3a. $r = (a \cdot b)$

① Given 3a, M_a generates $[a]$

$M_a = \rightarrow ① \xrightarrow{a} ②$

② Given 3a, M_b generates $[b]$

$M_b = \rightarrow ③ \xrightarrow{b} ④$

③ Given 3a, ① & ②, M_c generates $(a \cdot b)$

$M_c = \rightarrow ① \xrightarrow{a} ② \xrightarrow{\varepsilon} ③ \xrightarrow{b} ④$

3b. $r = ((a \cdot c) | b)$

① given 3b, M_a generates $[a]$

$M_a = \rightarrow ① \xrightarrow{a} ②$

② given 3b, M_b generates $[c]$

$M_b = \rightarrow ③ \xrightarrow{} ④$

③ given 3b, ① & ②, M_c generates $(a \cdot c)$

$M_c = \rightarrow ① \xrightarrow{a} ② \xrightarrow{\varepsilon} ③ \xrightarrow{b} ④$

④ given 3b, M_d generates $[b]$

$M_d = \rightarrow ⑤ \xrightarrow{b} ⑥$

⑤ given 3b, ③ & ④, M_e generates $((a \cdot c) | b)$

$M_e = ⑦ \xrightarrow{\varepsilon} ① \xrightarrow{a} ② \xrightarrow{\varepsilon} ③ \xrightarrow{b} ④$
$\xrightarrow{\varepsilon} ⑤ \xrightarrow{b} ⑥$

3c. $r = (a \cdot (1 | c)^*)$

① given 3c, M_a generates $[a]$

$M_a = \rightarrow ① \xrightarrow{a} ②$

② given 3c, M_b generates $[1]$

$M_b = \rightarrow ③ \xrightarrow{1} ④$

③ given 3c, M_c generates $[c]$

$M_c = \rightarrow ⑤ \xrightarrow{c} ⑥$

④ given 3c, ② & ③, M_d generates $(1 | c)$

$M_d = \rightarrow ⑦ \xrightarrow{\varepsilon} ⑤ \xrightarrow{c} ⑥$
$\xrightarrow{\varepsilon} ③ \xrightarrow{1} ④$

⑤ given 3c, ④, M_e generates $(1 | c)^*$

$M_e = \rightarrow ⑦ \xrightarrow{\varepsilon} ⑤ \xrightarrow{5} ⑥$
$\xleftarrow{\varepsilon} ③ \xrightarrow{1} ④$

5.

$L = \{ x y^n z \mid n \geq 0 \}$

$x = \emptyset$
$y =$
$z = $ died

⊥ the dog died $\in L$
   $\underbrace{\text{the}}_{x}$ $\underbrace{\text{dog}}_{y}$ $\underbrace{\text{died}}_{z}$ $\in L$

2| $\underbrace{\text{the}}_{x}$ $\underbrace{\text{cat the dog}}_{y}$ $\underbrace{\text{chased died}}_{z}$ $\notin L$

$\underbrace{\text{the}}_{x}$ $\underbrace{\text{cat the dog cat the dog}}_{y^2}$
$\underbrace{\text{chased died}}_{z}$ $\notin L$

3| $\underbrace{\text{the}}_{x}$ $\underbrace{\text{cat the dog the rabbit}}_{y}$
bit chased died.

the $\underbrace{\text{cat the dog the rabbit}}$
cat the dog the rabbit
cat the dog the rabbit
bit chased died. y^3
$\underbrace{\qquad}_{z}$ $\notin L$

Therefore this Language
doesn't satisfy the pumping
Lemma & is NOT regular

⑥ given x, ①, ⑤, M_f generates $(a \cdot (1 | c)^*)$

$M_f = \rightarrow ① \xrightarrow{a} ② \xrightarrow{\varepsilon} ⑦ \xrightarrow{\varepsilon} ⑤ \xrightarrow{5} ⑥$
$\xleftarrow{\varepsilon} ③ \xrightarrow{1} ④$