How do students I'm Pearl Dos Santos,

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In today's video I'm going to discuss

confirmations with respect to butane.

This comes under the topic stereochemistry.

Which is part of the FY BSc

chemistry semester one syllabus.

We're going to look at

conformational isomers.

The saw horse and Newman projections and the

energy profile of conformers of butane.

What we wish to learn from this

is to understand the concept

of conformational isomers,

exemplify confirmation isomers using butane,

and to interpret the energy

profile of butane.

So what are confirmations

a molecule can be rotated by the Sigma bond?

This rotation results in

different structures,

and these structures are

called as confirmations.

The confirmations that correspond to

the lower energy level are called as

conformers or conformational isomers.

So we are going to look at the

confirmation isomers of butane.

Here I have the molecular model.

OK, the black balls are the

carbon atoms and the white

balls are the hydrogen atoms.

So we have 4 carbon atom

chain which is butane.

So the difference between the

confirmation isomers of butane and

Ethane is that in the case of butane,

we have more than one staggered conformer

and more than one eclipse conformer.

We will have a look at what these

conformers are in this video.

So now if you look at this structure

over here, what can you see is

butane is in the staggered form.

You have the methyl group on

top two hydrogens here 2 hydrogens

here and the methyl group down.

So the staggered conformer is the most

stable conformer since it has the atoms

as far as possible from each other.

Because having these atoms

close by to each other can cause

some stearic torsional strain.

So if you look over here we have

one eclipse conformer over here.

And a staggered conformer.

Now, besides these two extremes of

Eclipse conformer and staggered conformer,

we have more than this so if

you look at the first structure

over here in the eclipse comma,

what can you see is the to CH3?

Groups are directly

each other or over each other?

So over here,

if you can see the two methyl

groups are directly over each other,

so this is 1 eclipsed form.

If you look at the next structure,

it's a staggered form.

In this case,

the two methyl groups are directly

opposite each other.

Can you see?

So this is one of these staggered

form having the two methyl groups

directly opposite each other.

Now look at the next staggered conformer.

So if I have this anti conformer over here,

one staggered conformer, I can have

another staggered conformer like this.

OK, what is the difference between

this conformer and the previous one?

Is that over here the methyl groups

are at 60 degree torsional angle

and in the previous case over here

you have the two methyl groups

at 180 degree torsional angle.

We can have one more stagger confirmation.

Like this now in this case also the two

methyl groups are 60 degrees apart,

but the difference between this

one and this one. Is that it?

Is the mirror image of each other,

Now this interaction with the two

methyl groups are at an angle

of 60 degrees torsional angle.

It's called as the.

Gauche conformer.

And there are two such they are enantiomers.

Now if you come to the next eclipse form,

this is 1 where the two methyl groups

at zero degree, torsional angle.

The next one is like this.

Right, so this case where the methyl are

not zero degrees angle, it's called

as the partially eclipsed conformer.

So here we have the structure of.

Partially eclipsed.
now,

Just like how Gauche exists

as two mirror images,

we can also have another eclipse

form another partially eclipsed

form which is just the mirror

image of the other one. OK.

Now we shall see how to interconvert

these conformers into each other.

So I'm going to start

with the anti conformer.

Anti means the two methyl groups

are at 180 degrees apart.

OK, now to get the next conformer.

What we must do is we will rotate

the C2-C3 Sigma bond but we will

keep the back carbon constant.

The carbon towards me and the

carbon away from you and we

will move only the front carbon.

We will move the front carbon

by an angle of 60 degrees.

OK so we start with the anti confirmar

methyl groups at 180 degrees apart.

We next go onto a rotation.

What do we get?

We will get an eclipse form specifically

the partially eclipsed conformer.

Another rotation by 60 degrees would

give you a. Staggered form right?

What kind of staggered?

Where the two methyl groups are at 60 degrees

apart or torsional angle 60 degrees,

this is the Gauche, conformer.

Now from the Gauche conformer again,

if we rotate to 60 degrees, what do we get?

We get the eclipse conformer. OK.

Eclipse means that two methyl groups

are directly over each other.

Further, rotation to 60 degrees would

give you another Gauche conformer now

this Gauche conformer is just the mirror

image of the previous Gauche conformer

And again, if we rotate this.

We will get the.

Eclipsed the partially eclipsed

conformer and then we get the identical.

The first anti confirmar.

Now in general, the staggered

conformers are at a lower energy

than the eclipse conformers.

OK because this staggered

conformer has all the atoms as

far as possible from each other.

Now if the atoms are too close to each other,

what can happen is a

repulsion can occur like a Van Der Waals repulsion

also called steric train?

So that is why the molecules prefer

to be as far as possible.

So the staggered conformers are more stable.

Or in other words less energy than

the corresponding eclipse conformers.

Now let us see exactly the energy profile.

Now if you look at this graph right

here of torsional angle and energy.

In kilo joules per mole.

What you will see is a

graph looking like this.

Alright, so you can see the

staggered conformers at a lower

energy than the eclipse conformers.

Now if you look at these two

staggered conformers.

This is the Gauche, and this is the anti.

So if you look at it,

the Gauche is at a slightly

higher energy as the anti,

because the methyl groups are

relatively much closer together.

Similarly,

the partially eclipsed form is at a

lower energy than the fully eclipsed form.

This is because here the

Methyl groups are very close

to each other and cause a

van der Waals repulsion alright.

So we come here. In conclusion,

the anti conformer is more

stable than the gauche conformer by

three point 3.8 KJ/mol
The eclipse conformer is higher

in energy than the partially

eclipse conformer again by 3.8 KJ/mol
and the

energy difference between the anti

conformer which is the most stable.

And the eclipse conformer which is unstable.

Is 18..4 KJ/mole
So what does that mean?

The eclipse has the most highest energy

compared to the partially eclipse.

Then the Gauche and then the anti conformer.

And energy and stability are inversely

related so higher the energy unstable.

So that is why the stability is

anti more stable than Gauche then

partially eclipsed and eclipsed.

These are the references. Thank you.