1. Exercise set 1.3

11: The argument is valid, since whenever the premises are both true, the conclusion is true:

p	q	$p \to q$ (*premises*)	$\sim q$ (*premises*)	$\sim p$ (*conclusion*)	
T	T	T	F	F	
T	F	F	T	F	
F	T	T	F	T	
F	F	T	T	T	*

†12:

(b) This argument is not valid, because there is a case where both premises are true, but the conclusion is false:

p	q	$p \to q$ (*premises*)	$\sim p$ (*premises*)	$\sim q$ (*conclusion*)	
T	T	T	F	F	
T	F	F	F	T	
F	T	T	T	F	*
F	F	T	T	T	

19: The truth table shows that whenever the premises are both true, the conclusion is true, so the argument is valid:

p	q	r	$p \to q$ (*premises*)	$q \to r$ (*premises*)	$p \to r$ (*conclusion*)	
T	T	T	T	T	T	*
T	T	F	T	F	F	
T	F	T	F	T	T	
T	F	F	F	T	F	
F	T	T	T	T	T	*
F	T	F	T	F	T	
F	F	T	T	T	T	*
F	F	F	T	T	T	*

25: The argument is

$$\begin{array}{rl} & m \to \sim h, \\ & \sim h \to \sim e \\ \therefore & m \to \sim e \end{array}$$

where m stands for "I go to the movies", h stands for "I will finish my homework", and e stands for "I will do well on the exam tomorrow".
It is valid by the rule of hypothetical syllogism.

2. Excercise set 2.1

†5: For $a = -1 \in \mathbf{Z}$, we have $(a-1)/a = 2$, which *is* an integer.

11:
(b) $\forall$ real number x, x is positive, negative, or zero.

†12:
(b) $\exists$ a real number x such that x is rational.

25: Not correct. Correct negation:
There is an irrational number and a rational number whose product is rational.

30: $\exists$ a computer program P, such that P is correct and P doesn't compile without error messages).

3. Excercise set 2.2

4: There is a book that everybody has read.

17: (a) $\forall$ integer x, ($\exists$ a prime number p: $x \leq p \leq 2x$).
(b) $\exists$ an integer x: ($\forall$ prime number p, $p < x$ or $2x \leq p$).

†19: (a) $\forall x \in \mathbf{R}, \exists y \in \mathbf{R}^-$ such that $x > y$.
(b) both statements are true. For the original statement, take x to be a non-negative number, which is certainly bigger than any negative number. For the statement in (a), for every $x \in \mathbf{R}$, if x is negative one can take $y = x - 1$, which

is certainly smaller than x, whereas if x is nonnegative, any $y \in \mathbf{R}^-$ will be smaller.

†25: statement: $\forall$ integer x, if x^2 is even, then x is even.
contrapositive: $\forall$ integer x, if x is odd, then x^2 is odd.
converse: $\forall$ integer x, if x is even, then x^2 is even.
inverse: $\forall$ integer x, if x^2 is odd, then x is odd.

32: If a number is divisible by 6, then it is divisible by 3.

4. Excercise set 2.3

4: $\left(5^{\frac{1}{2}}\right)^4 = 5^{(\frac{1}{2}\cdot 4)}$.

†12: The argument is invalid. It exhibits the inverse error.

15: The argument is invalid. It exhibits the converse error.