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Question - 1:

Given Input $\Sigma = \{a, b\}$

Language $L = \{aa, aaa, aab, baa, bab, \ldots\}$

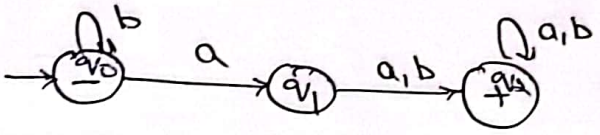
All words that have "a" as the 2nd letter and "a"s the 2nd last letter

Solution:

Regular expression for the given is

$$\boxed{b^* a (a+b)(a+b)^*}$$

The finite automata (fa) for given regular expression is



– → indicates starting state

+ → indicates final state

* The automata starts with "a" then it is processed to next state
* After first state it is moving to next state upon a, b
* In the final state it is accept any no. of a's and b's

Transition Table:

		a	b
–	q_0	q_1	q_0
	q_1	q_2	q_2
+	q_2	q_2	q_2

Acceptable strings:-

baa = $b^* a (a+b)(a+b)^*$

= $b^1 aa$ (valid)

bab = $b^* a (a+b)(a+b)^*$

= $b^1 a(b)$ (valid)

aabaa = $b^* a (a+b)(a+b)^*$

= $aa\, b(a+b)^1 (a+b)^1$ (valid)

aab = $b^* a (a+b)(a+b)^*$

= $a (a+b) (a+b)^1$ (valid)

Invalid strings:

a[redacted] = $b^* a (a+b) (a+b)^*$

= a (Invalid)

b = $b^* a (a+b)(a+b)^*$

= b (Invalid)