Schwartz
11.1 (a)

$$\gamma^5 = i\gamma^0\gamma^1\gamma^2\gamma^3$$

$$(\gamma^5)^2 = -\gamma^0\gamma^1\gamma^2\gamma^3\gamma^0\gamma^1\gamma^2\gamma^3$$

$$\{\gamma^\mu,\gamma^\nu\} = 2g^{\mu\nu} \Rightarrow \quad \gamma^3\gamma^0 + \gamma^0\gamma^3 = 0, \quad \gamma^3\gamma^0 = -\gamma^0\gamma^3$$

$$= +\gamma^0\gamma^1\gamma^2\gamma^0\gamma^3\gamma^1\gamma^2\gamma^3$$

$$\gamma^3\gamma^1 = -\gamma^1\gamma^3$$

$$= -\gamma^0\gamma^1\gamma^2\gamma^0\gamma^1\gamma^3\gamma^2\gamma^3$$

$$= \gamma^0\gamma^1\gamma^2\gamma^0\gamma^1\gamma^2\cancel{\gamma^3}\cancel{\gamma^3}$$

$$= \gamma^0\gamma^1\gamma^2\gamma^0\gamma^1\gamma^2$$

$$= -\gamma^0\gamma^1\gamma^2\gamma^1\gamma^0\gamma^2 = \gamma^0\cancel{\gamma^1}\cancel{\gamma^1}\gamma^2\gamma^0\gamma^2$$

$$= \gamma^0\gamma^2\gamma^0\gamma^2$$

$$= -\gamma^0\gamma^0\gamma^2\gamma^2$$

$$= (-1)(-1)(1) = \boxed{1.}$$

(b) $\gamma_\mu \not{p} \gamma^\mu = \gamma_\mu \gamma_\alpha p^\alpha \gamma^\mu$

$= \gamma_\mu \gamma^\alpha \gamma^\mu p_\alpha$

$= \gamma_\mu [\cancel{\gamma} \, 2g^{\alpha\mu} - \gamma^\mu \gamma^\alpha] p_\alpha$

$= 2 \gamma_\mu g^{\alpha\mu} p_\alpha - \gamma_\mu \gamma^\mu \gamma^\alpha p_\alpha$

$= 2\not{p} - 4\not{p} = -2\not{p}$

(c) $\gamma_\mu \not{p} \not{q} \not{p} \gamma^\mu = ?$

$\gamma_\mu \gamma_\alpha \gamma_\beta \gamma_\sigma \gamma^\mu p^\alpha q^\beta p^\sigma$

$= [2g_{\mu\alpha} - \gamma_\alpha \gamma_\mu] \gamma_\beta \gamma_\sigma \gamma^\mu \qquad \times p^\alpha q^\beta p^\sigma$

$= 2\gamma_\beta \gamma_\sigma \gamma_\alpha - \gamma_\alpha \gamma_\mu \gamma_\beta \gamma_\sigma \gamma^\mu$

$= 2\gamma_\beta \gamma_\sigma \gamma_\alpha - \gamma_\alpha [2g_{\mu\beta} - \gamma_\beta \gamma_\mu] \gamma_\sigma \gamma^\mu$

$= 2\gamma_\beta \gamma_\sigma \gamma_\alpha - 2\gamma_\alpha \gamma_\sigma \gamma_\beta + \gamma_\alpha \gamma_\beta \gamma_\mu \gamma_\sigma \gamma^\mu$

$= 2\gamma_\beta \gamma_\sigma \gamma_\alpha - 2\gamma_\alpha \gamma_\sigma \gamma_\beta + \gamma_\alpha \gamma_\beta [2g_{\mu\sigma} - \gamma_\sigma \gamma_\mu] \gamma^\mu$

$= 2\gamma_\beta \gamma_\sigma \gamma_\alpha - 2\gamma_\alpha \gamma_\sigma \gamma_\beta + 2\gamma_\alpha \gamma_\beta \gamma_\sigma - \gamma_\alpha \gamma_\beta \gamma_\sigma \gamma_\mu \gamma^\mu$

$= 2\gamma_\beta \gamma_\sigma \gamma_\alpha - 2\gamma_\alpha \gamma_\sigma \gamma_\beta + 2\gamma_\alpha \gamma_\beta \gamma_\sigma - 4\gamma_\alpha \gamma_\beta \gamma_\sigma \qquad \times p^\alpha q^\beta p^\sigma$

$= 2\not{q}\not{p}\not{p} - 2\not{p}\not{p}\not{q} + 2\not{p}\not{q}\not{p} - 4\not{p}\not{q}\not{p}$

$= 2\not{q}\not{p}\not{p} - 2\not{p}\not{p}\not{q} - 2\not{p}\not{q}\not{p}$.

Now consider $\not{q}\not{p} = \gamma_\alpha \gamma_\beta q^\alpha p^\beta$

$\gamma_\alpha \gamma_\beta + \gamma_\beta \gamma_\alpha = 2g_{\alpha\beta} \Rightarrow \gamma_\alpha \gamma_\beta = 2g_{\alpha\beta} - \gamma_\beta \gamma_\alpha$

$\Rightarrow \not{q}\not{p} = 2p \cdot q - \not{p}\not{q}$

Thus $2\not q \not p \not p - 2\not p \not p \not q - 2\not p \not q \not p$

$$= 2\left[2q\cdot p - \not p \not q\right]\not p - 2\not p\left[2q\cdot p - \not q \not p\right] - 2\not p \not q \not p$$

$$= \cancel{4\not p\, pq} \cancel{- 2\not p \not q \not p} \cancel{- 4\not p\, q\cdot p} \cancel{+ 2\not p \not q \not p} - 2\not p \not q \not p$$

$$= \boxed{-2\not p \not q \not p}$$

(d) $\{\gamma^5, \gamma^\mu\} = i\,[\gamma^0\gamma^1\gamma^2\gamma^3\gamma^\mu + \gamma^\mu\gamma^0\gamma^1\gamma^2\gamma^3]$

$\gamma^\mu \in \{\gamma^0, \gamma^1, \gamma^2, \gamma^3\}$, so in the process of moving this γ^μ to the right, we will encounter a term where it just commutes, for all other terms, it will anticommute, giving 3 factors of (-1), $(-1)^3 = -1$, thus we get left and right side in the bracket cancel to give 0.