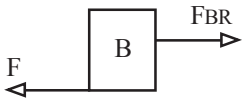
2000 A/L Physics

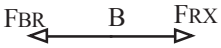
Marking scheme for (A and B) parts

Part - A

01. (a). (i).



---------- 01



---------- 01

(ii). F_{BR} and F_{RB} ---------- 01

(b). 100 N ---------- 01

(c). (i). 150 N ---------- 01

(ii). Ms = 150/500 or
= 0.3 or 3/10 ---------- 01

(d). (i). Applying F = ma for the string
200 - F_{RB} = 1 x 2 ---------- 01
F_{RB} (or F_{BR}) = 198 N ---------- 01

(ii). For the box F = 50 x 2
F = 98 N ---------- 01

(iii). Mk = 98/500
= 0.196 or 0.2 ---------- 01

For d (i) & d (ii), applying F = m a for the system and
then for the box 200 - F = 51 x 2 ---------- 01
F = 98 N ----------01
F_{BR} - 98 = 50 x 2
F_{BR} = 198 N ----------01

TOTAL 10

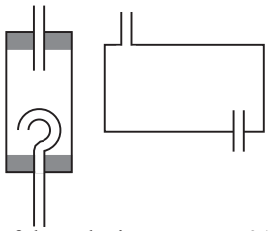
02.(i) Tube :- Dip the lower end of the tube in water.
(ii) Tube :- Keep the lower end of the tube above the water level (if both are correct. ------- 02)

(b) For the protection or
to prevent the increase of pressure or to maintain a constant pressure. ---------- 01

(c)(i) Since the condensed water in B can get mixed with the water in the calorimeter. ---------- 01

(ii) For the correct diagram. ---------- 01

(d)(i) 1. Mass of the empty calorimeter.
2. Mass of the calorimeter with water
3. Mass of the calorimeter with the composition after the vapour is sent out or the final mass of the calorimeter ---- 01



(ii) 1. Specific heat capacity of the compound which the calorimeter is made or the specific heat capacity of Cu or Al. ---------- 01
2. Specific heat capacity of water. ---------- 01

(e)(1) Place a screen in between the calorimeter and the burner.

(2) Reduce the temperature of water, 5^0C than the room temperature. Then add vapour until the final temperature of the mixture get increased by 5^0C than the room temperature (01 mark for any)

(f) Use the correct boiling point of water (or measure) (720 mmHg) ---------- 01

TOTAL 10

03.(a) On the sonometer box (in between the bridges) or on the box. ---------- 01

(b) First bring the two brides as close as possible. Then increase the gap between the bridges until the resonance occurs. (for the first time) ---------- 01

(c) $f = \frac{1}{2l}\sqrt{\frac{Mg}{m}}$ or for any correct form. ---------- 01

(d)(i) The maximum value obtained for l or the maximum data in the graph corresponding to the value of l or for maximum load l tension (corresponding value of l) ---------- 01

(ii) the percentage error for the maximum value obtained for l is low. ---------- 01

(e) For the two arrows in any of the given points.
(i) (1,100), (3,350), (5,600), (7,850) ---------- 01
(ii) 125 cm^2kg^{-1} (120-130) or
0.0125 m^2kg^{-1} (0.012-0.013) ---------- 01

(f) gradient = g / $4f^2m$
For the indentification of the correct form in the gradient. ---------- 01

$f = \sqrt{\frac{10}{4 \times 125 \times 10^{-4} \times 8 \times 10^{-4}}}$ for the correct substitution --- 01
= 500 Hz (490 - 510) ----------01

TOTAL 10

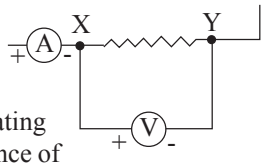
04.(a) $R = P\frac{l}{\pi r^2}$ ---------- 01

(b) $R_0 = \frac{6}{50 \times 10^{-6}}$ or $R_0 + 100 = \frac{6}{50 \times 10^{-6}}$
$R_0 = 1.2 \times 10^5\ \Omega$ ---------- 01
Therefore the suitable value for R_0 = 100 kΩ ---- 01
or
R_0 = 100 kΩ + 10 kΩ or
R_0 = 100 kΩ + 10 kΩ + 1kΩ ---------- 01

(c) $V_{XY} = 50 \times 10^{-6} \times 100$
$= 5 \times 10^{-3} = 5$ mV ---------- 01
Therefore the most suitable full scale deflection.
= 10 mV ---------- 01

(d) For denoting (+) and (-) at eithersides of A
For denoting (+) and (-) at either sides fo V } ------ 01

(e) Yes.
Since the temperature of the wire doesn't change by a considerable amount or the heating of the wire is low or the resistance of the wire doesn't change by a considerable amount. ----------01



(f) $P = \frac{105 \times \frac{22}{7} \times 25 \times 10^{-10}}{}$

$= 8.25 \times 10^{-7}\ \Omega m$ (8.2 or 8.3) ` ---------- 01

(g) Using a resistor box (instead of R_0) Using a variable resistor. (instead of R_0) (A rheostat) ---------- 01

TOTAL 10

Part - B

01. (i) Kinetic energy in a unit volume of a moving air column. $E = {}^1/_2\ \rho v^2$ ---------- 01

(ii) Volume of air blowing through a cross-sectional area of A at a unit time $= Av$ ---------- 01

The rate of obtaining the energy of the wind by the mill $= Av \times {}^1/_2\ \rho v^2$ (for the correct multiplication) - 01

(iii) $\omega = \omega_0$ -(or $+ \alpha t$)

$\omega_0 = \frac{2\pi \times 30}{60}$ rad s^{-1} (for the convertion) --- 01

$= \pi$ rad s^{-1}

since $\omega = 0$

$\alpha = \frac{\frac{2\pi \times 30}{60}}{2 \times 60} = \pi/120$ rad s^{-2} ---------- 01

Therefore the frictional torque (τ)

$\tau = I\alpha$ ---------- 01

$= \frac{10^4 \times \pi}{120} = 262$Nm (261 - 263) (for the correct substitution)-- 01 --------- 01

(iv) (When the wind mill is rotating with a uniform angular velocity, rate of grasping of the wind energy is equal to the workdone against the frictional torque)

Therefore the rate of grasping of wind energy by the mill $= \tau\omega$ ---------- 01

$= 262 \times \pi$ ---------- 01

(For the correct substitution or for the sentence given in the bracket) ---------- 01

$= 823$ W (820 - 827) ---------- 01

(v) Rate of incident of energy on the mill

$= {}^1/_2\ PAV^3$

$= {}^1/_2 \times 1.3 \times 30 \times 10^3$ ---------- 01

$= 19500$ W ---------- 01

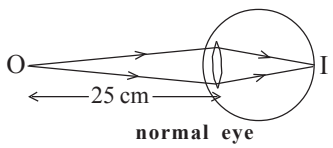
Therefore wind mill is rotating freely.

The efficiency $= \frac{823}{19500} = 0.042$ or 4.2%

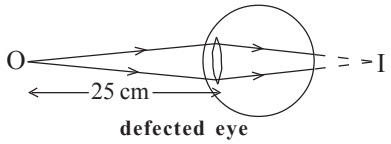
(for the division) ----- 01

TOTAL 15

02.(i)



normal eye



defected eye

(ii) Sign convention.

All the distances of the lenses must be measured from the optical centre. The distances measured towards the direction of the incident rays are (-) and the distances measured towards opposite of the direction of the incident rays are (+) ---------- 01

When spectacles are worn, the image of the object in 25cm form on the retina. Therefore the image distance for the spectacles V = 100 cm ---------- 01

When applying the lens law.

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{100} - \frac{1}{25} = \frac{1}{f}$ (for the correct substitution) --------- 01

$f = \frac{-100}{3} = -33.3$ cm ---------- 01

The focal length of the spectacles = 33.3 cm --------- 01

The lens of the spectacle is convex or converging --- 01

(iii) If the focal length of this lens combination is F, by applying $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{-1}{2.5} - \frac{1}{25} = \frac{1}{f}$ (for the correct substitution) ----01

$\frac{1}{f} = \frac{-11}{25}$

For the lens combination

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{f_2} = \frac{-11}{25} + \frac{3}{100}$ Correct substituition ---------- 01

$f_2 = -2.4$ cm ---------- 01

Or

The image formed by the spectacle which is 25 cm away, it becomes the object for the eye lenses.

Therefore U = 100 cm ---------- 01

Applyling

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{2.5} - \frac{1}{100} = \frac{1}{f}$ $f = -2.4$ cm ---------- 01

The focal length of the eye lens = 2.4 cm -------- 01

(iv) When the eye is focused to an object at infinite, the focal length of the eye lens = 2.5 cm --------- 01

Therefore the power of the eye lens $= \frac{1}{2.5 \times 10^{-2}}$ ------ 01

$= 40$ (Diopter) --01

(40 D)

TOTAL 15

03.(i)(a) Magnetic force is always perpendicular to the moving direction of the proton ($F = qvB$) --------- 01

Therefore the path of the proton is circular.

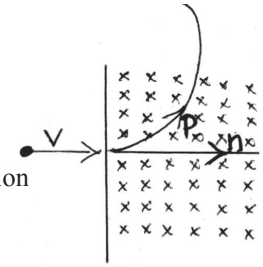
From the Newton's second law of motion.

$qvB = mV^2/r$ $\quad r = mV/qB$

$r = \frac{1.7 \times 10^{-27} \times 8 \times 10^5}{1.6 \times 10^{-19} \times 0.017}$ $r = 0.5$m or 50cm ---------- 01 correct substitution ---------- 01

NOTE

The path of the proton must be a semi circle instead of the straight line. The correct direction must be mark.



for the diagram. ---------- 02

(b) The electron must move to the opposite direction with a small radius or a small path must be marked in the diagram. ---------- 01

(ii) The charge of an α particle is twice of that of a proton. ---------- 01
Mass of an α particle is four times of that of a proton. ---------- 01
Since V and B is equal to both the particles radius of the α particle = 2 x 0.5
= 1 m or 100 cm ---------- 01

(iii) Marking a straight path in the diagram or mentioning that there is no deflection. ---------- 01

(iv) The electric force on the charged particle = qE
Since the deflection is neutralized
qE = qVB or E = VB = $8 \times 10^5 \times 0.017$ ---- 01
∴ The magnitude of the electric field = 1.36×10^4 Vm^{-1} - 01
direction (perpendicular to the vertical magnetic field) downwards or should be marked in the diagram --- 01
No change in the velocity of the particle.
Reason :- There's no resultant force acting on the particle towards it moving direction. ---------- 01

TOTAL 15

04. Poiselle's equation.

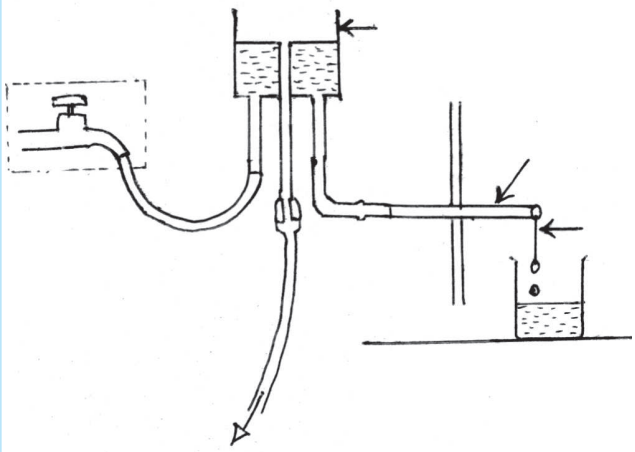
$$\frac{Q}{t} = \frac{\pi a 4 (P_1 - P_2)}{8\eta l}$$ ---------- 01

Q = The volume of fluid moving through a tube within at time gap.
a = Internal radius of the tube.
P_1 = The initial pressure of the fluid.
P_2 = Pressure of the fluid at the end of the tube.
l = length of the tube.
η = Co-efficient of viscocity.
(If all are correct) ---------- 01

or

$$Q = \frac{\pi a^4 P}{8\eta l}$$ ---------- 01

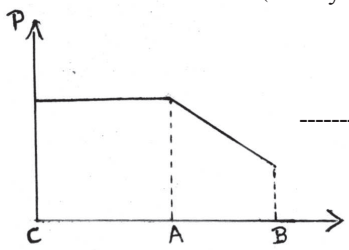
Q = Rate of volume flow of the liquid
a = Internal radius of the tube
P = Pressure difference across the tube
l = length of the tube
η = co-efficient of viscocity
(If all are correct) ---------- 01



For the constant pressure head 01
For the remaining equipments 01 ----- 02
If all are correct ---------- 01
Inorder to increase the final result,
- Clean the tube.
- Fix the tube horizontaly
- Measure the internal radius of the tube correctly (using a mercury column)
- Add water to the beaker for a long time
- Measure the correct volume flow rate of the pressure head for different heights.
- Do not make a large liquid column. (In order to control the water level and the flow rate of water)

(for any 3) ------ 02
(for any 2) ------- 01

(i)



----------01

(ii) Appyling Poisell's equation.
If P_O is the atmospheric pressure then $P_B = P_O$

$$\frac{1 \times 10^{-6}}{10} \qquad \frac{\pi(0.02 \times 10^{-2})^4 \ (P_A - P_B)}{8 \times 1 \times 10^{-3} \times 2 \times 10^{-2}}$$ ---------- 01

For identifying the correct units in substitution. -- 01
For converting into SI units ---------- 01
Therefore the pressure difference = PA-PB
= 3.2×10^3 Nm^{-2} ----- 01
(3.1 - 3.3)

(iii) The rate of flow of fluid is equal to that of (ii) the pressure difference across AB for the both occassions is sam.
Therefore $P_A - P_B = P'_A$ - Blood pressure
(or inorder to make a normal pressure difference across AB, the excess pressure of B musle equal to that of A) $P_A + (P'_A = A)$
Therefore the excess pressure of A = 100 mmHg -- 01
hρg = $100 \times 10^{-3} \times 13.6 \times 10^3 \times 10$
(for the correct substitution of hρg) ---------- 01

Therefore, the additional force that should be exerted on D, $= (P'_A - PA) \times 0.75 \times 10^{-4}$
[For multiplying by the cross-sectional area] --- 01
$= 1.02$ (or 1) N ---------- 01

TOTAL 15

05.(a)(i) For the electric bulb $W = V I$ ---------- 01
$60 = 12 \times I = 5$ A ---------- 01

(ii) If n is the amount of conducting electrons in 1 m^3,

$$n = \frac{6.0 \times 10^{23}}{0.063} \times 9 \times 10^3$$ ---------- 01

or

$$n = \frac{6 \times 10^{23}}{63} \times 9 \times 10^6$$ ---------- 01

$= 8.6 \times 10^{28}\ m^{-3}$ (8.5 - 8.7) ---------- 01

(iii) $I = nqAVd$ ---------- 01

$$Vd = \frac{5}{8.6 \times 10^{28} \times 1.6 \times 10^{-19} \times {}^{22}/_{7} \times (0.7 \times 10^{-3})^2}$$

(for correct substitution) -------- 01

$$Vd = \frac{5}{8.6 \times 1.6 \times 22 \times 7 \times 10}$$

$= 2.4 \times 10^{-4}\ ms^{-1}$ (2.3 - 2.5) ---------- 01

(iv) ${}^{1}/_{2}\, mV^2$ r.m.s. $= {}^{3}/_{2}\, kT$

or

$$V \text{ r.m.s.} = \sqrt{3kT/m}$$ ---------- 01

$$= \sqrt{\frac{3 \times 1.4 \times 10^{-23} \times 300}{9.1 \times 10^{-31}}}$$

(for correct substitution) -------- 02

V r.m.s.$= 1.2 \times 10^5\ ms^{-1}$ (1.1 - 1.3) ---------- 01

V r.m.s. measures the speed between electron collision. (or speed of the random motion) -------- 01

And, Vd measures the resultant velocity of the electrons which are in the direction of the electric field. ---------- 01

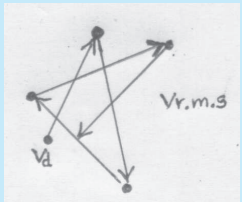
or

While e is in motion, they collide with molecules. Then, the direction of their velocity change. -------- 01

Therefore, the velocity which is in the forward direction is lesser than the velocity in between the collisions. [Neglegible] ---------- 01

or

For drawing the diagram.



---------- 02

(v) Time spent $= \frac{1}{2.4 \times 10^{-4}}$

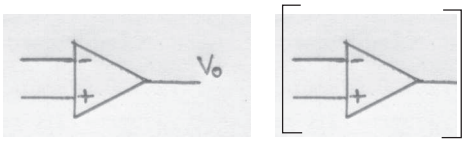
$= 4.2 \times 10^3$ s (or 70 mins or (4 - 4.4) 1 hour & 10 mins) --- 01

Instantly (similar to the speed of light) an electric field is created inside the wire. All of the e starts to move along the wire at the same time. ---------- 01

Therefore for any lone e, the time taken to move from one end of the wire to the other does not effect the occuring of the current.

TOTAL 15

(b)



(For the correct circuit symbol) -------- 01
(For the correct naming) -------- 01

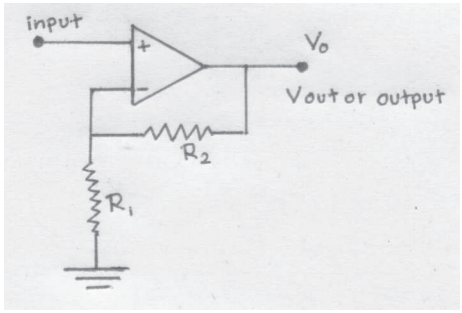
$V_O = A(V_1 - V_2)$ ---------- 01
$V_O = 10^5 [-3 - (-5)]$
or
$V_O = 10^5 [-3 - (-5)] \times 10^{-3}$ ---------- 01
$= 2 \times 10^5$ mV or 2×10^2 V ---------- 01

Therefore, the polarization of the output voltage is positive (or + ve) ---------- 01

(WIthout the calculation if only the correct polarization is given, award only 01 mark)

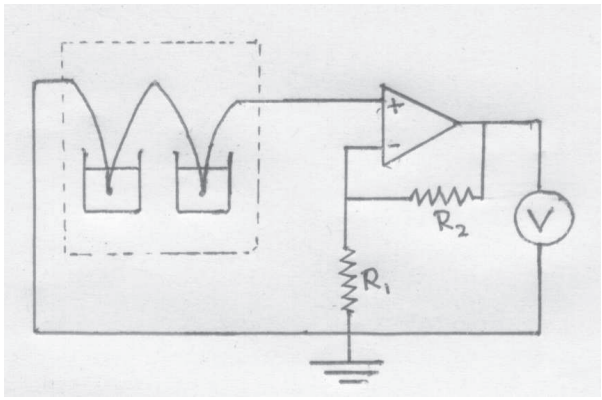
The correct magnitude $V_O = 15$ V (13 V - 15V) -------01

(ii)(a)



(For the circuit diagram) ---------- 01
(If the naming is correct) ---------- 01

(b)



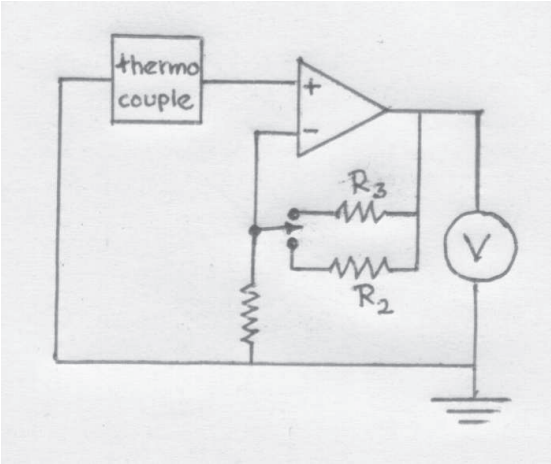
---------- 01

(c) The voltage gain to obtain the full scale deflection should be 100. ---------- 01

$$\frac{V_O}{V_1} = \frac{R_1 + R_2}{R_1} \text{ or } \frac{R_1 + R_2}{R_1} = 100$$ ---------- 01

When $R_1 = 1\ k\Omega$

$R_2 = 99\ k\Omega$ ---------- 01



---------- 01

$\frac{R_1 + R_3}{R_1} = 10$

When $R_1 = 1\ k\Omega$

$R_3 = 9\ k\Omega$ ---------- 01

TOTAL 15

06.

(a)(i) If we consider that 1st situation is possible,

If the final temperature is θ, the heat given by the copper vessel $= 2 \times 4.0 \times 10^2\ (150 - \theta)$ ---------- 01

The heat absorbed by water,

$= 0.1 \times 4.0 \times 10^3\ (\theta - 30)$ ---------- 01

$2 \times 4.0 \times 10^2\ (150 - \theta) = 0.1 \times 4.0 \times 10^3\ (\theta - 30)$

(For the expression) -------- 02

$2\ (150 - \theta) = \theta - 30$

$\theta = 100\ ^0C$ ---------- 01

$\theta > 100\ ^0C$ (or for writting in words) ------01

Therefore the 1st situation is not possible.

(ii) If we consider that the 2nd situation is possible.

If m is the mass of the vapour produced. The heat given by the vessel. $= 2 \times 4.0 \times 10^2\ (150 - 100)$ ---- 01

Heat absorbed by water

$= 0.1 \times 4.0 \times 10^3\ (100-30)$ ---------- 01

Heat absorbed as latent heat.

$= m \times 2 \times 10^6$ ---------- 01

$0.1 \times 4.0 \times 10^3 \times 70 + m \times 2 \times 10^6 = 2 \times 4 \times 10^2 \times 50$

(For the expression) ---------- 01

Because, $m < 0.1$kg (or for writting in words) -------- 01

Therefore this happens for real.

(iii) If m is the mass of water that should be poured to the vessel initially.

$= m' \times 4 \times 10^3\ (100 - 30)$ ---------- 01

Heat absorbed as latent heat,

$= m' \times 4 \times 10^6$ ---------- 01

$m' \times 2 \times 10^6 + m' \times 4 \times 10^3 \times 70 = 2 \times 4 \times 10^2 \times 50$

(For the expression) -------- 01

$m' = 0.018$ kg (0.017 - 0.02) ---------- 01

TOTAL 15

(b)(i) A - Anode or ---------- 01

B - Cathode or filament ---------- 01

(ii) Avoiding the loss of e due to the collisions or formation of ions.

or

Avoiding the energy loss of e due to collisions.

or

Avoiding the spread of e ---------- 01

(iii) Heating of the cathode / filament.

or

Sending a current through cathode / filament

or

Production of e ---------- 01

(iv) Positive or + ---------- 01

(v) In an unit time, the energy of the amount of electons that collide. or

filament current or

Voltage of P_2 or

Rate of production of e ---------- 01

(vi) Energy of the e that collide or

Voltage of P_1 ---------- 01

(vii) If V is the voltage that should be present, kinetic energy

$E = eV$ (or qV) ---------- 01

$V = \frac{5.6 \times 10^{-15}}{1.6 \times 10^{-19}}$ (for correct substitution) – 01

$V = 3.5 \times 10^4$ V (or 35 kV) ---------- 01

(viii) If λ is the wave length of the required X rays.

$\frac{hc}{\lambda} = E$ ---------- 01

$\frac{6.6 \times 10^{-34} \times 3 \times 10^8}{\lambda} = 5.6 \times 10^{-15}$ ---------- 01

$\lambda = 3.5 \times 10^{-11}$ m (or 0.035 nm or 0.35 Å) -- 01

(ix)(a) For obtaining X ray images of different parts of the body in medical science.

(b) For treating cancer.

(c) For the safety measures in the airport.

(d) For the observing the errors of materials.

(e) For obtaining crystalline structures of materials or molecules. Or

For any 2 answers (of 2 different sections)

(one mark for each answer) ---------- 01

(x) In photo electric emission or photo cells. ---------- 01

TOTAL 15

2000 A/L MCQ Answers

01	2	11	2	21	1	31	5	41	5	51	5
02	4	12	2	22	2	32	2	42	1	52	1
03	3	13	3	23	1	33	1	43	3	53	2
04	5	14	4	24	1	34	all $\frac{\mu_0 i}{4}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$	44	3	54	1
05	3	15	3	25	5			45	5	55	1
06	4,5	16	3	26	2	35	4	46	4	56	3
07	3	17	4	27	2	36	5	47	3	57	2
08	3	18	1	28	2	37	4	48	4	58	1
09	4	19	5	29	3	38	2	49	5	59	2
10	4	20	3	30	1	39	4	50	5	60	4
						40	4				