**1: Random (Formalization):**

**T:** Formalization 01:

**P:** Given the sentence below, choose the right translation to predicate logic

The hats of French workers are red

use: F(x)= x is French, T(x)= x is a worker, C(x,y)= x has y colour, the function h(x)= x's hat and the constant r= red

**A:** ∀x (T(x) ^ F(x) -> C(h(x),r))

**T:** Formalization 02:

**P:** Which ones of the following formulas are the translation of the statement "It does not exist any recursive primitive function being total" into predicate logic? Use P(x): x is recursive primitive function and T(x): x is total

**A:** ¬∃x (P(x) ^ T(x)) **AND** ∀x (P(x) -> ¬T(x))

**T:** Formalization 03:

**P:** Choose the right translation for the sentence

Everyone who drinks water is either homeless or a graduate student

**A:** ∀x (drinksWater(x) -> homeless(x) v IsAGradStudent(x))

**T:** Formalization 04:

**P:** "No cat is red" can be translated as:

**A:** ¬∃x(cat(x) ^ red(x))

**T:** Formalization 05:

**P:** Translate into predicate logic: For any persons x,y and z, if z is y's parent and y is x's parent then z is the grandparent of x

Use the predicates: p(x,y)=x is parent of y, g(x,y)=x is grandparent of y

**A:** ∀x ∀y ∀z (p(y,x) ^ p(z,y) -> g(z,x))

**T:** Formalization 06:

**P:** Translate into predicate logic: All computer scientists like some operating system

**A:** ∀x (CS(x) -> ∃z (OS(z) ^ Likes(x,z)))

**T:** Formalization 07:

**P:** Translate into predicate logic: The Barber of Seville shaves all men who do not shave themselves

**A:** ∀x (¬Shaves(x,x) -> Shaves(bs,x))

**2: Random (Evaluation):**

**T:** Evaluation 01:

**P:** Consider ∃x ∀y (P(x,y) <-> Q(a))

Select the interpretation making the formula TRUE

**A:** Dom={1,2}, P(x,y)="x ≤ y", Q(x)="x is odd", a=1

**T:** Evaluation 02:

**P:** Consider ∃x ∀y (P(x,y) <-> Q(a))

Select the interpretation making the formula TRUE

**A:** Dom={1,2}, P(x,y)="x < y", Q(x)="x is odd", a=2

**T:** Evaluation 03:

**P:** Consider ∀y ∃x (P(x,y) <-> Q(a))

Select the interpretation making the formula TRUE

**A:** Dom={1,2}, P(x,y)="x = 2", Q(x)="x is even", a=1

**T:** Evaluation 04:

**P:** Consider ∀y ∃x (P(x,y) <-> Q(a))

Select the interpretation making the formula TRUE

**A:** Dom={1,2}, P(x,y)="x = 1", Q(x)="x is even", a=2

**T:** Evaluation 05:

**P:** The formula ∃X p(X) <-> ¬∀Y ¬p(Y) is:

**A:** Valid

**T:** Evaluation 06:

**P:** Let I = { D={a,b,c}, R={(a,a),(a,b),(a,c),(b,c)} } be an interpretation.

Consider F = ∃x ∀y R(x,y) and G = ∀x ∃y R(x,y), then:

**A:** F^I = T and G^I = F

**T:** Evaluation 07:

**P:** Let I be the interpretation defined by the domain {0,1,2} and the predicates :

P(x) = x is even, I(x,y) = x equals y

Which of the next formulas are true given I?

**A:**

∃x ∀y (P(x) -> ¬I(x,y)) **AND**

∀y ∃x (P(x) -> ¬I(x,y)) **AND**

∀y ∃x (P(x) ^ ¬I(x,y))

**T:** Evaluation 08:

**P:** Let I be the interpretation

D={1,3,9}, v(X,Y) = X can be divided by Y, p(X) = X is even

Then, under this interpretation, the formula

∀x (p(x) -> v(x,3))

is .....?

**A:** true

**T:** Evaluation 09:

**P:** Let I={ D={1,4,7}, P(x,y)="x is less than or equal to y", Q(x)="x equals 1" } be an interpretation. Select the formulas evaluated as TRUE under I.

**A:** ∃y ∀x (P(y,x) ^ Q(y)) **AND** ∃y ∃x (P(y,x) ^ Q(y))

**3: Random (SNF):**

**T:** SNF 1:

**P:** The SNF of this formula is

∃x(¬∀y¬p(x,y)→p(x,x))

**A:** ¬p(a,y)∨p(a,a)

**T:** CF 1:

**P:** The clausal formula of

∀x(∃y(p(x,y)→p(y,y))→∃yq(y))

is

**A:** The set {p(x,y)∨q(f(x,y)), ¬p(y,y)∨q(f(x,y))}

**T:** SNF 2:

**P:** Choose the SNF for the formula

∃Z ∀X [(p(X,a) -> ∃U q(X,U,Z)) -> ¬∀Z r(X,Z)]

**A:** ∀X ∀U [(p(X,a) v ¬r(X,f(X,U))) ^ (¬q(X,U,b) v ¬r(X,f(X,U)))]

**T:** SNF 3:

**P:** ∃Z ∀X [(p(X,a) -> ∃Y q(X,Y,Z)) -> ¬∀Z r(X,Z)] is equivalent to

**A:** ∃Z ∀X ∀Y ∃T [(p(X,a) v ¬r(X,T)) ^ (¬q(X,Y,Z) v ¬r(X,T))]

**T:** SNF 4:

**P:** Choose the SNF for the formula

∃Y ∃Z ∀X [(p(X,Y) -> ∀Y q(X,Y,Z)) -> ¬∃Z r(X,Z)]

**A:** ∀X ∀T [(p(X,a) v ¬r(X,T)) ^ (¬q(X,g(X),b) v ¬r(X,T))]

**T:** SNF 5:

**P:** Which one of the following formulas is equivalent to

∃Z ∀X [ (p(X,a) -> ∀Y q(X,Y, Z) ) -> ¬∃Z r(X,Z)] ?

**A:** ∃Z ∀X ∃Y ∀T [ (p(X,a) v ¬r(X,T)) ^ (¬q(X,Y, Z) v ¬r(X,T))]

**4: Random (Resolvent):**

**T:** Resolvent 01:

**P:** A resolvent of

 {¬P(x)∨Q(x),P(y)∨¬Q(a)}

is

**A:** Q(x) v ¬Q(a) **AND** Q(y) v ¬Q(a) **AND** ¬P(a) v P( y)

**T:** Resolvent 02:

**P:** The resolvent of  ¬Q(y)∨¬R(a,y) and ¬P(x)∨Q(x)∨R(x,f(x)) is

**A:** ¬R(a,x)∨¬P(x)∨R(x,f(x)) if we resolve with regard to *Q*, being the mgu {y/x} **AND** ¬Q(f(a))∨¬P(a)∨Q(a) if we resolve with regard to *R*, being the mgu {x/a, y/f(a)}

**T:** Resolvent 03:

**P:** Given

S={¬s(y)∨p(x,y), ¬w(x,y)∨s(x), ¬p(x,x)∨¬s(x), w(x,y)}

¿Can we obtain from S the empty clause using resolution?

**A:** Yes. Thus it is inconsistent

**T:** Resolvent 04:

**P:** Select a resolvent of these formulas

p(z,f(z))∨q(x,z,z)   and  ¬p(v,f(a))∨¬q(v,f(v),a)

**A:** q(x,a,a)∨¬q(a,f(a),a)

**T:** Resolvent 05:

**P:** Consider the clauses

p(x,f( y))∨q(a,f(x))   and  ¬p(v,u)∨¬t(z,f(u))

Choose a resolvent of them

**A:** q(a,f(v)) ∨ ¬t(z,f(f( y)))

**T:** Resolvent 06:

**P:** Consider the clauses

p(z,a) v p(x,f(x)) and ¬p(f( y),u) v q(u)

Choose a resolvent of them

**A:** p(z,a) v q(f(f( y)))