1A

$[q] \in M$ 1B

Σ global shape

2A $\omega = GM/c^2$;

Thm coplanar $\Delta t \leq \pi/\omega$.

Cor: ∞ many.

Inspiration 2B

- only many syzygies
- Littlejohn.

$Sh(3,4) \simeq \mathbb{R}^6$.

Set-up $\langle \, , \rangle_m$

3A $\ddot{q} = -\nabla V$.

Invariance.

$q_a \mapsto q_a + c$

$q \mapsto gq$. 3B

$\Sigma \subset M(3,4)_{\mathbb{R}^3}$

metric $M^1(3,3)$ π

submus $SO(3)$

$Sh = Sh(3,4)$

4A upstairs $\ddot{q} = -\nabla V(q)$,

downstairs $\nabla_{\dot{\gamma}} \dot{\gamma} = -\nabla V(\gamma)$

Thm A $\ddot{s} = -sg$, $g \geq \omega^2$.

Thm B $\mathrm{codim}(\mathrm{Sing}\, S) = 2$

5A

$\dot{S} =$

$\ddot{S} = \langle \nabla S,$

$= \underbrace{\langle \nabla S, -\nabla V\rangle}_{\mathrm{I}} + \underbrace{\omega(\dot\gamma, \dot\gamma)}_{\mathrm{II}}$

I $g_1 > 0$, (B) $\Rightarrow g_1 \geq \omega^2$

II. $g_2 \geq 0$.

6A I ctd.

$\frac{d}{d\tau} r_{ab}(\tau)^2 = 2\tau |v_{ab}|^2$

$= 2S |v_{ab}|^2$

etc.

& $\sum m_a m_b |v_{ab}|^2 = M$.

7A II. $Q_\gamma = \langle \nabla_v \nabla S, v\rangle$

claim $= -S\Gamma$

1) $K_{sn} \geq 0$ @ne:ll

2) $Q \sim \mathrm{II}$

3) sign & mean.

1) $M \downarrow$

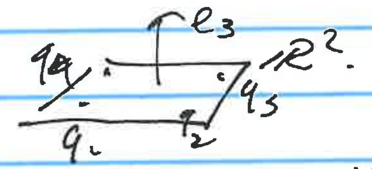
3 (i) ↗ outward N in $\mathbb{R}^n$ convex, $\mathrm{II} \geq 0$.

8A

5B

I. use $\|\nabla S\| = 1$

$\overline{\underline{\;\iota\ /\ /\ /\;}}$



$\frac{dq}{d\tau} = \nabla S q(\tau)$

$q(\tau) = q + \tau v$,

$v_4 \in \mathbb{R} e_3$

6B.

$\frac{\sim}{\sim\sim}$

$\sim$

↑↑ $\nabla S = N$ to $\{S = c\}$.

2 $\overline{\underline{\;/\ /\ /\;}}$

$\mathrm{II}(v, v) = \langle \nabla_v N, v\rangle$

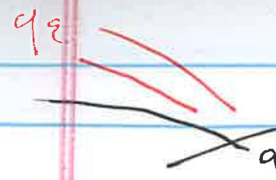
$Q = -S\,H$.

7B.

Thm Σ tot geod in M.

$S =$ signed dist..

9A



$S^\varepsilon \longrightarrow S$.

$S^\varepsilon \pitchfork$ zero

$\Delta t \sim \pi/\omega$. +OK!

if $r^\varepsilon_{in} < \varepsilon$ +OK

9B.

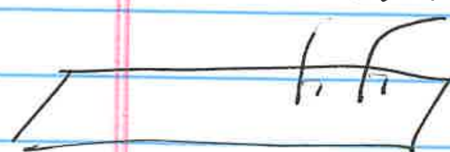
$\Sigma \subset M(3,3)$

$\|q\|^2 = \mathrm{tr}\, q q^+$

$g_1 q g_2^+$

$S = x_3$.

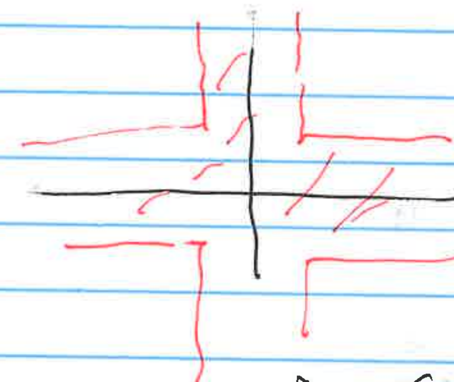
10. D as slice



$|S| = \min |x_i|$.

OK!

11



Sing$(S) \cap D = \{x_1 = \pm x_2\}$

So Sing$(S) \cap D \subset \{x : x_i = \pm x_j\}$

these orbits have extra symm.

are smaller! yes/

$-1 - 1 = -2$