

Consider the following translation key:

$P_ : _$ is a pelican

$Q_ : _$ is a bird

$R_ : _$ is a mammal

$S__ : _$ flies higher than $_$

a : Petros

b : Polly

1. Match the sentences in English to their translation in predicate logic given the translation key above:

◆ Petros is a bird.

◆ $\neg\exists x(Rx \wedge Px)$

◆ Petros is not a mammal.

◆ Sba

◆ Every pelican is a bird.

◆ $\neg Ra$

◆ No mammal is a pelican.

◆ $\exists x(Qx \wedge Px)$

◆ Some birds are pelicans.

◆ $\forall x(Px \supset Qx)$

◆ Polly flies higher than Petros

◆ Qa

2. Determine which of the following are atomic formulas, non-atomic formulas, or neither:

(a) $\forall x\forall y Rxy$

(d) $\exists x(Qa \supset Pe)$

(b) $\forall y_1 QRy_1$

(e) $\forall(Px \supset T_2x)$

(c) Px

(f) $\forall x(Px \supset \exists yTx)$

3. Mark the free variables in the following formulas:

(a) $\exists x(Py \vee Qy)$

(c) $\forall z\forall x_1(Rx_1z \supset \exists xTxz)$

(b) $\forall y\exists xTxyza$

(d) $\exists z_1\forall x(Tx \supset S_4z_1) \wedge \exists x(T_1x \wedge S_4z_1)$

4. Which of the above are open formulas? Which are closed?

5. Translate the following sentences given the key above:

(a) Every pelican is a bird but not every bird is a pelican.

(b) Unless Petros is a mammal, all pelicans are birds.

(c) Something flies higher than something else.

(d) Nothing flies higher than itself.

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