B solution

a) word ≡ finite sequence of characters of S

$w = \{s_i \mid 1 \le i \le n\}$, $\ell(w) = n$, or EMPTY WORD

event = set of words over S.

b) $M \equiv (Q, S, q, f, A)$. Given $\alpha \in Q$, $s \in S$, define $\alpha_s = f(\alpha, s)$. If $w = \{s_i\}_1^n$, then M accepts w iff $(..(q_{s_1})_{s_2}..)_{s_n} \in A$. M accepts E if it accepts precisely the words of E.

c) $+$ (UNION of sets of words)

$\cdot$ (set of CONCATENTIONS of words)

$*$ (set of ARBITRARY REPETITIONS of words)

d) regular events defined inductively by closure from 0 (empty event), 1 (unit event), and input symbols $\{s\}$ where $s \in S$, ~~by~~ under application of regular operators.

B sol^n (ctd)

Kleene's Thm Event over alphabet S is REGULAR iff it is accepted by a DFA M having input alphabet S.

Suppose $E \neq \emptyset$. Choose $w \in E$ such that $\ell(w)$ is MINIMUM. If $\ell(w) \geq N$, consider the $(N+1)$ states defined by transitions

$$q^0 = 2 , \quad q^n = q^{n-1}_{s_n} , \quad 1 \leq n \leq N ,$$

where $w = \{ s_i \mid 1 \leq i \leq \ell(w) \}$.

$\{q_n\}_0^N$ must contain at least one repeat, contrary to minimality of $\ell(w)$. Hence result.

Given machines M, M', we can construct DFA to recognise :

B sol: ctd)

a) $(S^* \setminus E), \ (S^* \setminus E');$

b) $(S^* \setminus E) \cup E', \ (S^* \setminus E') \cup E;$

c) $S^* \setminus \{(S^* \setminus E) \cup E'\}, \ S^* \setminus \{(S^* \setminus E') \cup E\}.$

But these events are precisely $(E \setminus E'), (E' \setminus E)$.
We can determine whether each of these events is empty, as above. Hence decide $E = E'$

Once again rather a lot of definition at the start of the question; the think part at the end is all in the notes, but it's pretty abbreviated. Certainly not too long.

OK, I think.

"$\ell(w) < N$" isn't really defined: maybe