Assignment 1
Grammars & Truth Tables

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1. Here is a simple grammar for strings representing decimal numbers, which includes the possibility of writing numbers in scientific notation. The start symbol is N.

N	$\rightarrow$	F | F [e] S I
F	$\rightarrow$	I [.] I
I	$\rightarrow$	D | D I
D	$\rightarrow$	[0] | [1] | [2] | ... | [9]
S	$\rightarrow$	[+] | [-]

   For each of the following numbers, either draw the parse tree showing how it can be derived from the grammar above or, if that is not possible, explain how to modify the grammar so that it can be derived.

   (a) 6.02e+23

   (b) 1e-6 **[8 marks]**

2. As shown in lectures, here is a grammar for formulae in propositional logic, assuming just three atomic propositions P, Q and R. The start symbol is F.

F	$\rightarrow$	Ap | $\neg$ F | F $\wedge$ F | F $\vee$ F | F $\rightarrow$ F
Ap	$\rightarrow$	[P] | [Q] | [R]

   Describe how to extend this grammar to represent *arguments* in propositional logic, expressed using *sequent* notation.

   [7 marks]

3. Using a truth table, explain whether the following argument is valid:

   If Alice studies logic, then Bob studies it too.
   If either Alice or Bob studies logic, then Alice definitely does.
   Therefore, both Alice and Bob study logic. **[7 marks]**

4. Using a truth table, explain why the following argument is *invalid*:

$$P \rightarrow Q,\ Q \vee R\ :\ \neg(P \wedge Q) \rightarrow R$$

   Then give a propositional logic formula that includes atomic propositions P and Q (but not R) and which, when added as a premise to this argument, makes it valid. Explain why it does.

   [8 marks]