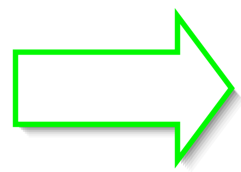
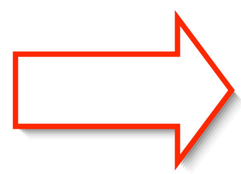
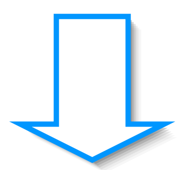
Legend:

State markers:	Start 2 3
Main user visible content and interface:	Text, etc.
Auxiliary user visible content and interface:	Text, etc.
Correct move:	
Incorrect move:	
Navigational move:	
Feedback content:	Text, etc.
Hint content:	Hint text, etc.

Start

Complete the following derivation by filling in the missing formulae. To fill in the formula on a given line, just click anywhere on that line.

1.	$(\forall x)(P(x) \rightarrow Q(x))$	Premise
2.	$(\forall y)(Q(y) \rightarrow R(y))$	Premise
3.	$\neg(\exists x)R(x)$	Premise
4.	?	RBV: 2
5.	?	$\forall$HS: 1,4
6.	?	$\neg\exists$: 3
7.	?	$\forall$MT: 5, 6
8.	?	$\forall\neg$: 7

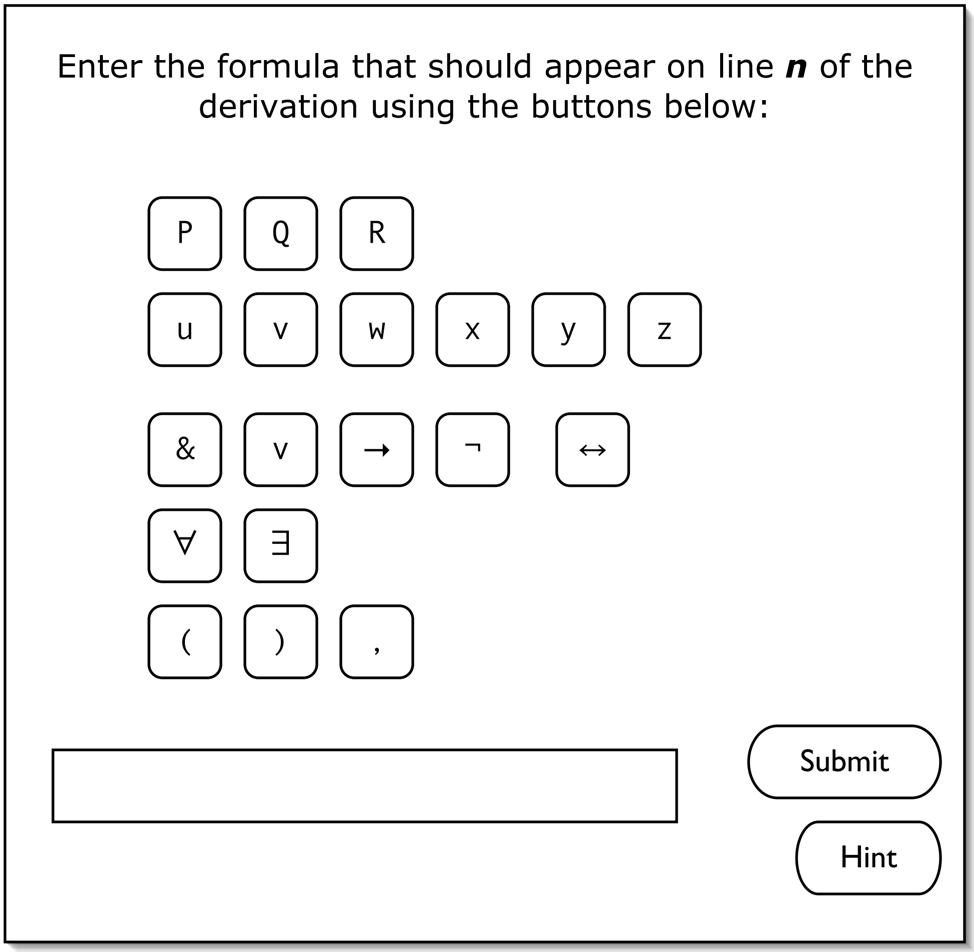
4 5 6 7 8

2 3 4 5 6

Completed Derivation:

1.	$(\forall x)(P(x) \rightarrow Q(x))$	Premise
2.	$(\forall y)(Q(y) \rightarrow R(y))$	Premise
3.	$\neg(\exists x)R(x)$	Premise
4.	$(\forall x)(Q(x) \rightarrow R(x))$	RBV: 2
5.	$(\forall x)(P(x) \rightarrow R(x))$	$\forall$HS: 1,4
6.	$(\forall x)\neg R(x)$	$\neg\exists$: 3
7.	$(\forall x)\neg P(x)$	$\forall$MT: 5, 6
8.	$\neg(\exists x)P(x)$	$\forall\neg$: 7

Interface for entering formulae:



2

$(\forall x)(Q(x) \rightarrow R(x))$

That's right.

$(\forall v)(Q(v) \rightarrow R(v))$
$v \neq x$

Not quite. You are correct that this formula could be derived from the formula on line 2 by an application of RBV, but this formula doesn't have the correct variable of quantification to serve as justification for the application of $\forall$HS made on the next line.

anything else

That formula couldn't be derived from the formula on line 2 just by renaming the bound variable.

3

$(\forall x)(P(x) \rightarrow R(x))$

That's right.

$(\forall v)(P(v) \rightarrow R(v))$

$v \neq x$

Not quite. The only problem with your formula is the variable of quantification. It has to be the same variable as in the formulae on lines 1 and 4.

any other universally quantified conditional with x as the variable of quantification, e.g., $(\forall x)(R(x) \rightarrow P(x))$

You're on the right track, but this formula isn't quite right. You are correct that the formula will be a universally quantified conditional, but your antecedent and consequent are incorrect.

anything else

Recall that $\forall$HS is the following rule:

a.	$(\forall \boldsymbol{x})(\varphi \rightarrow \psi)$	
b.	$(\forall \boldsymbol{x})(\psi \rightarrow \rho)$	
	.	
	.	
	.	
d.	$(\forall \boldsymbol{x})(\varphi \rightarrow \rho)$	$\forall$HS: a, b

4

$(\forall x)\neg R(x)$

That's right.

$(\forall v)\neg R(v)$

$v \neq x$

The rule $\neg\exists$ doesn't change the variable of quantification, otherwise you have the correct formula.

anything else

Recall that $\neg\exists$ is the following rule:

a.	$\neg(\exists \boldsymbol{x})\,\varphi$	
	.	
	.	
	.	
c.	$(\forall \boldsymbol{x})\neg\varphi$	$\neg\exists$: a

5

$(\forall x)\neg P(x)$

That's right.

$(\forall v)\neg P(v)$

$v \neq x$

The variable of quantification has to be the same as in the formulae that justify the application of ∀MT, otherwise you have the correct formula.

anything else

Recall that ∀MT is the following rule:

a.	$(\forall \mathbf{x})(\varphi \rightarrow \psi)$	
b.	$(\forall \mathbf{x})\neg\psi$	
	.	
	.	
	.	
d.	$(\forall \mathbf{x})\neg\varphi$	∀MT: a, b

6

$\neg(\exists x)P(x)$

That's right.

$\neg(\exists v)P(v)$

$v \neq x$

The rule $\forall\neg$ doesn't change the variable of quantification, otherwise you have the correct formula.

anything else

Recall that $\forall\neg$ is the following rule:

a.	$(\forall \boldsymbol{x})\neg\varphi$	
	.	
	.	
	.	
c.	$\neg(\exists \boldsymbol{x})\varphi$	$\forall\neg$: a

Hints

Each hint should contain the following, after specific hint content:

Click on a rule name to view the rule : RBV, ∀HS, ∀MT, ∀¬, ¬∃.

The links should be to the following files, as indicated by both order and colour:

RBV.gif
AllHS.gif
AllMT.gif
AllNot.gif
NotExists.gif

2

Most derived predicate rules require the instantiating variables of outermost quantifiers to be the same in all formulae to which the rule is applied.

↓

The instantiating variable of outermost quantifier in the formula on line 1 is x rather than y.

↓

Replacing the variable y with x in the formula $(\forall y)(Q(y) \rightarrow R(y))$ results in the following:

$(\forall x)(Q(x) \rightarrow R(x))$.

3

Recall that the hypothetical syllogism has to do with the transitivity of the conditional.. The predicate version is no different - it just does it all inside universal quantifiers.

Look at the universally quantified conditionals on the lines cited, and note that the consequent of one of the conditionals is the antecedent of the other.

The formula to enter here is $(\forall x)(P(x) \rightarrow R(x))$.

4

Remember that the single negation and quantifier rules all change the outermost quantifier of the formula and move the negation to the other side of that quantifier.

If it isn't the case that something with a given property exists, then everything that does exist doesn't have the property in question.

The formula you need to enter is $(\forall x)\neg R(x)$.

6

Remember that Modus Tollens means "the mood that denies", and serves to derive the negation of a conditional's antecedent. The predicate version is no different - it just does it all inside universal quantifiers.

Look at the universally quantified formulae on the lines cited. Note that the second formula is the universal quantification of the negation of the consequent of the universally quantified conditional.

The formula to enter here is $(\forall x)\neg P(x)$.

6

Remember that the single negation and quantifier rules all change the outermost quantifier of the formula and move the negation to the other side of that quantifier.

If everything there is doesn't have a given property, then there is nothing that does have the property.

The formula you need to enter is $\neg(\exists x)P(x)$.