SECTION A

Q. No.	(a)	(b)	(c)	(d)	Q. No.	(a)	(b)	(c)	(d)
1				X	16	X			
2		X			17	Question dropped			
3			X		18				X
4				X	19		X		
5			X		20		X		
6			X		21	X			
7				X	22		X		
8		X			23			X	
9	X				24				X
10			X		25	X			
11	X				26	X			
12				X	27		X		
13	X				28			X	
14	X				29		X		
15				X	30			X	

SECTION B

QUESTION 31

A.

I. Total fluid if 70 % of body weight i.e. 70% of 70Kg = 49 Kg
Blood is 8% of the total fluid i.e. 8% of 49 kg = 3.92 kg
Converting kg into volume- 3920/1060 = **3.698 litres**

II. DNA in White blood cells: 7000 x 1000 x1000x 3.69 x 46

III. Weight of albumin = 7% of 3.92= 0.2744 x58%= .159kg
66000 g =1 mole
159g = 159/66000 moles

B.

Label	Composition of blood (choose between oxygenated or deoxygenated)	Direction of flow (choose between away from or towards the heart)
1	Oxygenated	Away from
2	Deoxygenated	Away from
3	Oxygenated	towards
4	Deoxygenated	towards

QUESTION 32

A.I) $Al_2O_3 + 3C + 3Cl_2\,(g) \rightarrow 2AlCl_3 + 3CO\,(g)$

II) $6FeS_2 + 6H_2O + 21O_2 \rightarrow 6FeSO_4 + 6H_2SO_4$

$2Al_2O_3.2XSiO_2 + 6H_2SO_4 \rightarrow 2Al_2(SO_4)_3 + 2xSiO_2 + 6H_2O$

……. Or

$6FeS_2 + 21O_2 + 2Al_2O_3.2XSiO_2 \rightarrow 2Al_2(SO_4)_3 + 2xSiO_2 + 6FeSO_4$

B. $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_{2(g)}$

2x84 22.4 L

Amt of $NaHCO_3$ equivalent to 56 mL of CO_2 at NTP = (56x168)/22400= 0.42g

Equivalent of $NaHCO_3$ present = 0.42/84= 0.005 or 5 milli eq.

The amt. of HCl consumed by $NaHCO_3$ and Na_2CO_3 in the mixture= 30.5mL of 1N HCl= 0.0305 equivalents or 30.5 milli eq.

The amt. of HCl consumed by Na_2CO_3 =30.5-5=25.5 m.e.

Hence the amt. of Na_2CO_3 present = $25.5 \times 53 \times 10^{-3}$ g = 1.35 g

Thus amt. of NaCl in 3g of the mixture= 3-0.42-1.35= 1.23

% 0f NaCl= 41%= (1.23x100)/3

QUESTION 33

I) Sample 1) 2mg of $CaSO_4$ =$2x10^{-3}$ of $CaSO_4$= $2x10^{-3}/136$ =$1.5x10^{-5}$mol of $CaSO_4$1mol of $CaSO_4$ = 1mol of $CaCO_3$ =100g of $CaCO_3$

Therefore $1.5x10^{-5}$mol of $CaSO_4$ =$1.5x10^{-5}$ x100 = $1.5x10^{-3}$ g of $CaCO_3$

Thus, 1000g of water contains $CaSO_4$ equivalent to $1.5x10^{-3}$ g of $CaCO_3$

10^6 g (one million) of water contains =[($1.5x10^{-3}$)/1000]x10^6 = 1.5g of $CaCO_3$

Or [(2x100)/136]= 1.5g of $CaCO_3$ **(direct method)**

0.5mg of $MgCl_2$= $5x10^{-4}$ g of $MgCl_2$ = $5x10^{-4}/95$=$0.053x10^{-4}$mol of$MgCl_2$

1mol of $MgCl_2$ = 1mol of $CaCO_3$ =100g of $CaCO_3$

$0.053x10^{-4}$mol of$MgCl_2$=$0.053x10^{-4}$x 100 = $0.053x10^{-2}$ g of $CaCO_3$

10^6 g (one million) of water contains = [($0.053x10^{-2}$)/1000]x10^6 = 0.53g of $CaCO_3$

Or [(0.5x100)/95]= 0.53g of $CaCO_3$ **(direct method)**

Hence degree of hardness of sample 1 is 1.5+ 0.53= 2.3ppm

Sample 2) 3mg of $MgSO_4$ =$3x10^{-3}$ of $MgSO_4$ = $3x10^{-3}/120$ =$2.5x10^{-5}$mol of $MgSO_4$

1mol of $MgSO_4$ = 1mol of $CaCO_3$ =100g of $CaCO_3$

Therefore $2.5x10^{-5}$mol of $MgSO_4$ =$2.5x10^{-5}$ x100 = $2.5x10^{-3}$ g of $CaCO_3$

Thus, 1000g of water contains $MgSO_4$ equivalent to $2.5x10^{-3}$ g of $CaCO_3$

10^6 g (one million) of water contains = [($2.5x10^{-3}$)/1000]x10^6 = 2.5g of $CaCO_3$

Hence degree of hardness of sample 2= 2.5ppm

Or [(3x100)/120]= 2.5g of $CaCO_3$ **(direct method)**

II) $Ca(HCO_3)_2 + 2NaOH \rightarrow CaCO_3 + Na_2CO_3 + 2H_2O$

(Any one reaction either with Calcium or Magnesium)

$CaSO_4 + Na_2CO_3 \rightarrow CaCO_3 + Na_2SO_4$

$2MgCl_2 + 2Na_2CO_3 \rightarrow 2MgCO_3 + 4NaCl$

(Any two reactions either with sulphate or chloride of Calcium or Magnesium)

QUESTION 34

A. The evaporation of water through the pores causes decrease in the temperature. Let *m* kg be the mass of the water evaporated.

Heat of vaporization = 42000 J/mol = 7000/3 J/g = (7/3) x 10^6 J/kg

(20 - *m*)*4200* 5 = *m*(7 x 10^6 /3) $\therefore (20 - m)21 = 7000m/3$

$\therefore$ 420 – 21*m* = 7000*m*/3 $\therefore$ 1260 – 63*m* = 7000*m* $\therefore$ 1260 = 7063*m* $\therefore m \cong 0.18$ kg (or, 0.17 kg)

B. Voltage across LED for 625 nm (red) light = 1250/625 = 2 V.

Remaining voltage (from 5 V) will be across the resistance.

$\therefore\ V_{res_{red}} = 5 - 2 = 3\,V.$ Current through LED, i. e. through circuit is 20 mA (for significant brightness).

$\therefore\ R_{red} = \frac{3}{20 \times 10^{-3}} = 150\ \Omega$

Out of this 40 Ω is a fixed resistance. Thus maximum additional resistance of 110 Ω will be 625 nm light.

Voltage across LED for 500 nm (green) light = 1250/500 = 2.5 V.

Remaining voltage (from 5 V) will be across the resistance.

$\therefore\ V_{res_{green}} = 5 - 2.5 = 2.5\,V.$ Current through LED, i. e. through circuit is 20 mA (for significant brightness).

$\therefore\ R_{red} = \frac{2.5}{20 \times 10^{-3}} = 125\ \Omega$

Out of this 40 Ω is a fixed resistance. Thus minimum additional resistance of 85 Ω will be 500 nm light.

Required range of rheostat resistance is 85 Ω to 110 Ω.

QUESTION 35

I) c)Variation in character should be available in the population

II) b)Bar eye is a mutant character because it is found rarely in the nature

III) c)bb

IV) d)Adult

V) a) red, round-eyed

b) Yes

c) It shows a 9:3:3:1 ratio, a hallmark of independent assortment

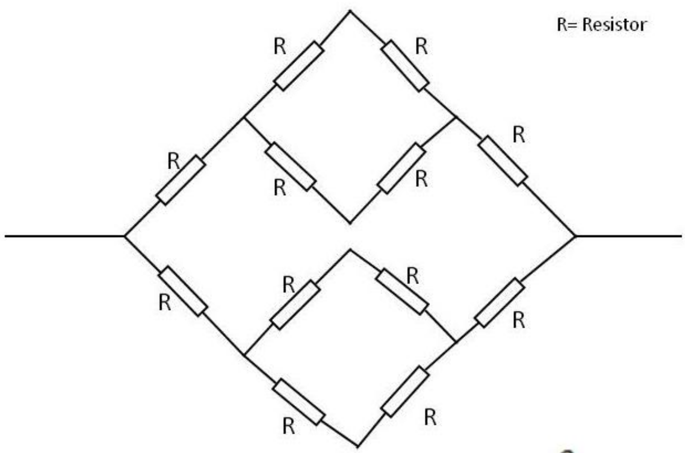
QUESTION 36

A. Current through 8 Ω resistance after removing *R* is 5/20 = ¼ A. ∴ the p. d. across 8 Ω resistance is 2 V. ∴ in the original circuit, the p. d. across 6 Ω resistance is 3 V. ∴ the current through it is ½ A. ∴ the current through *R* is ¼ A and p. d. across it is 2 V ∴ *R* = 8 Ω

B. Current rating 3600 mAh means if we draw a constant current of 3.6 A, the battery will last for 1 hour. In the present case it lasts for 24 hours. ∴ *I* = 3.6/24 = 0.15 A.

V = 3.6 V and *I* = 0.15 A. Thus equivalent resistance of the circuit in the first case is R_x = 3.6/0.15 = 24 Ω.

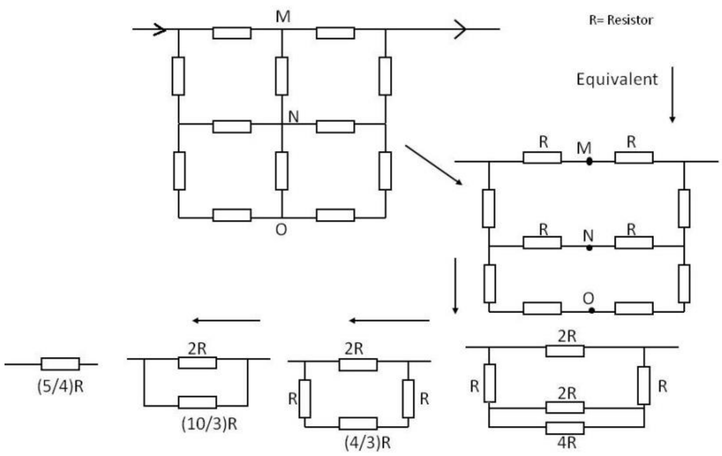
The equivalent circuit is given besides. Rx, the resistance between A and C is = 3R/2. Thus, *R* = 16 Ω



$$\therefore X = \frac{3}{2}R$$

Part 2) When used across DC, then the points M, N and O are equipotential due to symmetry, the circuits can be reduced to following and $(R_x)_2$ = 5R/4 = 20 Ω.

Total energy is constant. ∴ V^2t/R_x = constant. Battery voltage 3.6 V is the same. ∴ t is proportional to R_x. ∴ t_2 = 20 hours.



QUESTION 37

A.

I) c)3n
II) a)Mitochondrial DNA only
III) a) To retain large quantity of cytoplasm in the oocyte.
IV) b) Primary oocytes are already produced in the ovary when a girl is born.

B.

I) c)One male and two females all contributing genetically
II) a) F
b) T
c) T
d) T
e) F

QUESTION 38

A. The answer is NO. If a student writes answer YES and gives the angles of emergence, it is not correct and no credit will be given. For answer NO, the sector through which the rays emerge is given in terms of angles α and β at the center. The rays to the left of D and to the right of E will enter the glass, but suffer total internal reflection.

$\sqrt{3} = \frac{\sin 60^0}{\sin r} = \mu \therefore r = 30^0, for\ all\ the\ rays.$

$\frac{1}{\mu} = \frac{1}{\sqrt{3}} = \sin i_c \therefore i_c = sin^{-1}\left(\frac{1}{\sqrt{3}}\right) \cong 35^0$

As seen from the figure, the rays through glass just emerge (grazing emergence) at A and B.

From $\Delta ACD, \alpha = 180 - 60 - 35 = 85^0$

For $\Delta BCE, \beta = \angle ACB\ is\ exterior\ angle\ for\ \angle CEB\ and\ \angle EBC. \therefore \beta = 120 + 35 = 155^0$

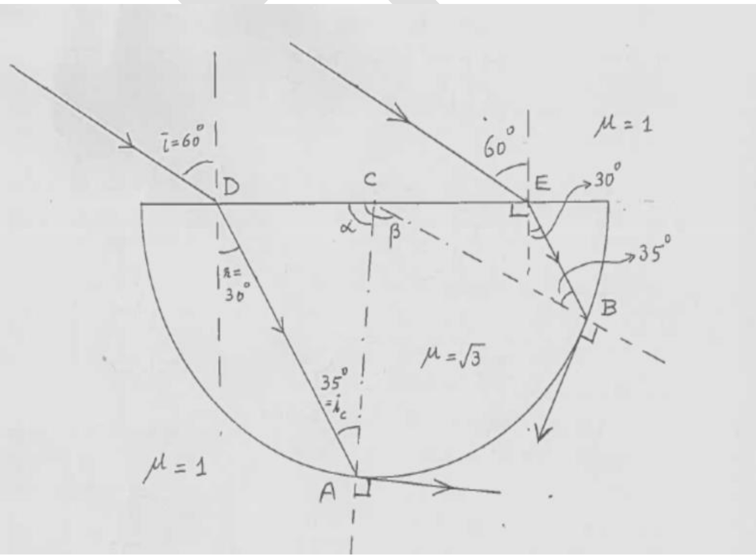
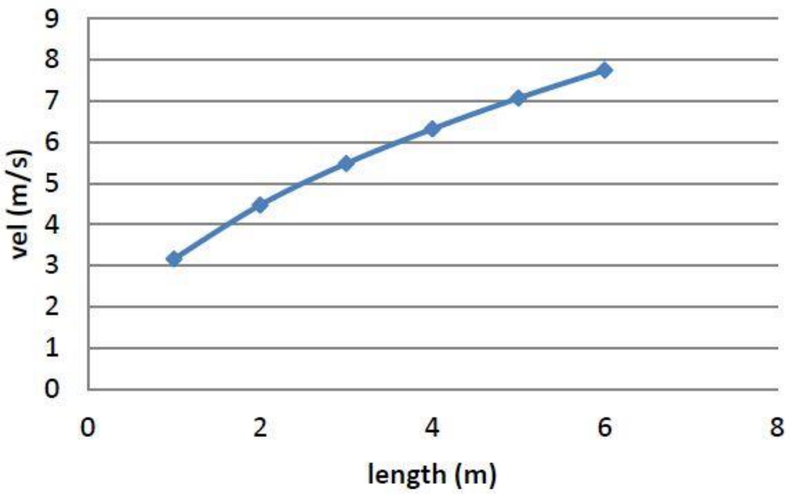


Diagram given may not be to the scale.

B. λ = 20 g/m = 0.02 kg/m, g = 10 m/s^2

Distance x in metre from the free end	Tension T = mg in newton at that distance	$\frac{T}{\lambda}$ in m^2s^{-2}	$v = \sqrt{\frac{T}{\lambda}}$ in m/s
1	0.2	10	3.16
2	0.4	20	4.47
3	0.6	30	5.48
4	0.8	40	6.32
5	1.0	50	7.07
6	1.2	60	7.75

Final answer is 5.9 m/s



QUESTION 39

A. Given C: H :: 10.5:1 Total : 11.5

For molecular weight of hydrocarbon in gas phase

PV= $\frac{W}{M}\ RT$

1×1 = $\frac{2.8}{M}\ 0.0821 \times 400$ M=92

11.5g of hydrocarbon has 1.0g of hydrogen

92. g of hydrocarbon will have $\frac{92}{11.5} \times \frac{1.0}{1} = 8\ g\ of\ hydrogen$

Hydrocarbon will have 92—8 = 84 g of carbon

8 g of hydrogen = 8 atoms of hydrogen

84 g of carbon = $\frac{84}{12}$= 7 atoms of carbon

Molecular formula: C_7H_8

B.

$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$$

$$2H_2 + O_2 \rightarrow 2H_2O$$

	$2H_2$	O_2
Volume before reaction	a	b
Volume after reaction	(a-2b)	0

a+b = 40

a-2b = 10

a= 30 ml, b= 10 ml

Mole % of hydrogen = Volume % of hydrogen = $\frac{30}{30+10} \times 100 = 75$

Ans : 75 %.

QUESTION 40

I. a) False
b) False
c) True

II. (i) chloroplast, (ii) photosynthesis (iii) decreases (iv) endosmosis (v) higher (vi) lower (vii) increase

III. c) Decrease in the rate of nitrogen fixation.

IV. a) The environment is hypertonic with respect to cell A.

V. c) Water will flow out from the guard cell

VI. a) Stoma remains in state 1 for an extended period of time.

QUESTION 41

3.5 hrs = 3.5 × 60 = 210 min

Amount of air inhaled = 210 × 8 = 1680 litres

20 % of oxygen present in air ,

Amount of oxygen in 1680 litres air = $\frac{1680 \times 20}{100}$ = 336 litres

5% of it is consumed by the body at STP

Amount of oxygen consumed by body in 3.5 hrs at STP = $\frac{336 \times 5}{100} = 16.8\ litres$

22.4 litres = 1 mole at STP

Hence 16.8 litres of oxygen at STP = $\frac{16.8}{22.4} = 0.75 mole$

$C_6H_{12}O_6$ (aq) + $6O_2$ (g) → $6CO_2$ (g) + $6H_2O$ (l) + Energy

1Mole 6 Mole 6 Mole

0.125mole 0.75 mole 0.75 mole

Molecular mass of $C_6H_{12}O_6$ = 72+12+96 = 180

0.125 mole of $C_6H_{12}O_6$ = 0.125 ×180 = 22.5g

Amount of carbon dioxide exhaled in 3.5 hrs during the process = 0.75 mole

= 0.75× 44 (molecular mass of CO_2) = 33 g

QUESTION 42

Volume of 40% of 1000 litre is 400 L whose mass is 400 * 1000 * 1.1 g = 440 kg

Volume of 60% of 1000 litre of H_2O has mass of 600 * 1000 * 1 g = 600 kg.

Energy required to raise temperature from 4 to 10 degrees

= 440 * (10-4) * 4.25 + 600 * (10-4) * 4.15 = 11220 + 14940 = 26160 KJ

At 4 degrees the melting of D_2O will require *L.m* = 340 * 440 = 149600 KJ

Now change of water from 0 to 4 degrees requires

600 * (4-0) * 4.15 = 9960 KJ

Melting of ice requires 600 * 330= 198000 KJ

Remaining energy = 3872 KJ

Specific heat = 3872/ (4 * 440) = 2.2 kJ/kg/K

At point A, Q = 198000 kJ, T = 0 ^{0}C
At point B, Q = 211832 kJ, T = 4 ^{0}C
At point C, Q = 361432 kJ, T = 4 ^{0}C
At point D, Q = 387592 kJ, T = 10 ^{0}C