iv) $[H, H^2] = 0$ so that gives nothing new.

v) $[x, H^2] = xH^2 - H^2x = (xH - Hx)H + H(xH - Hx)$

$= [x, H]H + H[x, H]$

$= i(pH + Hp)$

a <u>third</u> order Hamiltonian

vi) similarly $[p, H^2] = -i(xH + Hx)$

another third order Hamiltonian

So we're starting to get more.

vii) $[p, pH + Hp] = p[p, H] + [p, H]p$

$= -i(px + xp)$

a <u>new</u> second order Hamiltonian

viii) Similarly, can get

$[x, xH + Hx] = i(xp + px)$ same as vii) up to a - sign.

ix) $[H, px + xp] = \frac{1}{2}\left([p^2, xp + px] + [x^2, xp + px]\right)$

$= \frac{1}{2}\left([p^2, x]p + p[p^2, x] + x[x^2, p] + [x^2, p]x\right)$

$= \frac{1}{2}\left(-p^2 + x^2\right)$, so get $\pm(x^2 - p^2)$