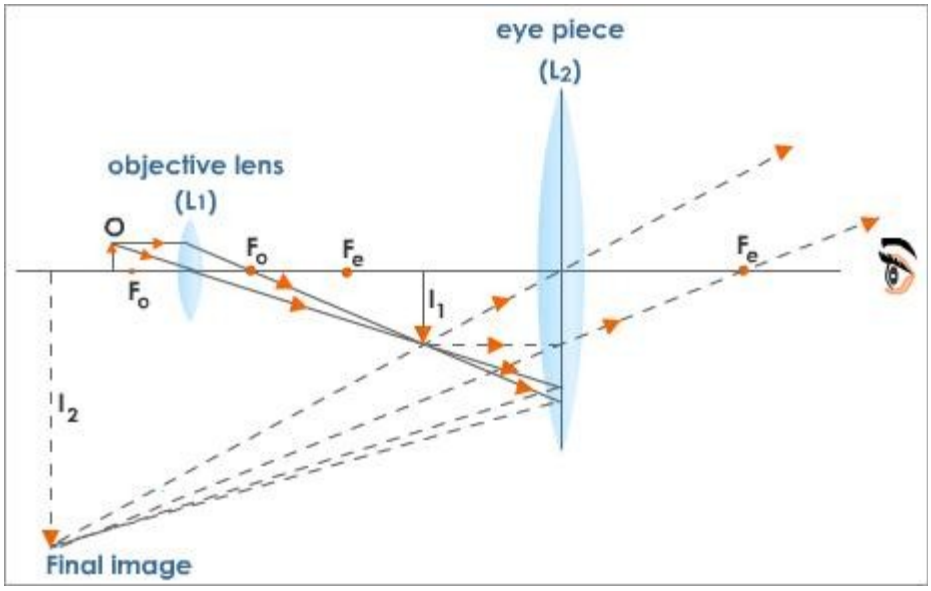
Also, $\frac{1}{f_e} = \frac{1}{v_e} - \frac{1}{u_e}$ or $\frac{1}{5} = \frac{1}{-25} - \frac{1}{u_e}$

$\therefore\ u_e = 4.17$ 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. c) Cladogenesis is the only process which can give rise to formation of new species.

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 5382 = 289444, 10382 = 1077444.