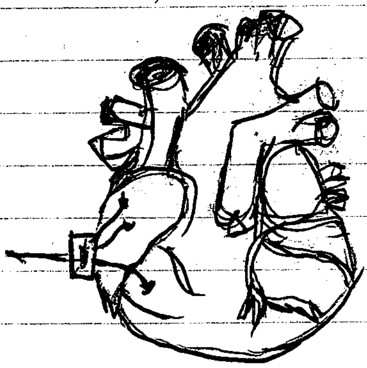
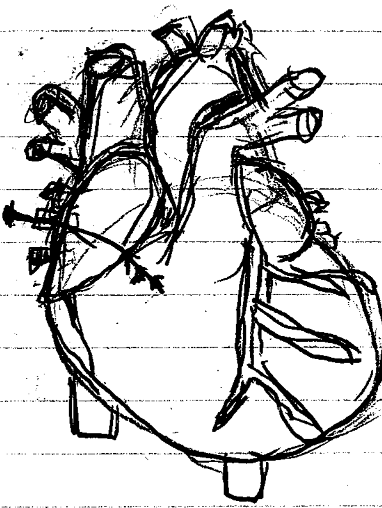
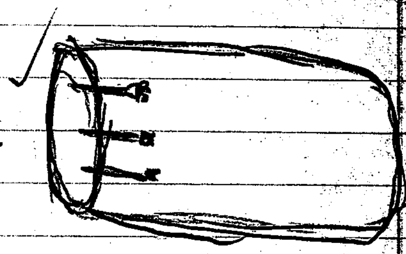




a.



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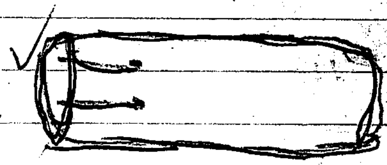
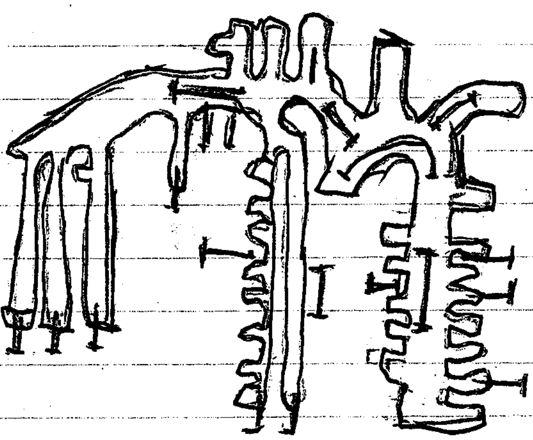




↑ Blood Volume → Atrial Pressure +

+

Atrial Pressure ↓ Kidney

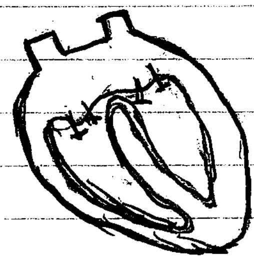
+

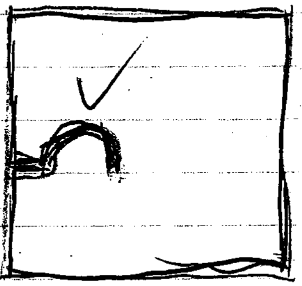
Pituitary → Blood Volume

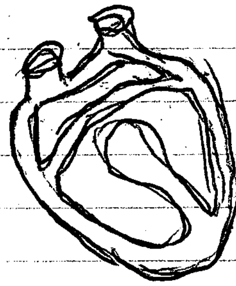
Pituitary ↓ Adrenal cortex

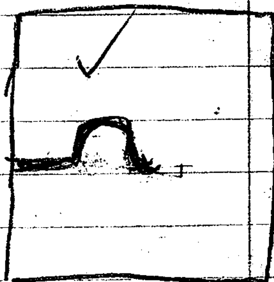
$O_2$

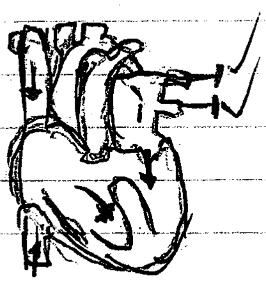
$CO_2$





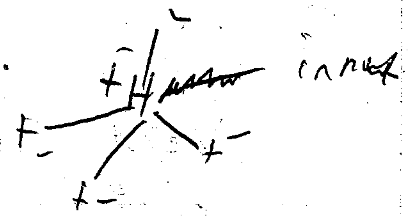






Tederal

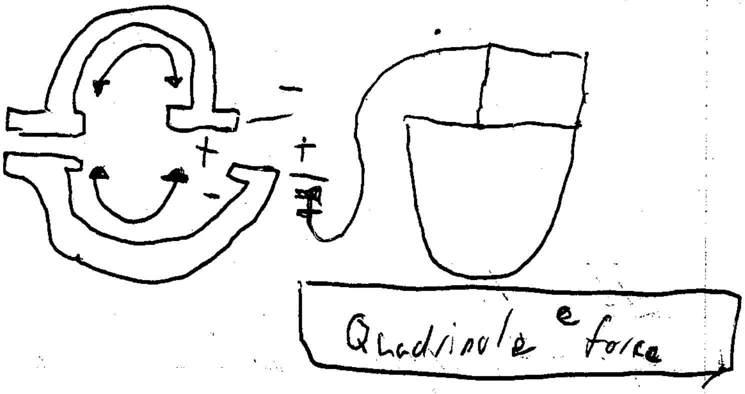
bond




$-I$

electron charge $\frac{1}{2}$ $-n$

= opposite charges




Lead cathode

Lead Anode

Battery –

Anode

Battery

cathode +

| | | |
|---|---|---|
| 2 e- <br> 2Li —— 2 Li + | electrolyter <br> LiI | 2e- <br> MI2 —— M + 2I |

The anodal termaled of the battery is negatively charged as lithium release electrons to the lead, then exciting a Ao bond. The portion of the battery itself become positively charged with the reaction $2Li \rightarrow 2\overset{+}{Li} + 2e^-$

$\frac{1}{2} = \frac{-I}{-n}$

C +

Void invert: (ATP)
"{CA ++ / na +"
"{1, 2, 3,)"
"{a - b}" current

Cardiac Pacing & ICDs

Basic concepts of pacing

97

The Power source of all pulse generators ~~almost~~ presently in use is a chemical battery. Modern pulse generators generate the cathode element

Pto

At the battery terminals the anode gives up electrons and is negatively charged, & the cathode accepts the positive charge +

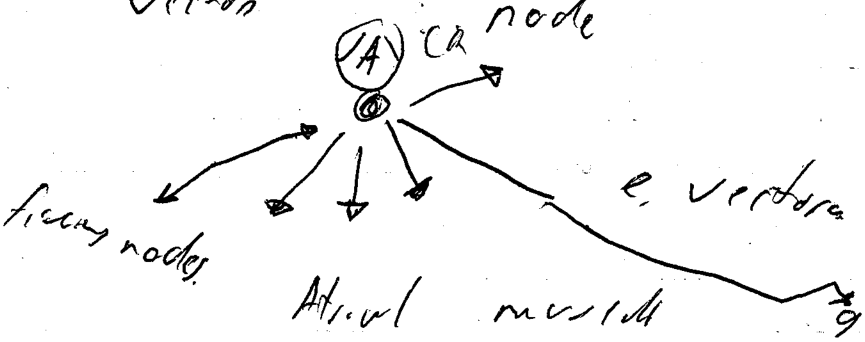
Clamps are specified on pci input pins to help maintain good bus signal integrity

22/2/2020 CAnell ®

# Vectors & Mean Electrical Axis

The ECG records time-dependent changes in electrical activity within the heart. At a given instant in time. At a given instant a wave of depolarisation originating within the SA node & then spreads into the atrial muscle.


When the SA node fires, many separate depolarisation waves emanate from SA node and travel throughout the atria. These separate waves can be depicted as arrows representing individual electrical vectors

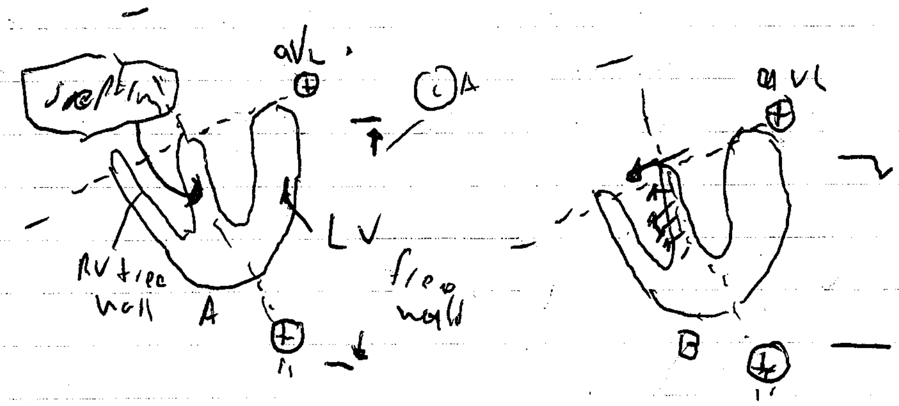



At any given instant, many individual instantaneous electrical vectors exist. Each one represents action potential conduction in a different direction.

Chapter two (cardiovascular Physiology concepts)

electrical activity of the heart

Qrs complex from two different recordings of electrodes




A. ventricular prior to depolarisation: isoelectric (0) voltage recorded by electrodes aVL & II.

B septal depolarisation: volt at II, aVL <=.

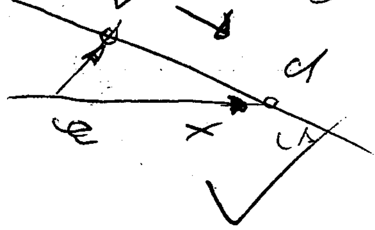
An instantaneous mean electrical vector can be derived by summing the individual instantaneous vectors.

In the heart the, the mean electrical vector changes its orientation as different regions of the heart undergo depolarisation or repolarisation. the direct. of the mean electrical vectors relative to the axis between positive and negative recordings of voltage of electrodes determines the magnitude of the recorded voltage

(Math 160) The size of vector arrow is related to mass of ...

The parametric equations of a line

We consider the straight line which passes through the point (with ...) and has direction $D$.



If $x$ is a general point on a line then the diagrams we see that $x = vD + O$

Hence $\boxed{x = vD + De}$

The scalar $T$ is called a parameter of the line and the equation is called a parameter equation of the line that $v$ with direction $D$.

The parameter $t$ can take on any real value as it varies, the point $x$ moves along the lines, some position of corresponding value.

1.17 23/2/20 CA

(R)

Hypotention of cardiac cycles

Hypotension is often defined clinically as a systolic artery pressure eg. coagulation by a lower factor.

Gdx to ~~DFY1~~ → Or 4,4 caridair output

PVI[(CI] + X1 ⊕

dimethyl 2,2' bipyridine

Vascular system

Os 44 ⊕

2,2'62 - terpiridine $^{2+}$

⊕

redox problem

The arterial because of rate or pressure over cardic output..

When hypertion occurs the body attempts to restore artical pressure

hypotension

SV

Cardiac output — heart rate — Vascular Restore

charts 6 - 7

The changes in pressure and voulumes described in the cardiac cycle diagram and by the pressure voulume loop are for normal adult hearts at resting heart rates.

The primary function of the heart is to impart energy to blood to generate and sustain an arterial blood pressure sufficient to adequately prefuse organs. the heart achieves this by contracting its muscular walls around a closed chamber to generate sufficient pressure to propel blood from the left ventricle, through the aortic valve, and into the aorta.

Each time the left ventricle contracts, a volume of blood is ejected into the aorta.

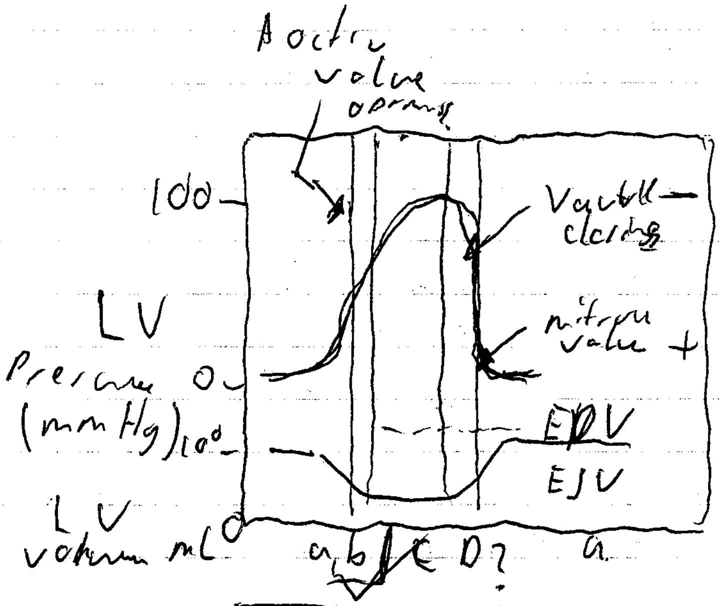
This SV multiplied by the number of beats per minute (heart rate, HR)

= the cardiac output

$$CO = SV \cdot HR$$

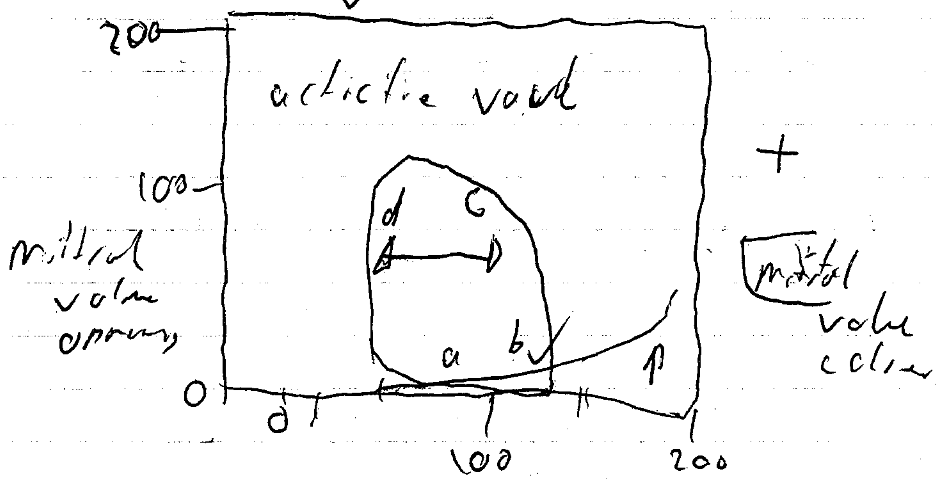
Therefore, changes in either SV or heart rate alter cardiac output

# Ventrica pressure volume loops




d = ciclar

c = dimaken




+

mitral valve closing

Ventricle pressure loops.
In experimental settings cardiac output can be measured by Doppler flowmeters placed around the pulmonary artery. obviously this approach could be used in humans. therefore indirect techniques are used such as a cardiac output computer is used to calculate

Chapter 4.

cardiac flow

[illegible] changes in flow within the heart, pulmonary artery or [illegible] aorta

Various radionuclide techniques can also be used to measure change in ventricular dimension

During the cardiac cycle in order to calculate SV which, when multiplied by heart rate gives cardiac output

The Flick method permits time-averaged calculation from measurements of arterial & venous blood oxygen content ($CaO_2$ & $CvO_2$, respectively: mL $O_2$/mL blood (e.g. blood pressure)

and whole body oxygen consumption ($VO_2$: mL $O_2$/min)

$$CO = \frac{VO_2}{(CaO_2 - CvO_2)}$$

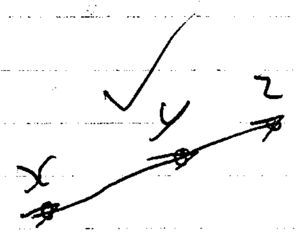
24/2/20 A R

Math 160

# Scalar multiplication

The sum $x + x + x$
clearly forms ~~and~~ new vector
with the same direction sense as
$x$ but with three times the
magnitude ✓

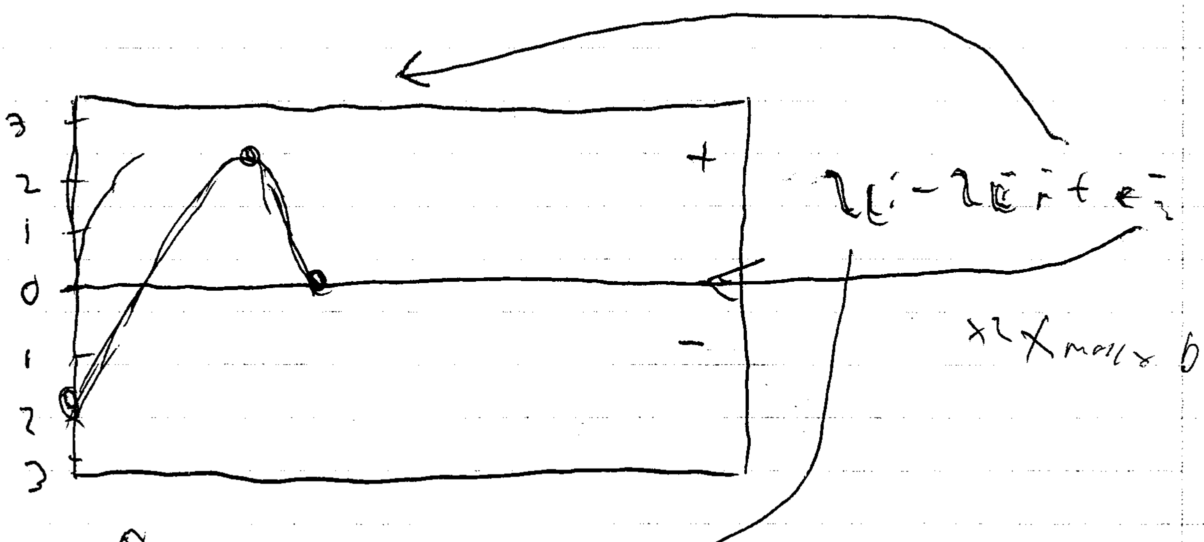
to scale



It is natural to write it
as $x3$

Similarly if $c$ is scalar then
$cv$ is vector with the same
direction as $z$

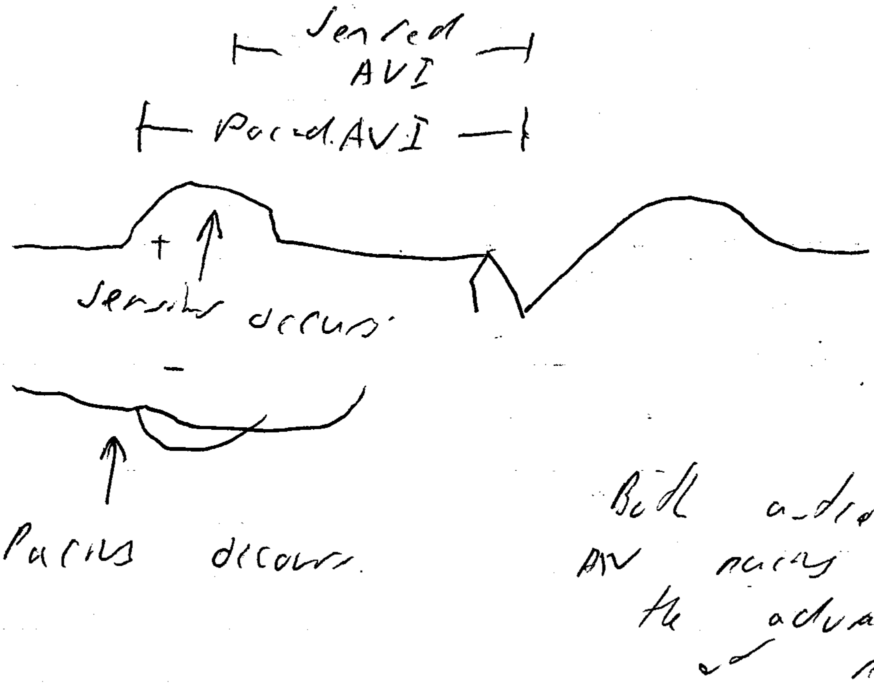
When multiplying a vector by a scalar
we just multiply all components by
that scalar.



1-6

Atrial sensed vs atrial paced atrioventricular intervals.
Appropriate programming of the AV interval may depend on whether the atrium is sensed - or + paced.

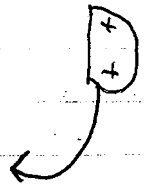
Programming differential AV interval for sensing & pacing may give rise to small but significant increases in cardiac output in patients with LV dysfunction due to differences in paced vs sensed atrial conduction (velocity) times. if atrial activity is sensed this marks the initiation of the pacemaker AV intervals.
Because some atrial activity activation has already occurred at this time, the AV interval based on sensed atrial activity should be shorter than when the atrium is paced, to be the both the av interval & atrial electrical + mechanical.



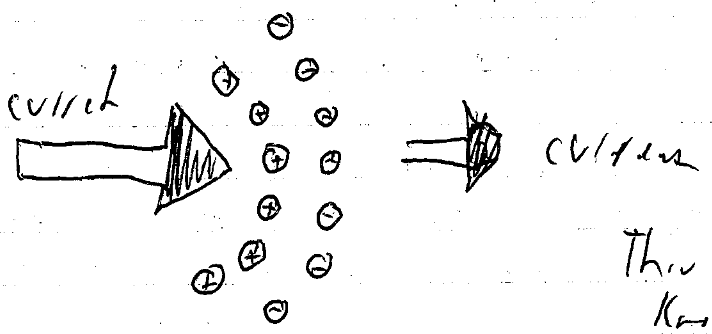

Both atrial & AV pacing have the advantage of possible AV synchrony.

Chapter 3.
Hemodynamics of cardiac pacing.

When current is applied to the myocardium the area cathode becomes surrounded by a layer of positively charged ions

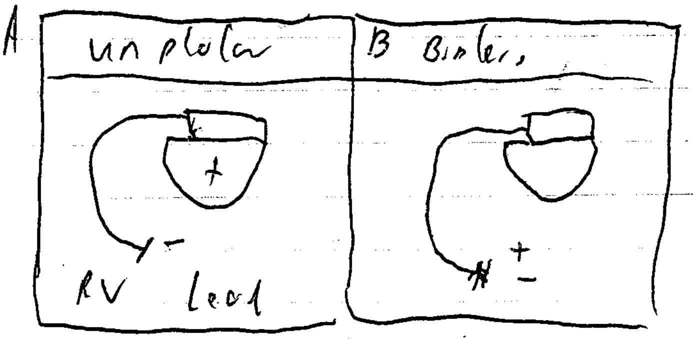



Which in turn attracts a layer of negatively charged ions




This effect is known as electrode polarization

The relationship between the voltage wave form of a constant voltage pulse of pump



A) A uniplar pacing configuration uses the distal pacemaker electrode as the circuit cathode and the metal of the pacemaker can as the circuit anode.

B A bipolar pacing configuration requires a pacemaker lead with two separate conductors, one leading to the distal tip electrode, which is the pacing cathode & the second leading to the closed screw but narrow proximal "ring" electrode which is the pacer anode. RV. single ventricular

The term unipolar pacing is technically a misnomer, as both bipolar & unipolar configuration require an anode & a cathode to complete the electrical circuit.

Because both unipolar & bipolar pacing use an electrode in contact with the myocardium (usually as cathode) the difference in these configuration lies in the location of the treatment band — & electrode. The pacer impedance is slightly higher with bipolar than with unipolar pacing because the two conducting wires are required. The stimulation threshold is slightly lower with uniplolar than with bipolar pacing, but the difference is of a small magnitude that may have clinical significance ✓

Chapter 2

cardiac pacing

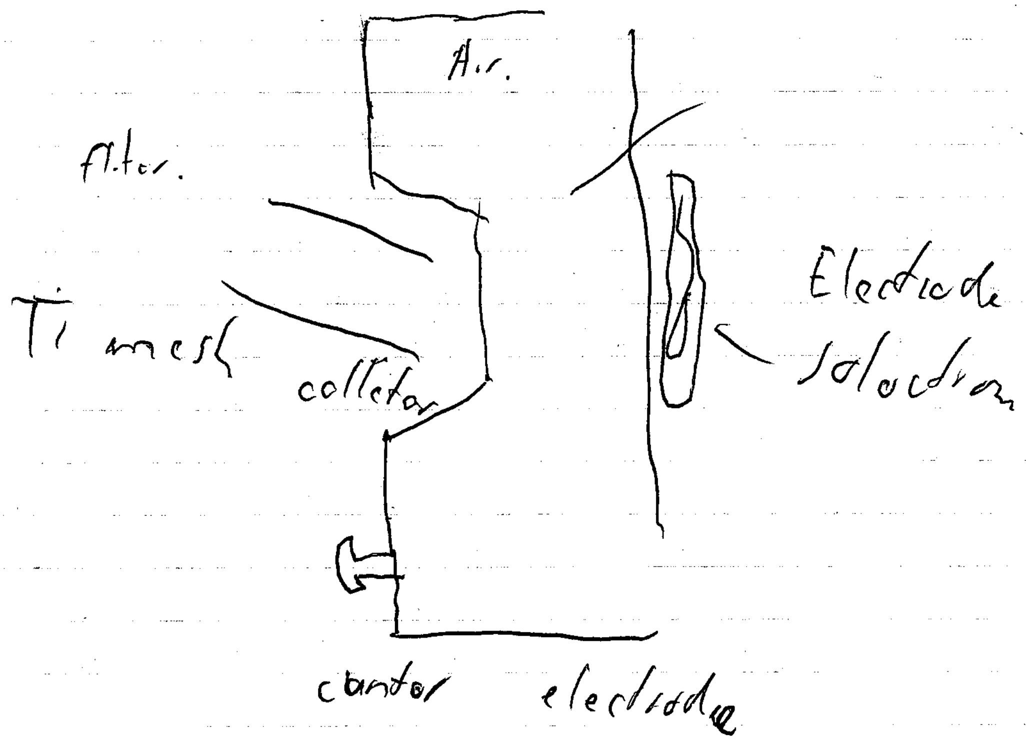
24/12/20

ch (?)

Chem 101. Carbon stems

electrode

AgI AgCl tetrafluoro...

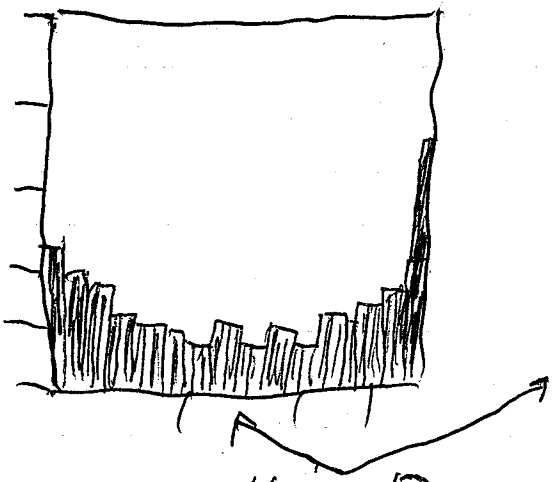



Recent research on bio cathode designs has focused on gas-diffusion layers at the cathode to afford air-breathing bio cathode configurations.

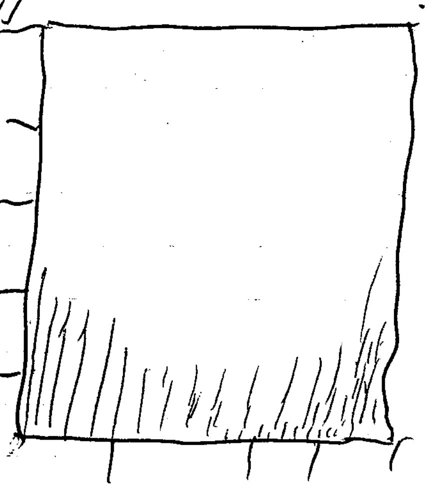
Such configurations can overcome the cathode due to its low solubility / O diffusion coefficient in the aqueous electrolytes used heretofore.

magnitude.

A



B)



cathode potential

3

volume normalized current density (μA cm$^{-3}$)

surface area normalized current density (μA cm$^{-2}$)

Such biocathodes yielded current densities in the mA cm$^{-2}$ range

However, the use of cred as a biocatalyst meant that the steady-state currents for ORR were only observed at potentials negative than 0.2V vs Ag/AgCl. It was dependent $\frac{1}{n}$ on buffer concentration in the electrolyte. however was limited by supply of protons as the current was dependent on buffer concentration in electrolytes

the use of a 1.0 M citrate electrolyte (pH=5.0) resulted in a steady-state current density of 20 mA cm$^{-2}$, the highest yet reported for a steady-state current density for the ORR at a biocathode

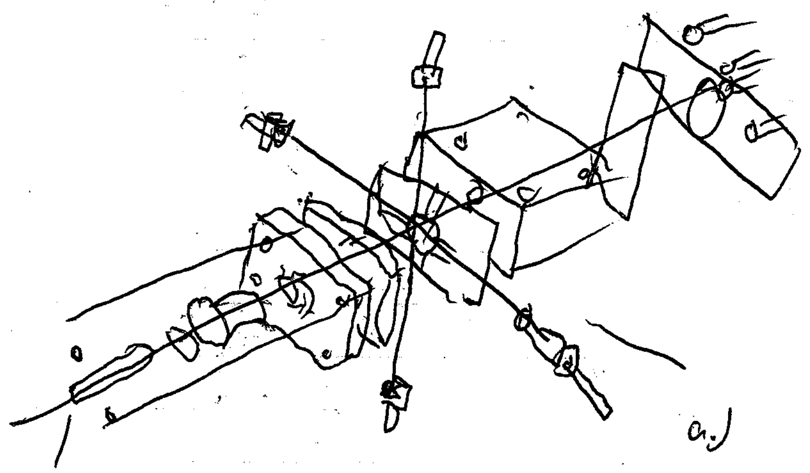
Advances in nanostructured carbon materials for DET have resulted in impressive current densities for the ORR.

And application of these three dimensional materials to DET from MCOs other than CcO may provide biocatalysts with the characteristics suitable for an implantable (EFC).

While a DET approach using MCOs can provide for ORR at potentials approaching the thermodynamic reduction potential for oxygen,

the current density achievable in this approach still relies upon intimate contact & correct orientation of the MCO to a conducting surface. Use of a mediator capable of close interaction with the T1 site of the MCOs and with a redox potential tailored to promote rapid electron transfer to the T1 site can eliminate the requirement for direct contact in the correct orientation between MCO & electrode, and offer the possibility of a three dimensional biocatalytic reaction layer on electrode for high volumetric ORR current densities

Assembled bio fuel cells




Three-dimensional drawing of the modular stack half cell showing the central reaction chamber with electrode inlet + solution filling ports a & b).

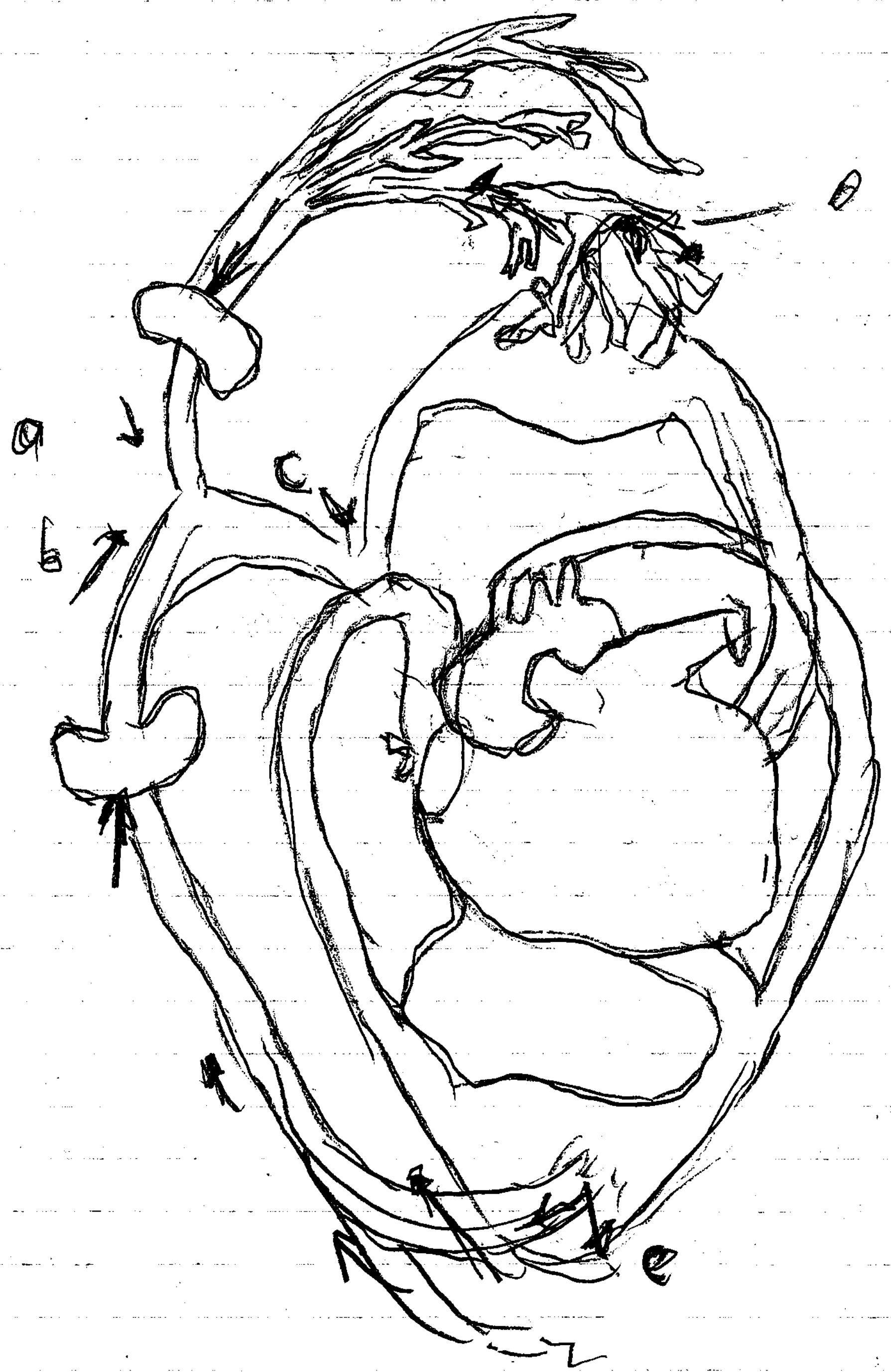
Microfluidic EFCs are designed to operate within the microchannel preventing crossover & mixing, using laminar flow delivery of almost parallel streams of fuel & oxidant within the chamber.

Results indicating that placement of the cathode upstream from the anode can protect the anode from oxygen & lead to an increase in maximum cell currents.

5.4 257 biofuel cells

25/2/20 CA (R)

Flud Exchange
Between the capillary
systems with
T cells 18 12
4



# Embriololgy of develpment

The primary heart field, secondary heart field, cardice neuralcrest and proepicardium are the four major embryogenic regions involved in the process of vertebrate heart development

Which makes an important contribution to overall cardic development. which occurs with complex dependen timers & regulation.

The heart is the first organ to fully form & function during vertebrate development and many of the underlying mechanisms are considered molecular & developmentally conserved

These discoveries were a critical step in advancing our understanding of how the outflow tract of the heart form, an area in which many congenital heart defects arise & thus have had important implications for the understanding & prevention of human congenital heart disease. in addition great strides have also been made in our knowledge of the contribution of the cardic neural crest & the epicardium to overall heart development

# Primary heart field & linear heart tube formation

The cells that will become the heart are among the first cell lineages formed in the vertebrate embryo - by day 15 of human development the primitive streak has formed & the first mesodermal cells migrate to an anterior gastrulation through the primitive streak are cells fated to become the heart.

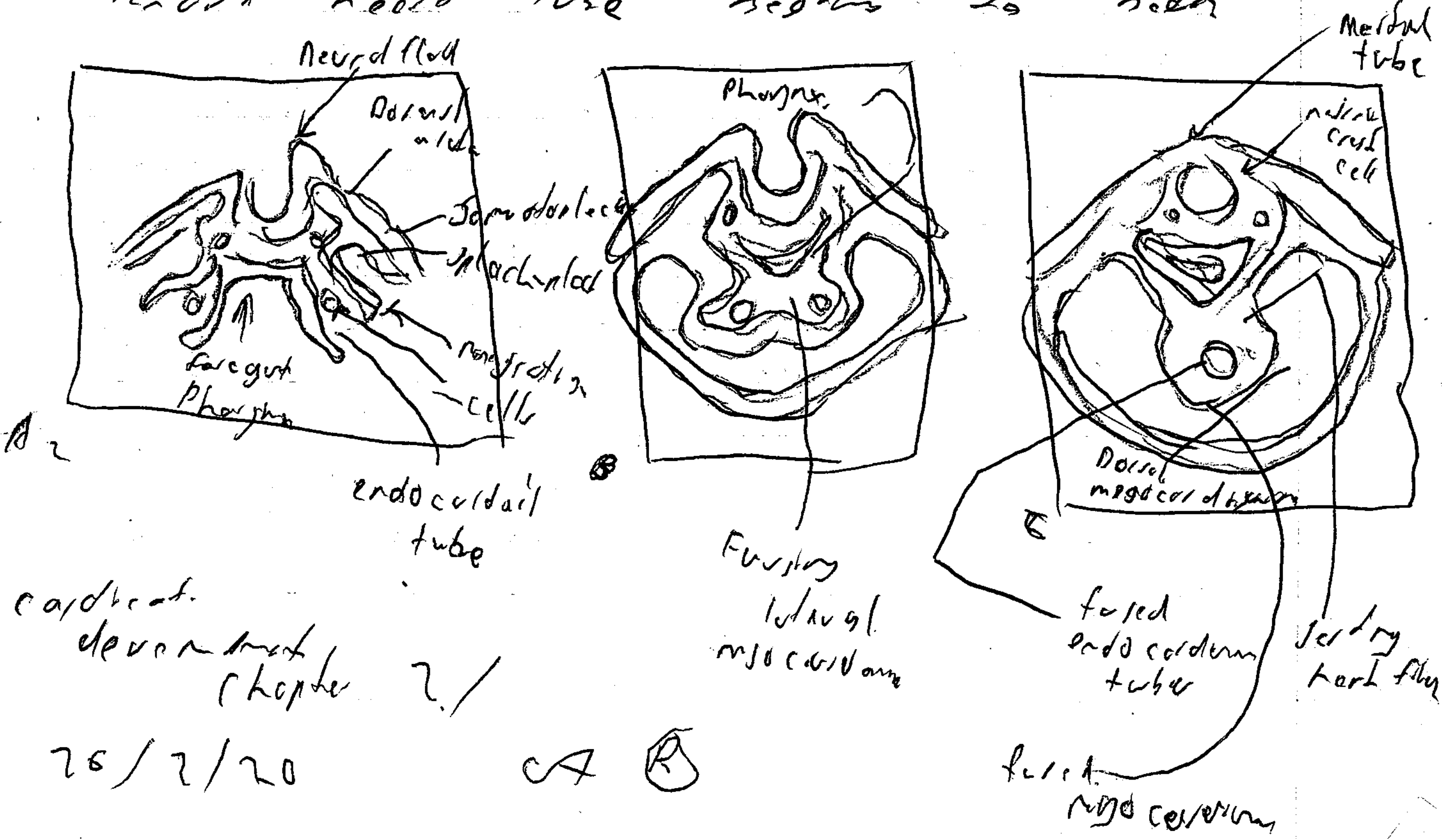
At day 18 of human development the lateral plate mesoderm is split into two layers: somatopleuric and splanchnic pleural. It is the splanchnopleuric mesoderm layer that contains the myocardial & endocardial precursors in the region of the primary heart field. Premature endocardial cells delaminate from the splanchnic mesoderm & coalesce via vasculogenesis to form two lateral endocardial tubes.

During the third week of human development, two bilateral layers of myocardium surrounding the endocardial tubes are brought into the ventral midline during closure of the ventral foregut via cephalic & lateral folding of the embryo.

The lateral borders of the myocardial mesoderm layers are the first heart structure to fuse, followed by fusing of the two endocardial tubes to form one endocardial tube surrounded by splanchnic mesoderm-derived myocardium. The medial border of the myocardial mesoderm layer are the last to fuse. Thus, the early heart is continuous with noncardiac splanchnic mesoderm across the dorsal mesocardium. This will eventually partially break down to form the ventral aspect of the linear heart tube with a posterior inflow & anterior outflow & the dorsal wall of the pericardial cavity.

During the fusion of the endocardial tubes, the myocardium secretes an acellular matrix forming the cardiac jelly layer that separates the myocardium & endocardium.

By day 22 of human development the linear heart tube begins to beat.




cardiac development chapter 2.1

26/2/20

# Coronary circulation

To sustain viability, it is not possible for nutrients to diffuse from the chambers of the heart through all the layers of cells that make up the heart tissue. Thus the coronary circulation is responsible for delivering blood to the heart tissue itself (the myocardium). The normal heart functions almost exclusively as an aerobic organ with little capacity for anaerobic conditions, to produce energy even during resting conditions 70%-80% of the oxygen available in the blood circulating through the coronary vessels is extracted by the myocardium.

It then follows that, because of the heart's inability to increase oxygen by further increasing oxygen extraction, increases in myocardial demand for oxygen eg. during exercise or stress must be met by equivalent increases in coronary flow. Myocardial ischaemia exists when the arterial blood supply fails to meet the needs of the heart muscle for oxygen or metabolic substrates. even mild cardiac ischemia can result in angina pain, electrical changes (detected on an electrocardiogram), and the cessation of regional contractile function within a given region will likely result in infarction.

As noted as in any microcirculatory bed the greatest resistance to coronary blood flow occurs in arterioles.

Blood flow through such vessels varies approximately with the fourth power of radii of these vessels; hence the key regulatory variable for the control of coronary blood flow is the degree of constriction or dilatation of coronary arterial smooth muscle. As with all systemic vascular beds, the degree of coronary is mediated by different loop - feedback these mechanisms include - neural, humoral and local metabolic and local nervous regulation.

It should be noted that the local metabolic regulators of ... are usually the most important for coronary flow regulation these feedback systems involve oxygen demand of the local cardiac myocytes in ... of any ... the ... coronary blood flow is ... in ... of ... "A B C D" ... by ... all the different controlling feed back loops into a single response (i.e. ... either arterial smooth muscle constriction or dilatation) it is also common to consider that some of these feed back loops are in opposition ... coronary arteriolar vasodilatory ... (perfusion pressure is vital ... "delivery ... ... of intense exercise can result in a decrease of mean coronary blood flow of Approx 0.5 ... - 0.4 ml./min/g.

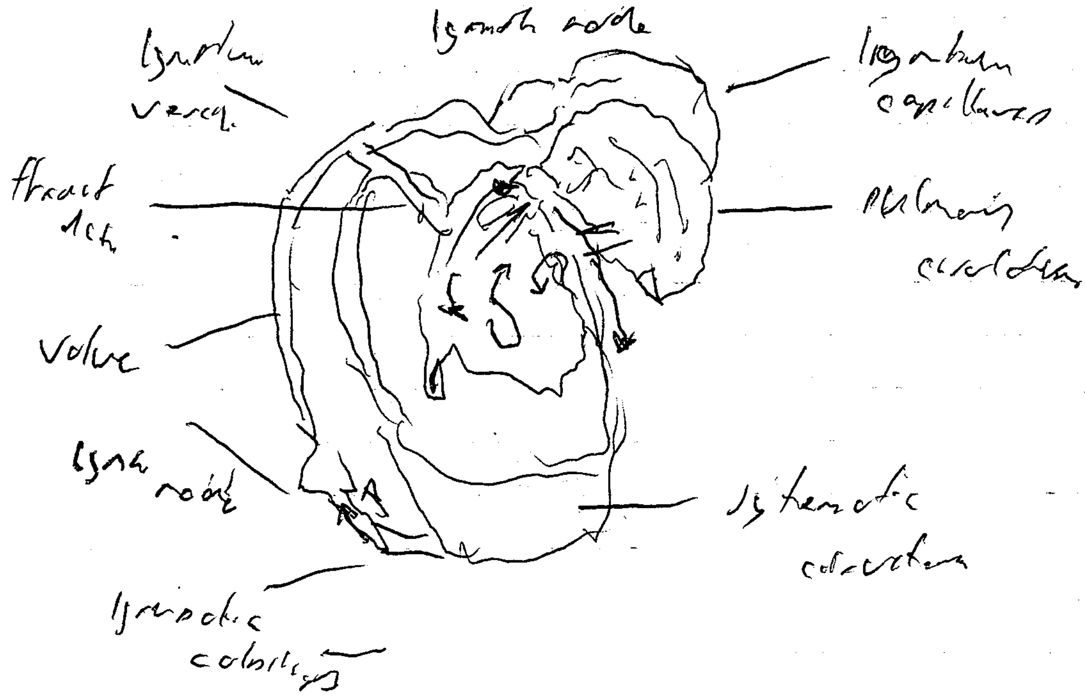
28/2/20 chapter 2.

Ch

As with all systemic organs vascular bed the medium or atrial pressure (perfusion pressure (P waves) is vital for delivery through the coronary & thus needs to be considered another important determinant of coronary flow.

More specifically coronary blood flow varies directly with the pressure across across the coronary microcirculation, which can be considered essentially as the arterial pressure because coronary venous pressure is typically near zero 0.01w However because the coronary circulation perfuses the heart some very unusual determinants coronary bed flow occur in the condition of all other vascular beds in the body

vascular beds — or +




Lymph flow is unidirectional through nodes

# Lymphatic system

The lymphatic system represents an accessory pathway by which large molecules (eg. proteins & long-chain fatty acids) can re-enter the general circulation & these would accumulate in interstitial spaces. If such particles accumulate in the interstitial space the oncotic forces exceed reabsorption forces & edema occurs. Almost all tissues in the body have lymph channels that drain excess fluid from the interstitial space, exceptions may include endomysium of muscle & bone which have prelymphatic channels.

The lymphatic system begins in various tissues with blind-ended specialised lymphatic capillaries, are roughly the size of regular circulatory capillaries but are less numerous.

However, the lymphatic capillaries are very porous & thus can easily collect the large particles within the interstitial fluid known as lymph. This fluid moves through lymph nodes, in which bacteria & foreign matter (antibodies) are removed. Foreign particles that are trapped in the lymph nodes are destroyed by tissue macrophages lining an inner meshwork of sinuses. Lymph nodes also contain T & B lymphocytes vessels which can destroy foreign substances by a variety of immune responses.

There are approximately 600 lymph nodes located along the lymphatic vessels, they are 1-25mm long (bean shaped) & covered by a capsule of dense connective tissue

28/2/20 chapter 1 CA

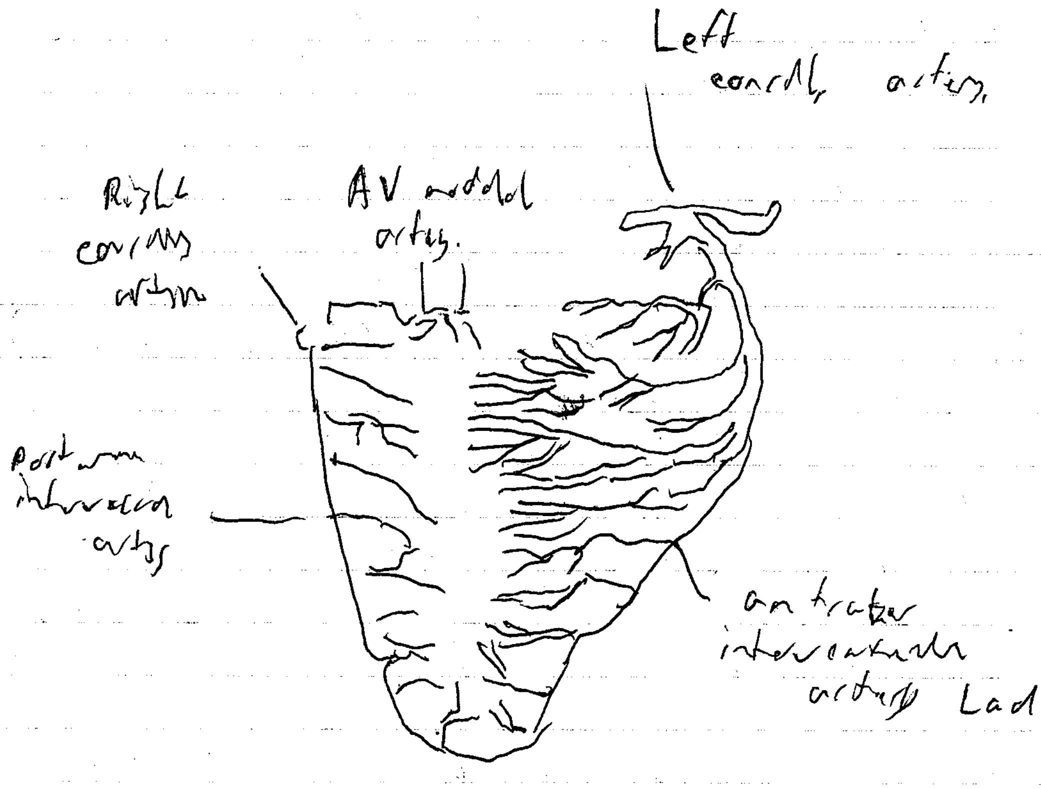
The Lymphatic system is also one of the major routes for absorption of nutrients from gastrointestinal tract (particularly for absorption of fat & lipid soluble vitamins A, D, E, K.

The majority of lymph then re-enters the circulatory system in the thoracic duct, which empties into the venous system at junctions of the internal jugular & subclavian veins (which then enters into the right atrium. The flow of lymph from tissues toward the entry point into the circulatory system is introduced by two main factors ① higher tissue than interstitial pressure & ② the activity of the lymphatic pumps contraction within the lymphatic vessels than other contractions of surrounding muscles, movements of parts of the body vessels .. eg thoracic duct the pump action can generate pressure as high as 50-100mm. Their vessels like veins and the prevent of backflow of lymph.

Around 2.5 L of lymphatic fluid enters the general blood circulation (cardiac) per each day - in the body state this indicates a total body net transcapillary fluid filtration rate of 2.5 L per day.

When compared with the total amount of blood that circulates each day (approx 7000L per day this seems insignificant however, blockage of such flow will quickly cause severe edema. Therefore the lymphatic circulation plays a critical role in keeping the interstitial protein concentrated low - and in removing excess capillary filtrate from tissues throughout the body.

Cardiac veins




30/2/20 chapter 8-3 cardiac veins

ck

The coronary arteries supply the heart with nutrients & oxygen. At the same time, waste products & carbon dioxide must be removed. An extensive network of interconnecting veins provide venous drainage from the heart. The venous drainage of deoxygenated blood from all tissues is collected in the right atrium: this include venous drainage of the heart.

Venous drainage of the heart is accomplished through three separate systems (1, 2, 3) in the heart both

1 the cardiac venous tributaries which converge to form the coronary sinus

2. the anterior cardiac (anterior right ventricular)

3. the smallest cardiac (thebesian) venous system

Most of the myocardium is drained by the great cardiac veins (the great, middle & smaller cardiac veins) converging to form the coronary sinus

On the anterior side of the heart the great (anterior interventricular) vein lies within the anterior hairline and the anterior interventricular artery

At the base of the heart, near the bifurcation groove around the left coronary artery, it turns and runs within the atrioventricular groove around the left side of the heart to the posterior - in the atrioventricular groove, on the posterior side of the heart. The great cardiac vein becomes the coronary sinus, which then empties into the right atrium. It can be seen that the coronary sinus opens into the right atrium, forming an opening at a location anteriorly & inferiorly to the orifice of the inferior vena cava. There is a valve, Thebesian valve that covers to various degrees the opening of the coronary sinus to prevent back flow. The great cardiac vein is formed by the confluence of small venous tributaries from the left & right ventricles & anterior portion of the interventricular septum. As it ascends towards the coronary sinus it receives tributaries from the left ventricle & left atrium: it also receives a large left marginal vein which runs parallel to the left marginal artery.

There are two structures that serve as the boundary between the termination of the great cardiac vein & the beginning of the coronary sinus. The first is the valve & function of Vieussens which has the ~~the~~ appearance of a typical venous valve & functions to prevent back flow.

of blood from the coronary sinus into the great cardiac vein.

The second is the space between the early result of oblique vein of the left atrium & the posterior vein of the left ventricle. The oblique vein of marshall runs similar to inferior along the posterior side of the left atrium provides venous drainage of the area. The posterior vein ascends to the coronary sinus from the inferior portion of the left ventricle & provides drainage of the area. In addition to the great cardiac vein the coronary sinus receives the middle cardiac vein, located on the posterior surface of the heart it arises near the posterior apex of area of the heart, it runs from inferior to superior, then the posterior interventricular sulcus. It then joins the coronary sinus with the main of the sinus entering into the right ventricle & the interventricular septum.

The second system of venous drainage of the heart is the anterior cardiac veins. This system is distinct from other cardiac venous systems because the anterior right ventral wall, travel superior to cross the right atrioventricular sulcus & enter the right atrium directly. Thus the release of venous blood pocket in the ordinary system

Through this advances follow the anterior cardiac veins. The right coronary artery or a branch of the coronary artery, the right atrial or nodal artery, the anterior cardiac veins pass over the right coronary artery in close proximity or in a predictable course. A right marginal vein (when present) runs parallel with the right marginal artery before entering the right atrium directly and is usually considered part of the anterior cardiac venous system.

The third system of venous drainage of the heart is the smallest cardiac venous system. This system is composed of a multitude of small intramural "veins with walls" intramuscular veins also called thebesian veins. They are minute vessels that begin in the capillary beds of the myocardium and open directly into chambers of the heart. Although called veins they are valveless communications between myocardial capillary and a chamber of the heart. These veins drain primarily into the right atrium, and to a lesser extent the right ventricle near the septum, the openings of these veins can be seen microscopically (thebesian foramina) in the endocardium of the right atrium.

The sinoatrial node produces a regular series of impulses and is called the pacemaker of the heart.

CMR / Fiesta

The bessim value

varying degrees° to prevent back flow

parallel ⟷

RV    RV > LV    RA
RA > LA

Three different levels in blood obtained in the right atrium of right ventricle

Algebra let us split the first formula!

$$\frac{\text{Time accumulated}}{\text{Time observed}} = \frac{\text{Time accumulated}}{\text{number tasks}} \times \frac{\text{number tasks}}{\text{Time observed}}$$

mean number of tasks in system =

$$\frac{\text{Time accumulated}}{\text{Time observed}}$$

Mean response time ~~#~~ =
Time accumulated / number tasks

arrival rate = $\frac{\text{number tasks}}{\text{time observed}}$

if we substitute these three definitions into the previous formula & swap the resulting two terms on the right hand side we get Little's Law:

mean number of tasks in system =

arrival rate × mean response time

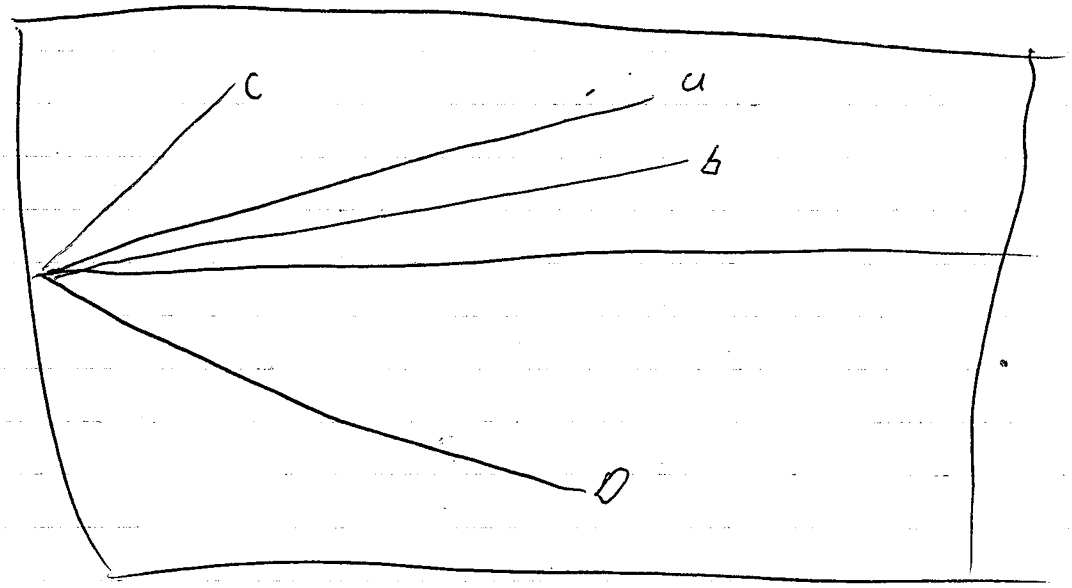
so that:

$$|V| = \sqrt{x^2 + y^2}$$

some times the magnitude is referred to as the modulus, or informally as the size or length of the vector

size of $\underline{a}$ = (a) (magnitude)

$= \sqrt{(\ )(\ )(\ )} = \sqrt{\ } =$



Algorithm

input: Linearly independent row vectors $f_1, \ldots, f_n \in \mathbb{Z}^n$.

output: A reduced basis $(g_1 \ldots g_n)$ of the lattice $L = \sum_{1 \le i \le n} \mathbb{Z} f_i \subseteq \mathbb{Z}^n$

1 for $i = 1, \ldots, n$ do $g_i \Leftarrow f_i$
compute the GSO $G^*, M \in Q^{n \times n}$, as in (1) & (2).
$i \Leftarrow 2$

2 while $i \le n$ do

3. for $j = i-1, i-2, \ldots, 1$ do

4. $g_i \Leftarrow g_i - \lceil \mu_{ij} \rfloor g_j$ update the GSO {reduction step}

5. if $i > 1$ & $\|g^*_{i-1}\|^2 > 2\|g_i^*\|^2$

then exchange $g_{i-1}$ & $g_i$ and update the GSO, $i \Leftarrow i-1$

6. return $g_1, \ldots, g_n$

We can see that the final vector is much shorter than the two input vectors $c$, $d$ and that the computed basis of $a$ & $b$ is nearly orthogonal. ◻

1

| | | | | | |
|---|---|---|---|---|---|
| A | 0 | 0 0 0 | 0001 | 0010 | 0011 |
| B | 0 | 0 100 | 0101 | 0111 | 1000 |
| | | | | | |

It

in mathematics orthogonal is the generalization of the notion of perpendicular to the linear algebra of bilinear form B and the orthogonal when B = 0.

Depending on the bilinear form the vector space may contain nonzero self-orthogonal vectors.

bind-segment-var — bind element var

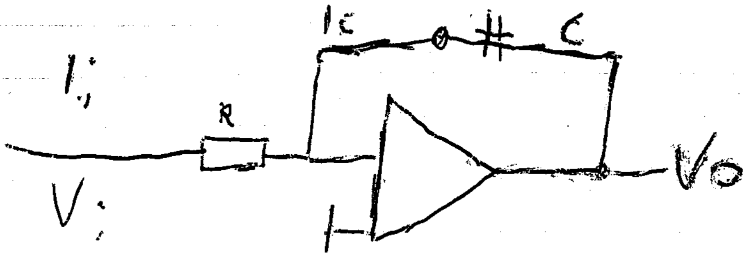
implementing a simplifier by using rewrite rules forces us to extend the substitution facilities of the pattern matcher beyond just plugging in constant value.

The value includes (1,2) as the value for (?? A) & (3 4) as the value for (??B))

returns

+ 01(A)(B00))

Yields 10




Ve - Ve
a if $k>0$,
b if $k>1$,

$$\begin{cases} m(n) = -1, & n = 0 \sim k \\ m(n) = 2^k, & k, n = k \\ m(n) = -1, & n = k+1 \sim 24 \end{cases}$$

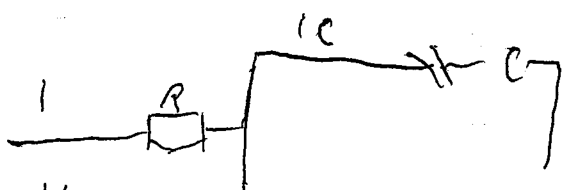
A unique aspect of the PCI bus transaction protocol is that address & data are multiplexed onto the same signal lines! Under 64 data bit extension option, address & data are also multiplexed onto the (add) signal lines.
During a read transaction, an extra signal line must be added after the address phase & at the beginning of the Data Phase portion of the transaction to change the resource driving the bus. This added CLK signal period allows the ASIC driving the address to a tri state

A

B

C

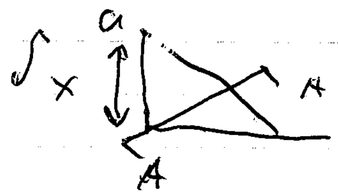
D

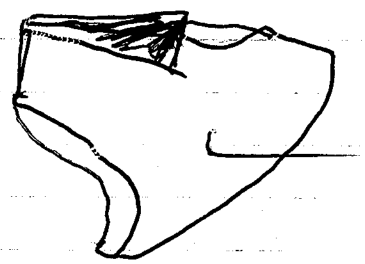


oblique axes

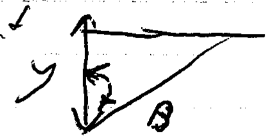
has no center of base

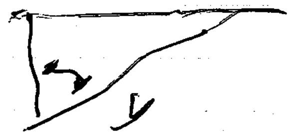
top





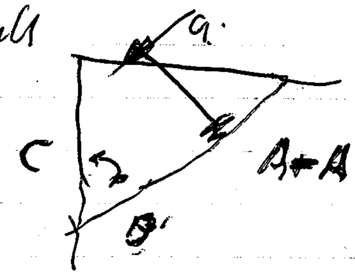
Front



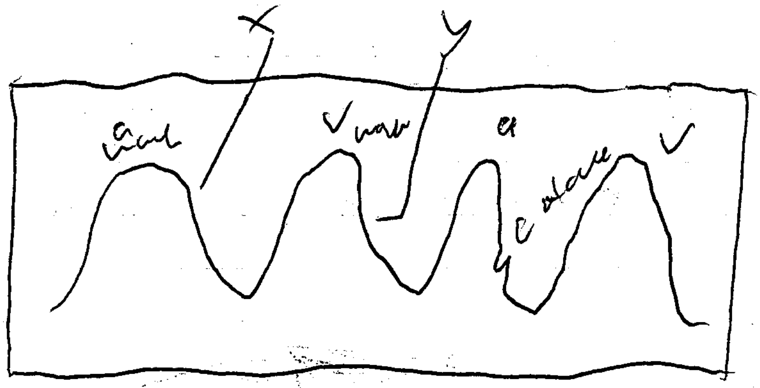


side

true normal



Venous pulsation the venous pulse has A wave due to atrial contraction and a v wave due to the rise in atrial pressure during ventricular systole. A smaller wave C is not usually not visable in the neck but represents onset of ventricular systole. There is Y & x descent in sinus rythms.




The heart sounds is not usually a audibly split despite the fact it represents the closure of the mitral & tricuspid valves & these two events are not completely synchronous

b. heart sound is caused by closure of the aortic & pulmonary valves. & the splitting can usually be appreciated, ~~often~~

The chest is palpated to determine the position of the cardiac apex which is the lowest & outermost point where the cardiac pulsation is felt

The effect of the vessel radius on blood flow is related to the friction of the moving blood against the walls of the vessel

2- & 3 dimensional vectors

Most vectors representing physical quantities can be pictured in 2D or 3D space we can specify vectors using components as in cartesian co-ordinates:

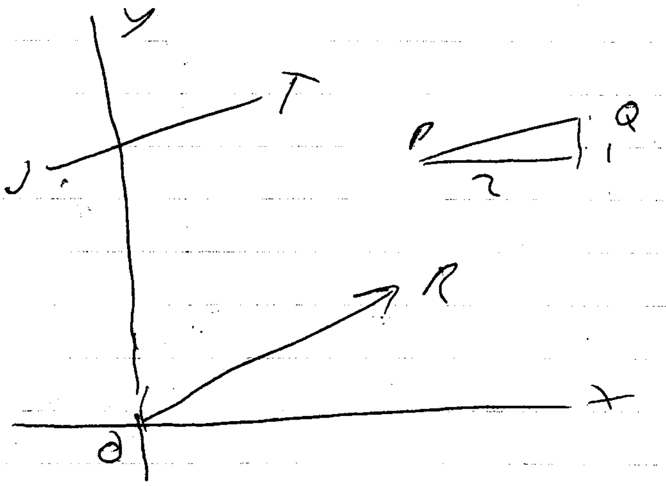
x & y components in 2D space
or x y & z components in 3D space

So 2,1 is a 2-dimensional vector: starting at any point P in the x-y plane, we move:

2 units in the x-direction,
1 unit in the y-direction
to reach the point Q

Then the vector 2,1 = PQ
= ST
= OR

in given coordinates



1, 2, 3, is a 3-dimensional vector P we move:

1 unit in the x-direction,

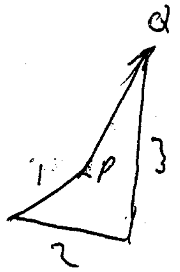
2 units in the y-direction;

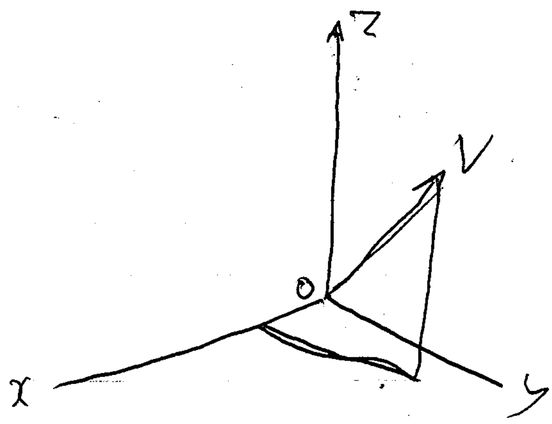
3 units in the z-direction

to reach point Q.

Then the vector (1,2,3) = PQ
or equivalently = OV

Where point V has coordinates of (1 2 3)



Perpendicular angle.

two lines

in elementary geometry, the property of being perpendicular is the relation between two lines which meet at a right angle.

continuum-free property

↓

conditional algorithm

or

structural algorithm

conditional algorithm take two numbers as input

—

structural algorithms are those based on statistical practice

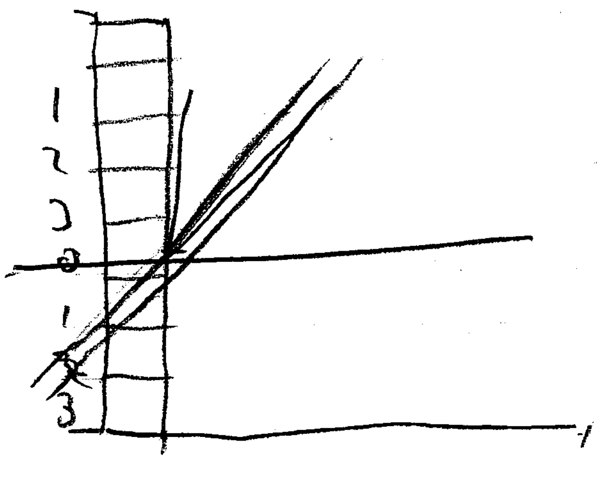
=

The definition implicitly defines an algorithm for determining whether or not a given cell set is a cellular line.

If a cell set can be encoded by a string $\mathcal{S}$, then for all $J \geq 0$ determine whether or not $\mathcal{S}^J$ exists. Notice that is a infinite process since there is a $J$ such that either $\mathcal{S}(J)$ does not exist or length $\mathcal{S}^J = 1$.

in particular we note that a cellular line may be denoted in terms of strings only

omitting the geometry of cell sets in cellular arrays



$\mathcal{S} = 7$

$\mathcal{S}(1) = 7$

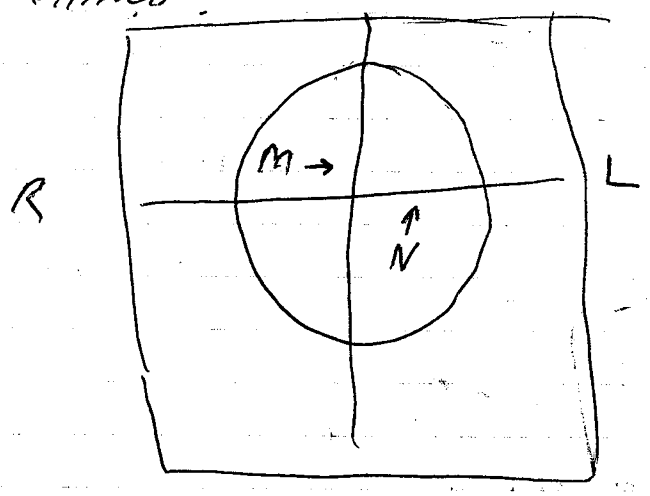
$= \mathcal{S}0 = 1$

Although it is a complex geometric shape, the left & right ventricle can be approximated with considerable accuracy by an ellipsoid

The volume of an ellipsoid is given by the equation:

$$V = \frac{4}{3}\pi \frac{L}{2}\frac{m}{2}\frac{n}{2} = \frac{\pi}{6} Lmn$$

Where V is volume, L is the long axis & m, n are the short axis of the ellipsoid. The long axis L is taken practically to be Lmax, the longest chord that can be drawn within the ventricular silhouette in either projections of the minor m, n, each of the biplane projections of the left ventricle is approximated by an ellipse.




They are calculated by the area length method from the silhouette areas & long-axis lengths in each projection.

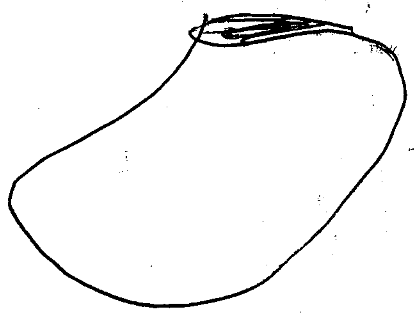
Using the standard geometric formula for the area of an ellipse as a function of its major & minor axes.

For biplane oblique RAO/LAO left ventriculography for example, the areas of the two ventricle silhouettes are given as

$$A_{RAO} = \pi \frac{L_{RAO}}{2} \frac{n}{2} \quad \&$$

$$A_{LAO} = \pi \frac{L_{LAO}}{2} \frac{n}{2}$$

$L_{RAO}$ & $L_{LAO}$ are the longest chords that can be drawn in the RAO & LAO silhouettes respectively. The area of each tracing



is obtained by planimetry & $n$ can be calculated by rearranging as follows

$$n = \frac{4 A_{RAO}}{\pi L_{RAO}} \quad \& \quad n = \frac{4 A_{LAO}}{\pi L_{LAO}}$$

$$V = \frac{\pi}{6} L_{max} \left(\frac{4 A_{RAO}}{\pi L_{RAO}}\right) \left(\frac{4 A_{LAO}}{\pi L_{LAO}}\right)$$

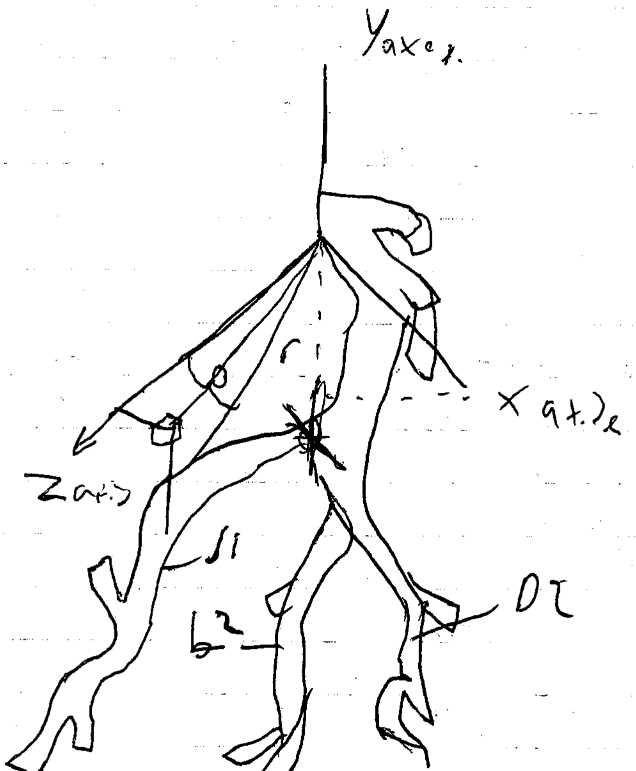
$$= \frac{8}{3\pi} \frac{A_{RAO} A_{LAO}}{L_{min}}$$

Where Lmos is the shorter of Lrao because Lrao is almost greater than Llao Lao is usually substituted for Lmin

is derived for projection at right angles of orthogonal projections, & is applicable to biplane oblique ventriculography in the 30° RAO & LAO 60° views

RAO & angulated LAO

Right ventricular volumes have been calculated from biplane AP & lateral films using a modification of the Simpson area formula



Forces is transmitted through a fluid medium as a pressure wave; & an important objective of the cardiac catheterization procedure is to measure accurately the force & therefore the pressure waves generated by various cardiac chambers. For example, a ventricular pressure wave may be considered "a complex periodic fluctuation in force per unit area," with one cycle consisting of the time interval from ~~the~~ onset of one ① systole to the onset of the subsequent systole.

The number of times the cycle occurs in 1 second is termed the fundamental frequency (volts) of cardiac pressure generation. Thus, a fundamental frequency of cardiac pressure generation of two frequency to two corresponds to a heart rate of 120 $(0.5)^{+}$ beats per minutes.

Considered as a complex periodic waveform the pressure wave may be subjected to a type of analysis devised by the French physicist Fourier, where by any complex waveform may be considered to a type of analysis mathematical summation of a series of simple sine wave of differing amplitude & frequency.

Pressure wave: complex fluctuation in force per unit area

Units : dynes/cm²: 1 dyne/cm²

= 1 microbar = $10^{-1}$ n/m²

= $7.5 \times 10^{-4}$ mm Hg

mm Hg : 1 mm Hg = 1 Torr = 1/760 atmospheric pressure

even the most complex wave form can be represented by its sum in which the sine wave frequencies are usually expressed as harmonics or multiples of 0-1 of the fundamental frequency

At a heart rate of 120 beats the fundamental frequency is 2 cycles per second "1-0" "0-1" to record pressure accurately a system must respond with equal amplitude for a given input throughout the range of frequencies contained within the pressure wave.

The frequency response of a pressure measurement system may be defined as the ratio of output amplitude to input amplitude over a range of frequencies of the input pressure wave. To measure pressure accurately the frequency response (ampl(ratio)) must be constant over a broad range of frequency variation.

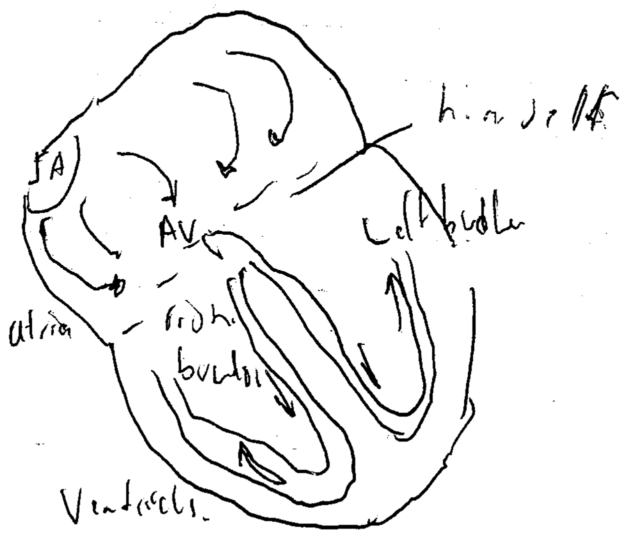
Each time the heart beats, ventricular contraction is triggered by a wave of electricity, which arises spontaneously in a collection of specialised cells in the right atrium. These cells are collectively called the sinoatrial node or sinus node because they are situated near the coronary sinus into which veins drain the (heart muscle drain). From the sinoatrial node the electrical impulses spreads rapidly through the left & right atria.

To be collected in a second node a.v. the atrioventricular node

The impulse slows down in this node & then again speeds up along a specialised bundle of conducting fibres, the before division into two major branches, the left & right bundles by which the electrical impulses spread throughout the ventricle to trigger ventricular contraction.

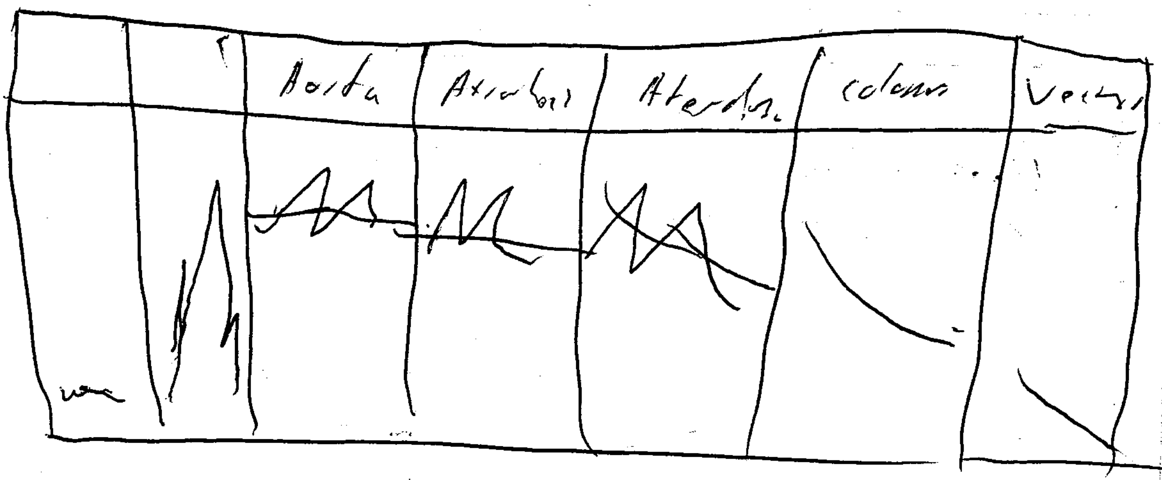
The spontaneous origin of the electrical impulse is ~~in~~ the sinoatrial node in the right atrium from where the impulse travels over the atria walls to be collected in the atrioventricular node.

conduction system




There are two anatomically separate vascular beds or circuits through which blood is driven ... — +

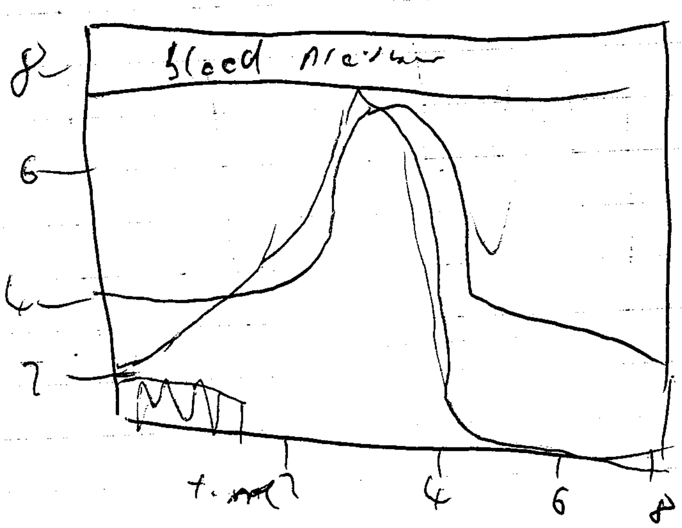
The left ventricle drives blood through the systemic circulation & the right ventricle drives it through the pulmonary circulation.

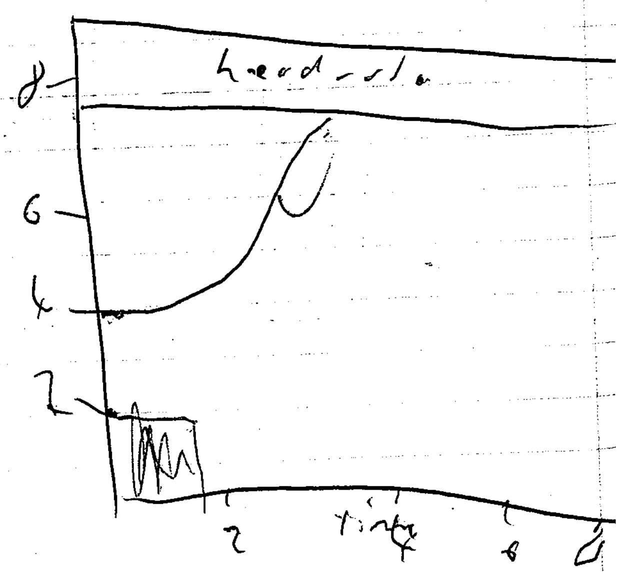


The pressure pattern in the circulation varies from high arterial to low venous values & can be measured invasively at any point by insertion of a needle connected to a pressure transducer. The pressure changes quite abruptly at the systemic vascular resistance component of the systemic vascular resistance.

The pressure pattern in the circulation has a crucial function of transforming ... increase & decrease of pressure.

This pressure smallness function is critical because a relatively high direct pressure is required to help drive blood to various organs outside the heart. Peak pressure in the major arteries is actually higher than the aorta. probably partly due to the increasing resistance offered by decreasing diameter arterial lumen & partly due to variations in time patterns (transmission velocity).



$$H = -\sum_{i=1}^{n} p_i \log_2 p_i$$

formulae means

First let it be made clear that it is in some ways an arbitrary way of measuring information because the minus - sign & logarithm to base 2 are just conventions to the measuring process, while the pii are probabilities to the measuring process associated with choosing a single out put from a whole set of messages each of which has a probability associated with it.

Suppose there are four beds in the house & let us suppose that they all have the same current and volume are both nothing

sum -

$$\frac{1}{4}\log 4 + \frac{1}{4}\log 4 + \frac{1}{4}\log 4 + \frac{1}{4}\log 4$$

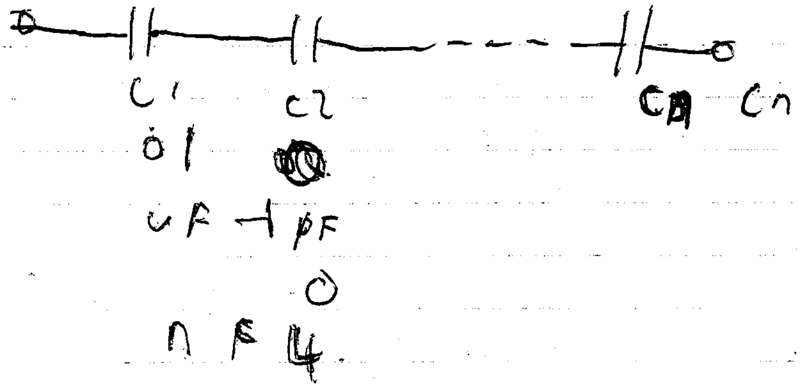
or adding up $\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 2$.

= 2 bits

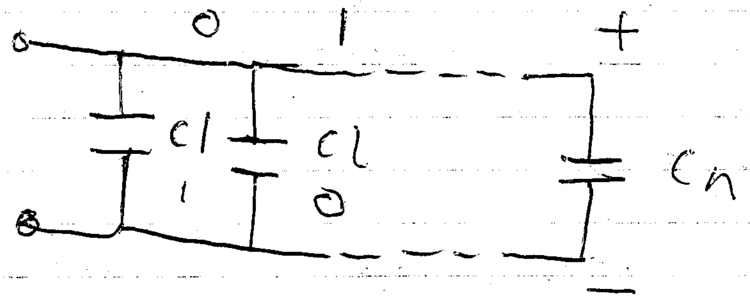
0 1

In simple log 4 which is 2. when the log is taken to base ~~2~~/01 2/01 when log is taken the information is worth 2 bits.

Sum capacitors in series.




Sum capacitors in parallel.




C1 : 10 uF

40 mhz

10000 nF

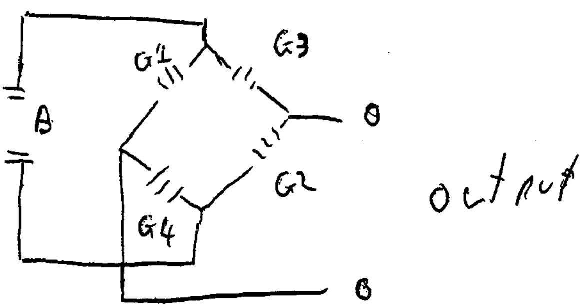
The binary systems make use of two symbols 0 & 1

| A | B | C | D |
|---|---|---|---|
| 00 | 01 | 10 | 11 |

= 8

This requires just 2 bits
3 bits would be used in 8

~~Big Beat Challenge~~




Chris Russell