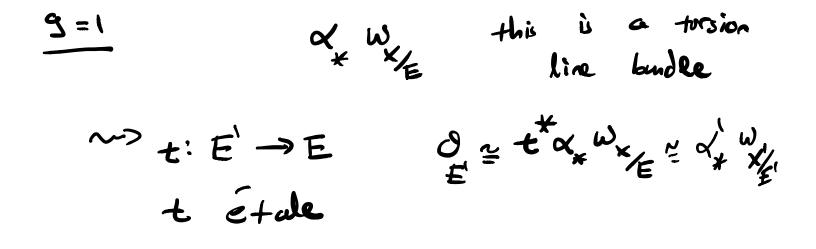
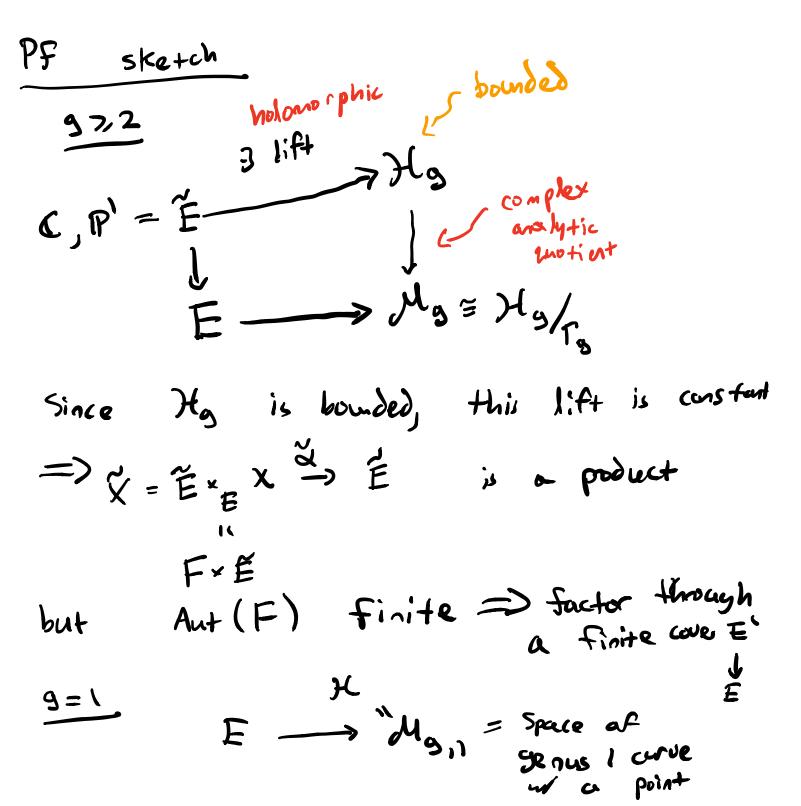
Minimal	M od els	in dim	12		
Def	X	s.t .	K _x i	s nt	
Thu (Nonvanishing) IS X is a minimal model, IS X is a minimal model,					
IS the	х іл H ⁰ (x, mkx)	n`ini ma ≠0	for some	w70
PF Su	ppose	W R	had	a m	inimal
mod el	×	but	. w/	К(x)	= - ∕ 0
$\Rightarrow \alpha$	х —	7 E ←	ellipt	ic curve	-
d is	50000+	n &	9	(F) ≯	
Thm	X · X ->1	E	snooth	proper	
w/ fibe	ers g(F) 7,1	<i>.</i>)(E) <	
+ hen	X is	isotr			
<u>922</u> E';	×F ≌ ×) ~ X	where is éta	t le
	Ŧ		Ê		





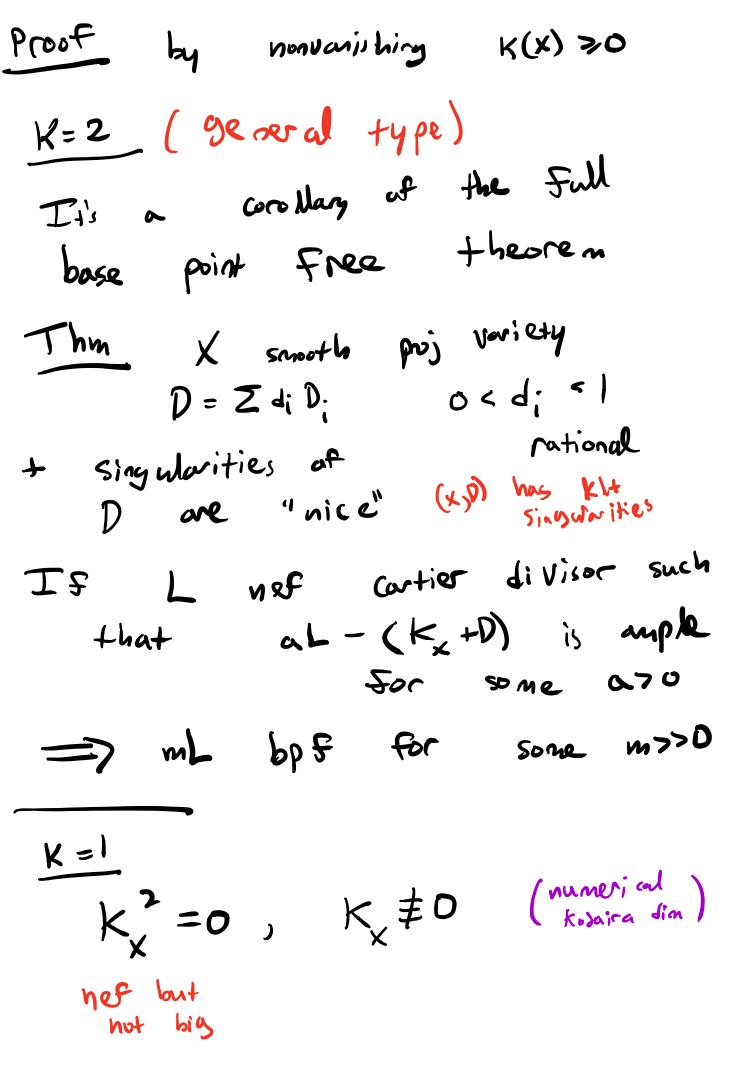
$$X \stackrel{\text{des}}{\to} E$$

$$Y \stackrel{\text{def}}{\to} E$$

$$J_{ar}(X) \stackrel{\text{Jef}}{\to} E$$

$$R \stackrel{\text{Jef}}{\to} E$$

 $t^* \propto \omega_{X/E} = \alpha'_{X} \omega_{X/E} = \mathcal{O}_{E'}$ $\alpha'_{*} \omega_{X'} = \alpha'_{*} \left(\left(\alpha' \right)^{*} \omega_{E'} \otimes \omega_{X'_{E'}} \right)$ formula $\implies H^{\circ}(X) O_{X}(K) = H^{\circ}(E'_{J} \omega_{E'}) = g(E)$ $\implies K(x) = K(x') \ge 0$ [Contradiction!] §2: Abundance in dim 2 If X is a minimal model Thm in dim 2, then the is semiample mkx is bpf Kx nef => Kx se niample



(mKx) = (M) + Ferfixed Ø moving port af M nef mkx $0 \le M^2 \le M. (M+F) \le (M+F)^2 = (mk_x) = 0$ \implies $M^{\prime} = M.F = F^{2} = 0$ moving divisor M w/ M2=0 => M is base point free b/c $(M' = \emptyset)$ M'em) \$ X -> Z conve) F.M = OSut is figing 3) F = fiber of Ø 2) $F^2 = 0$ Hodge / => F=Zm;Fi index E == Cilos Fi one fibers of ø

$$m K_{x} = M + F = p_{HI}^{*} H_{z} + Zm_{i} p_{i}^{*} p_{i}^{*}$$

$$= p_{i}^{*} \left(H_{z} + Zm_{i} p_{i}^{*} \right)$$

$$p_{ull lock of ample ample ample divisor
by a morphism
is by f
$$\frac{H = 0}{h(X_{i} O(m\kappa_{x})) \leq 1} \quad \text{for any}$$

$$m > 0$$

$$\chi(O_{x}) \geq 0 \quad P_{i} = P_{j} \text{ ersement pens}$$

$$|-h^{i}(O_{x}) + h^{i}(O_{x}(\kappa_{x})) \geq 0$$

$$\lim_{n \to 0^{+} = h^{n} = q(x)} \leq 1$$

$$(ases)$$

$$i) \quad P_{j} = q = 0 \quad 2k \sim 0 \quad \text{Enriques}$$

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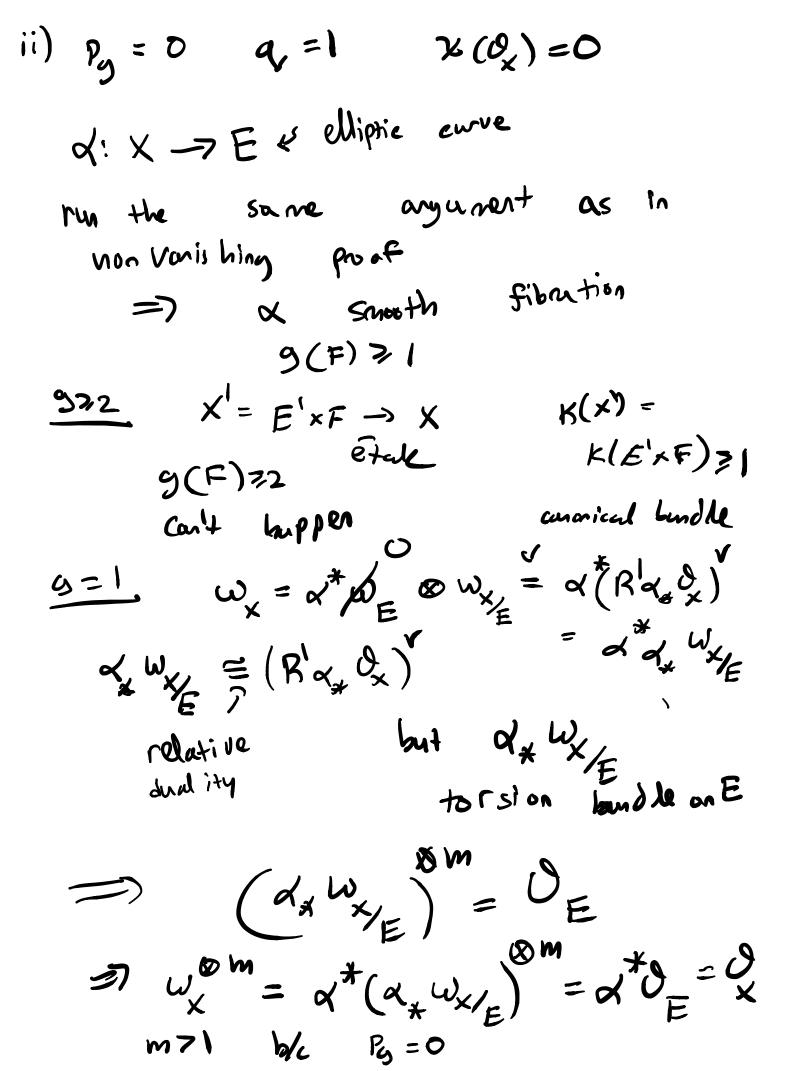
$$i) \quad P_{j} = q = 0 \quad k_{x} \sim 0 \quad \text{Enriques}$$

$$i) \quad P_{j} = 1, \quad q = 0 \quad k_{x} \sim 0 \quad k_{x} \text{ surface}$$

$$i) \quad P_{j} = z = 1 \quad \text{obelian surface}$$$$

ì

Need to check that MKx~O for some m70 i) $P_q = q = 0$, $\chi(\partial_\chi) = 1$ Cast & novos Rutionality if $P_2 = H^0(X, O_X(2K_X)) = D$ > × rutional, can't happen $H^{\circ}(X, \partial_{X}(2k_{X})) \neq D$ $h^{\circ}(X, O_{X}(-2K_{x})) > 1$ want 1 = h = 0 (d (3Kx)) < l => 2K~~0 h(X, Q(-2K, 1) + h(X, Q(-2K, 1)) $\geq \frac{1}{2}(-2k_{x}(-2k_{x}-k_{y})+2k_{y})$ 0 4c K2=0 $if h(x, Q(2k_x)) = 1 = h^{\circ}(x, Q(3k_x))$ Ex =) $h^{\circ}(3_{2}^{\circ}(5_{2})) = 1$ $\implies h^{2}(X, O_{x}(3k_{x})) = 0$



GE | Kx - M/ => 266 | 2Kx - 2M | $= |2k_{\chi}|$ DEIKXI |2kx | = 20=26 h° (2 kx)) <1 $K_v \sim D = G \sim K_x - M$ contradiction >> M~O ~(Q)=0 $v) P_{y} = 1 q = 2$ dimA=2 $q: X \rightarrow Ab(x) = A$ abelian surface Cluim 1 through a of does not fuctor cyrle d x -> C -> A = Ju(c) g(c) = 2

Pick some
$$t': C' \rightarrow C$$
 of the cover
 $x' \rightarrow c$ upt $g(c') > 2$
 T T
 $x' \rightarrow C' \rightarrow Jac(C') = Alb(x')$
 $H(x') = H(x) = 0$ dia $= 23$
 $g(x') = 3$ Not possible
So $g' = surjective$
Rieman -Hurwitz
 $K_x = g' K_A + E$
Use intersection products
 $+$ that \exists component of $E = uv$ meg
 $= 2IF$ int
to Conclude E containes a $g(c) = 1$
 \Rightarrow have an elliptic cave
 $x = a + A$