Problem session:

I finite group actions:

1. Does any rk 2 grp G act freely on \( X = S^n \times S^m \) for \( n, m > 0 \)?
   - True if \( \text{Qd}(p) \) not subquotient of G.
   - True if \( |G| \) odd.

2. Determine if \( \text{Qd}(p) = (\mathbb{Z}/p \times \mathbb{Z}/p) \times S(\mathbb{Z}/p^2) \) acts freely on \( S^n \times S^m \), \( p \) odd.
   - If \( \text{Qd}(p) \) acts on \( S^n \), then rk 2 isometry.

3. \( X \mapsto H^*(X; \mathbb{Z}_2) \) has "2 poly parameters"?
   - \( S^2 \times S^m \to \mathbb{C} \) where \( E = \text{prod cpx} \).

4. Given \( X = S^n \) G acts w/ periodic isotrops, what can we find a smooth action? What about \( X = S^2 \)?

Is the following equiv:

\[ \left\{ \begin{array}{c}
\text{G action w/ effective Euler class} \\
\text{periodic isotrops}
\end{array} \right\} \leftrightarrow \text{G action on } X = S^n \]

Known for \( \mathbb{C}^* \) Remarks: Hambledon, Volkov.
5) Set up the notion of an equivariant duality cpx and do surgery using the orbit map.

6) Does any $G$ act freely homologically f. on some $X = S^n \times \cdots \times S^n$ (smoothly)?

7) When does a rk 2 app $\pi$ of $ft$. vcd act freely on some $X = S^n \times \cdots \times S^n \times \mathbb{R}^k$?

Co-compactly?

8) \[ rK(G) = \max \left\{ n/\langle \mathbb{Z}/p \rangle^n \leq G \quad \text{p.ino.} \right\} \]

\[ \min h(G) = \min \{ k \mid G \text{ acts freely on some } X = S^n \times \cdots \times S^n \} \]

\[ rK(G) = h(G). \]

9) (G. Carlsson) $G = \langle \mathbb{Z}/p \rangle^r$ acts freely on a conn ft $\mathcal{C}X$. Then,

\[ \dim_{\mathbb{C}} X \leq \dim H^i(X; \mathbb{C}) \geq 2^r \]

for $i = 0$.

Note: Thm (Hurewicz) $\langle \mathbb{Z}/p \rangle^r$ acts freely on $X = S^n \times \cdots \times S^n$ if $p > 3k/r$. Then $r \leq k$. 
10. If \((Z/2)^r\) acts freely on a ft \(X\) with mr 2 class \(g\) by \(h\), 1-dim classes then
\[ r \leq 2 \dim H'(X; \mathbb{Z}/2) \]

11. If \(X\) ft. 1-conn.
Is \(H^*(B\text{Aut}(X); \mathbb{R})\) ft. transcendence degree?

[Note: OK if \(X\) elliptic]

12. \(G\) ft. opp acting effectively on a 2-dim contractible \(C^\infty\)-cpx. Does it have a fixed pt?

13. \(G\) ft. Cpx, reflection opp acting on \(G^n\). Then 
\[ M(A) = G^n \setminus \text{UH} \sim K(\pi_1) \]
\[ H \text{ hyperplanes.} \]
II Group Cohomology

14 k on p & S Simple module in the prime block of KG.
then is \( H^i(G, S) \neq 0 \) for some \( n \geq 0 \)?
[still open? nucleus?]

15 \( H^1(G; \mathbb{F}_p) \neq 0 \Rightarrow H^{2n}(G; \mathbb{F}_p) \neq 0 \ \forall n \geq 0

16 Does there exist \( N > 0 \) s.t. if
\( H_i(\mathbb{Z}; 2) = 0 \) \( 1 \leq i \leq N \) then \( G = 1 \)?
[Note \( H_i(G_{23}; 2) = 0 \) \( 1 \leq i \leq 9 \)]

17 Under what conditions does a map of tri. apps induce an inseparable isogeny induce an inseparable isogeny between the mod p cohom varieties?
If p is odd, is it true that this extends to the Sylow p-S-groups have the same order, inducing an iso in Cohomology?

is p odd is \( G \cong Z_2 \) with sylow p-fusion iso on mod p commute varieties?
18. Compute $H^*(GL_n(\mathbb{F}_q), \mathbb{F}_q)$.

In a cage?

19. Calculate $H^*(PU(n), \mathbb{F}_q)$.

20. Given

$$1 \to \left(\mathbb{Z}/2\right)^* \to U \to \left(\mathbb{Z}/2\right)^s \to 1$$

Can the EMSS collapse at $E_3$?

$$\text{Tor}_{\mathbb{Z}_2}^*(K(\mathbb{Z}/2), 2) \to H^*(U, \mathbb{Z}_2)$$

21. $H^*(QSp_\infty(2R), \mathbb{F}_q) = ?$

[See recent paper by A. Postnikov.]

22. If $|A_n(6)|$ contractible then it is equivalently contractible.
(23) Does $H^\ast(G; k)$ always have an associated prime $p$ s.t. $K$. nil dim of $H^\ast(G)/p = \text{depth}$.

(27) If $H^\ast(G)$ is generated by elt $\phi_0$ can you figure out its depth?

Depth $\lim_{n \to \infty} H^\ast(E) = ?$

$E \in \mathcal{F}(R)$

(25) Under what conditions on $N \times H$ does $E_2 = E_\infty$ in $LHS$ SS.

$N$ finite $p$-group with control s.t. for which each layer is a proj $F_p H$-module.

(26) Give necessary and sufficient cond for existence of a $G$-complex $X$ s.t.

$H^\ast(X; \mathbb{Z}) \cong M.$