Pensieve header: The $k=3$ building micro-blocks and gradings to cancel $\hbar$ and γ.

Warning. To test degree rules, use versions of SL2Invariant.m from before July 5, 2018, and unset $\hbar = \gamma = 1$.

In[∘]:=
```
SetDirectory["C:\\drorbn\\AcademicPensieve\\Projects/SL2Invariant"];
<< SL2Invariant.m
Block[{$k = 3}, quarks = {
    am → am_{i,j→k}, bm → bm_{i,j→k}, R → R_{i,j}, P → P_{i,j}, aS → aS_i, CC → CC_i, b2t → b2t_i, t2b → t2b_i
  }] // Column
```

This is Profile.m of http://www.drorbn.net/AcademicPensieve/Projects/Profile/.

This version: June 2018. Original version: July 1994.

$$\mathrm{am} \to \mathbb{E}\left[a_k\,(\alpha_i + \alpha_j),\ x_k\,\left(e^{-\gamma\,\alpha_j}\,\xi_i + \xi_j\right),\ 1\right]$$

$$\mathrm{bm} \to \mathbb{E}\Big[b_k\,(\beta_i + \beta_j),\ y_k\,(\eta_i + \eta_j),\ 1 - y_k\,\beta_i\,\eta_j\,\epsilon + \frac{1}{2}\left(y_k\,\beta_i^2\,\eta_j + y_k^2\,\beta_i^2\,\eta_j^2\right)\epsilon^2 + \frac{1}{6}\left(-y_k\,\beta_i^3\,\eta_j - 3\,y_k^2\,\beta_i^3\,\eta_j^2 - y_k^3\,\beta_i^3\,\eta_j^3\right)\epsilon^3 + O[\epsilon]^4\Big]$$

Out[∘]=

$$\mathrm{R} \to \mathbb{E}\Big[\hbar\,a_j\,b_i,\ \hbar\,x_j\,y_i,\ 1 - \frac{1}{4}\left(\gamma\,\hbar^3\,x_j^2\,y_i^2\right)\epsilon + \left(\frac{1}{9}\,\gamma^2\,\hbar^5\,x_j^3\,y_i^3 + \frac{1}{32}\,\gamma^2\,\hbar^6\,x_j^4\,y_i^4\right)\epsilon^2 + \frac{1}{1152}\left(24\,\gamma^3\,\hbar^5\,x_j^2\,y_i^2 - 72\,\gamma^3\,\hbar^7\,x_j^4\,y_i^4 - 32\,\gamma^3\,\hbar^8\,x_j^5\,y_i^5 - 3\,\gamma^3\,\hbar^9\,x_j^6\,y_i^6\right)\epsilon^3 + O[\epsilon]^4\Big]$$

$$\mathrm{P} \to \mathbb{E}\Big[\frac{\alpha_j\,\beta_i}{\hbar},\ \frac{\eta_i\,\xi_j}{\hbar},\ 1 + \frac{\gamma\,\eta_i^2\,\xi_j^2\,\epsilon}{4\,\hbar} + \frac{\left(36\,\gamma^2\,\hbar^2\,\eta_i^2\,\xi_j^2 + 40\,\gamma^2\,\hbar\,\eta_i^3\,\xi_j^3 + 9\,\gamma^2\,\eta_i^4\,\xi_j^4\right)\epsilon^2}{288\,\hbar^2} + \frac{1}{1152\,\hbar^3}\left(48\,\gamma^3\,\hbar^4\,\eta_i^2\,\xi_j^2 + 192\,\gamma^3\,\hbar^3\,\eta_i^3\,\xi_j^3 + 156\,\gamma^3\,\hbar^2\,\eta_i^4\,\xi_j^4 + 40\,\gamma^3\,\hbar\,\eta_i^5\,\xi_j^5 + 3\,\gamma^3\,\eta_i^6\,\xi_j^6\right)\epsilon^3 + O[\epsilon]^4\Big]$$

$$\mathrm{aS} \to \mathbb{E}\Big[-a_i\,\alpha_i,\ -x_i\,\mathcal{A}_i\,\xi_i,\ 1 + \frac{1}{2}\left(-2\,\hbar\,a_i\,x_i\,\mathcal{A}_i\,\xi_i - \gamma\,\hbar\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2\right)\epsilon + \frac{1}{8}\left(-4\,\hbar^2\,a_i^2\,x_i\,\mathcal{A}_i\,\xi_i + 2\,\gamma^2\,\hbar^2\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2 - 8\,\gamma\,\hbar^2\,a_i\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2 + 4\,\hbar^2\,a_i^2\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2 - 4\,\gamma^2\,\hbar^2\,x_i^3\,\mathcal{A}_i^3\,\xi_i^3 + 4\,\gamma\,\hbar^2\,a_i\,x_i^3\,\mathcal{A}_i^3\,\xi_i^3 + \gamma^2\,\hbar^2\,x_i^4\,\mathcal{A}_i^4\,\xi_i^4\right)\epsilon^2 + \frac{1}{48}\left(-8\,\hbar^3\,a_i^3\,x_i\,\mathcal{A}_i\,\xi_i - 4\,\gamma^3\,\hbar^3\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2 + 24\,\gamma^2\,\hbar^3\,a_i\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2 - 48\,\gamma\,\hbar^3\,a_i^2\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2 + 24\,\hbar^3\,a_i^3\,x_i^2\,\mathcal{A}_i^2\,\xi_i^2 + 32\,\gamma^3\,\hbar^3\,x_i^3\,\mathcal{A}_i^3\,\xi_i^3 - 84\,\gamma^2\,\hbar^3\,a_i\,x_i^3\,\mathcal{A}_i^3\,\xi_i^3 + 60\,\gamma\,\hbar^3\,a_i^2\,x_i^3\,\mathcal{A}_i^3\,\xi_i^3 - 8\,\hbar^3\,a_i^3\,x_i^3\,\mathcal{A}_i^3\,\xi_i^3 - 38\,\gamma^3\,\hbar^3\,x_i^4\,\mathcal{A}_i^4\,\xi_i^4 + 48\,\gamma^2\,\hbar^3\,a_i\,x_i^4\,\mathcal{A}_i^4\,\xi_i^4 - 12\,\gamma\,\hbar^3\,a_i^2\,x_i^4\,\mathcal{A}_i^4\,\xi_i^4 + 12\,\gamma^3\,\hbar^3\,x_i^5\,\mathcal{A}_i^5\,\xi_i^5 - 6\,\gamma^2\,\hbar^3\,a_i\,x_i^5\,\mathcal{A}_i^5\,\xi_i^5 - \gamma^3\,\hbar^3\,x_i^6\,\mathcal{A}_i^6\,\xi_i^6\right)\epsilon^3 + O[\epsilon]^4\Big]$$

$$\mathrm{CC} \to \mathbb{E}\Big[0,\ 0,\ \sqrt{B_i} - \frac{1}{2}\left(\hbar\,a_i\,\sqrt{B_i}\right)\epsilon + \frac{1}{8}\,\hbar^2\,a_i^2\,\sqrt{B_i}\,\epsilon^2 - \frac{1}{48}\left(\hbar^3\,a_i^3\,\sqrt{B_i}\right)\epsilon^3 + O[\epsilon]^4\Big]$$

$$\mathrm{b2t} \to \mathbb{E}\Big[a_i\,\alpha_i - \frac{t_i\,\beta_i}{\gamma},\ y_i\,\eta_i + x_i\,\xi_i,\ 1 + \frac{a_i\,\beta_i\,\epsilon}{\gamma} + \frac{a_i^2\,\beta_i^2\,\epsilon^2}{2\,\gamma^2} + \frac{a_i^3\,\beta_i^3\,\epsilon^3}{6\,\gamma^3} + O[\epsilon]^4\Big]$$

$$\mathrm{t2b} \to \mathbb{E}\Big[a_j\,\alpha_i - \gamma\,b_j\,\tau_i,\ y_j\,\eta_i + x_j\,\xi_i,\ 1 + a_j\,\tau_i\,\epsilon + \frac{1}{2}\,a_j^2\,\tau_i^2\,\epsilon^2 + \frac{1}{6}\,a_j^3\,\tau_i^3\,\epsilon^3 + O[\epsilon]^4\Big]$$

In[∘]:=
```
Print[degrule = Thread[{a, b, α, β, ξ, η, x, y, ℏ, γ, ϵ, t, τ, T, B, 𝒜} →
     {1, 1, -1, -1, -1, -1, 1, 1, -2, 1, 1, 2, -2, 0, 0, 0}]];
quarks /. 𝔼[L_, Q_, P_] ⧴ (𝔼[L, Q, P] ≡ (𝔼[L, Q, Normal@P] /.
      {v_{_i_} ⧴ s^{v/.degrule} v_i, (v : ℏ | ϵ | γ) ⧴ s^{v/.degrule} v}))
```

$$\{a \to 1,\ b \to 1,\ \alpha \to -1,\ \beta \to -1,\ \xi \to -1,\ \eta \to -1,\ x \to 1,\ y \to 1,\ \hbar \to -2,\ \gamma \to 1,\ \epsilon \to 1,\ t \to 2,\ \tau \to -2,\ T \to 0,\ B \to 0,\ \mathcal{A} \to 0\}$$

Out[∘]=

$$\{\mathrm{am} \to \mathrm{True},\ \mathrm{bm} \to \mathrm{True},\ \mathrm{R} \to \mathrm{True},\ \mathrm{P} \to \mathrm{True},\ \mathrm{aS} \to \mathrm{True},\ \mathrm{CC} \to \mathrm{True},\ \mathrm{b2t} \to \mathrm{True},\ \mathrm{t2b} \to \mathrm{True}\}$$

In[∘]:=
```
Print[degrule = Thread[{a, b, α, β, ξ, η, x, y, ℏ, γ, ϵ, t, τ, T, B, 𝒜} →
      {0, 1, 0, -1, 0, -1, 0, 1, -1, 0, 1, 1, -1, 0, 0, 0}]];
quarks /. 𝔼[L_, Q_, P_] :→ (𝔼[L, Q, P] ≡ (𝔼[L, Q, Normal@P] /.
      {v_i_ :→ s^(v/.degrule) v_i, (v : ℏ | ϵ | γ) :→ s^(v/.degrule) v}))
```

{a → 0, b → 1, α → 0, β → -1, ξ → 0, η → -1, x → 0,
 y → 1, ℏ → -1, γ → 0, ϵ → 1, t → 1, τ → -1, T → 0, B → 0, 𝒜 → 0}

Out[∘]= {am → True, bm → True, R → True, P → True, aS → True, CC → True, b2t → True, t2b → True}

In[∘]:=
```
Print[degrule = Thread[{a, b, α, β, ξ, η, x, y, ℏ, γ, ϵ, t, τ, T, B, 𝒜} →
      {1, 0, -1, 0, -1, 0, 1, 0, -1, 1, 0, 1, -1, 0, 0, 0}]];
quarks /. 𝔼[L_, Q_, P_] :→ (𝔼[L, Q, P] ≡ (𝔼[L, Q, Normal@P] /.
      {v_i_ :→ s^(v/.degrule) v_i, (v : ℏ | ϵ | γ) :→ s^(v/.degrule) v}))
```

{a → 1, b → 0, α → -1, β → 0, ξ → -1, η → 0, x → 1,
 y → 0, ℏ → -1, γ → 1, ϵ → 0, t → 1, τ → -1, T → 0, B → 0, 𝒜 → 0}

Out[∘]= {am → True, bm → True, R → True, P → True, aS → True, CC → True, b2t → True, t2b → True}