339 (Boole's binaries) If $\top=1$ and $\bot=0$, express

(a) $\neg a$

(b) $a\wedge b$

(c) $a\vee b$

(d) $a\Rightarrow b$

(e) $a\Leftarrow b$

(f) $a=b$

(g) $a\neq b$

using only the following symbols (in any quantity)

(i) $0\ 1\ a\ b\ (\ )\ +\ -\ \times$

(ii) $0\ 1\ a\ b\ (\ )\ -\ \uparrow\ \downarrow$

That's $7\times2 = 14$ questions.

After trying the question, scroll down to the solution.

§		(i)	(ii)
(a)	$\neg a$	$= 1-a$	$= 1-a$
(b)	$a \wedge b$	$= a \times b$	$= a \downarrow b$
(c)	$a \vee b$	$= a + b - a \times b$	$= a \uparrow b$
(d)	$a \Rightarrow b$	$= 1 - a + a \times b$	$= (1-a) \uparrow b$
(e)	$a \Leftarrow b$	$= 1 - b + a \times b$	$= a \uparrow (1-b)$
(f)	$a = b$	$= 1 - a - b + 2 \times a \times b$	$= (a \uparrow (1-b)) \downarrow ((1-a) \uparrow b)$
(g)	$a \neq b$	$= a + b - 2 \times a \times b$	$= (a \downarrow (1-b)) \uparrow ((1-a) \downarrow b)$