

# IN-CLASS EXERCISE (I4)

Student ID: .....

Duration: 15 mins

Date: 11/04/2023

Student name: .....

Score: ...../3

**Question 1 (1pt)** Find the MGU for each of the following pairs of clauses. If there exists such an MGU, write the substitution  $\theta$ . Otherwise, write No MGU and justify your answer.

- a.  $P(x, F(x, y), G(x, w))$  and  $P(A, F(w, B), G(w, x))$  where A and B are constant symbols

.....

- b.  $P(x, F(x), A, A)$  and  $P(y, F(A), y)$  where A is a constant symbol

.....

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Brioche is a creamy bun, yet it does not have eggs.
2	0.25	Every bun is sold in some convenience store.
3	0.25	Some convenience stores do not sell buns having eggs.
4	0.25	No convenience store sells all buns.
5	0.5	Only one convenience store sells Brioche bun.
6	0.5	Some buns are either creamy or has eggs (but not both at the same time).

using only the given predicates

- $\text{Store}(x)$ : x is a convenience store
- $\text{Bun}(x)$ : x is a bun
- $\text{Creamy}(x)$ : x is creamy
- $\text{Sells}(x, y)$ : x sells y
- Brioche is a constant
- $\text{Egg}(x)$ : x has eggs.

1. ....

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- a.  $Q(F(A), G(x))$  and  $Q(y, y)$  where A is a constant symbol

.....

- b.  $Q(A, x, F(G(y)))$  and  $Q(z, F(z), F(u))$  where A is a constant symbol

.....

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Baozi is a tasty bun, and it is not salty.
2	0.25	Every bun contains some eggs.
3	0.25	Some buns do not contain salty eggs.
4	0.25	No egg is contained in all buns.
5	0.5	Baozi bun contains at least two eggs.
6	0.5	Every egg is either tasty or salty (but not both simultaneously).

using only the given predicates

- Bun(x): x is a bun
- Baozi is a constant
- Tasty(x): x is tasty
- Salty(x): x is salty
- Contains(x, y): x contains y
- Egg(x): x is an egg

1. ....

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a.  $R(x, y, z)$  and  $R(u, H(v, v), u)$

.....

b.  $R(A, x, F(x))$  and  $R(A, y, y)$

where A is a constant symbol

.....

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Baguette is not a brown bread, and it is bad for diet.
2	0.25	Each shop sells some bread.
3	0.25	Some shop sells no brown bread.
4	0.25	There is no bread that all shop sells.
5	0.5	There is exactly one bread that is good for diet.
6	0.5	Each bread is brown or bad for diet (but both at different times).

using only the given predicates

- Bread(x): x is a bread
- Baguette is a constant
- Brown(x): x is brown
- Diet(x): x is good for diet
- Shop(x): x is a bakery shop
- Sells(x, y): x sells y

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a.  $S(x, G(x), x)$  and  $S(G(u), G(G(z)), z)$

.....

b.  $S(A, B, B)$  and  $S(x, y, z)$

where A and B are constant symbols

.....

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Sunflower seed is healthy or fatty.
2	0.25	Each seed is included in some bread.
3	0.25	Some bread includes no lean seed.
4	0.25	No bread includes all seeds.
5	0.5	There are at least two lean seeds.
6	0.5	Some seed is healthy or fatty (but both at different times).

using only the given predicates

- Bread(x): x is a bread
- Seed(x): x is a seed
- Lean(x): x is lean (not fatty)
- Sunflower is a constant
- Healthy(x): x is healthy
- Includes(x, y): x includes y

1. ....

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4. ....

5. ....

.....

6. ....

.....

# **SOLUTION**

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**Question 1 (1pt)** Find the MGU for each of the following pairs of clauses. If there exists such an MGU, write the substitution  $\theta$ . Otherwise, write No MGU and justify your answer.

- a.  $P(x, F(x, y), G(x, w))$  and  $P(A, F(w, B), G(w, x))$  where A and B are constant symbols

$\theta = \{ x/A, w/A, y/B \}$

- b.  $P(x, F(x), A, A)$  and  $P(y, F(A), y)$  where A is a constant symbol

No MGU. The two predicates have the same name but do not have the same number of arguments.

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Brioche is a creamy bun, yet it does not have eggs.
2	0.25	Every bun is sold in some convenience store.
3	0.25	Some convenience stores do not sell buns having eggs.
4	0.25	No convenience store sells all buns.
5	0.5	Only one convenience store sells Brioche bun.
6	0.5	Some buns are either creamy or has eggs (but not both at the same time).

using only the given predicates

- Store(x): x is a convenience store
- Bun(x): x is a bun
- Creamy(x): x is creamy
- Sells(x, y): x sells y
- Brioche is a constant
- Egg(x): x has eggs.

7.  $Bun(Brioche) \wedge Creamy(Brioche) \wedge \neg Egg(Brioche)$

8.  $\forall x Bun(x) \rightarrow [\exists y Store(y) \wedge Sells(y, x)]$

9.  $\exists x Store(x) \wedge [\forall y Bun(y) \wedge Egg(y) \rightarrow \neg Sells(x, y)]$

10.  $\neg \exists x Store(x) \wedge [\forall y Bun(y) \rightarrow Sells(x, y)]$

11.  $Bun(Brioche) \wedge [\exists x Store(x) \wedge Sells(Brioche, x) \wedge (\forall y Store(y) \wedge \neg (x = y) \rightarrow \neg Sells(Brioche, y))]$

12.  $\exists x Bun(x) \wedge [Creamy(x) \leftrightarrow \neg Egg(x)]$

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- a.  $Q(F(A), G(x))$  and  $Q(y, y)$  where A is a constant symbol

No MGU. We cannot unify y with both F(A) and G(x), these two functions are not unifiable. ....

- b.  $Q(A, x, F(G(y)))$  and  $Q(z, F(z), F(u))$  where A is a constant symbol

$\theta = \{z/A, x/F(A), u/G(y)\}$  .....

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Baozi is a tasty bun, and it is not salty.
2	0.25	Every bun contains some eggs.
3	0.25	Some buns do not contain salty eggs.
4	0.25	No egg is contained in all buns.
5	0.5	Baozi bun contains at least two eggs.
6	0.5	Every egg is either tasty or salty (but not both simultaneously).

using only the given predicates

- Bun(x): x is a bun
- Baozi is a constant
- Tasty(x): x is tasty
- Salty(x): x is salty
- Contains(x, y): x contains y
- Egg(x): x is an egg

1.  $Bun(Baozi) \wedge Tasty(Baozi) \wedge \neg Salty(Baozi)$  .....

2.  $\forall x Bun(x) \rightarrow [\exists y Egg(y) \wedge Contains(x, y)]$  .....

3.  $\exists x Bun(x) \wedge [\forall y Egg(y) \wedge Salty(y) \rightarrow \neg Contains(x, y)]$  .....

4.  $\neg \exists x Egg(x) \wedge [\forall y Bun(y) \rightarrow Contains(y, x)]$  .....

5.  $Bun(Baozi) \wedge [\exists x, y Egg(x) \wedge Egg(y) \wedge Contains(Baozi, x) \wedge Contains(Baozi, y) \wedge \neg (x = y)]$  .....

6.  $\forall x Egg(x) \rightarrow Tasty(x) \leftrightarrow \neg Salty(x)$  .....

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a.  $R(x, y, z)$  and  $R(u, H(v, v), u)$

$\theta = \{x/u, y/H(v, v), u/z\}$  .....

b.  $R(A, x, F(x))$  and  $R(A, y, y)$  where A is a constant symbol

No MGU. We cannot unify y with both x and F(x), which are not unifiable. ....

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Baguette is not a brown bread, and it is bad for diet.
2	0.25	Each shop sells some bread.
3	0.25	Some shop sells no brown bread.
4	0.25	There is no bread that all shop sells.
5	0.5	There is exactly one bread that is good for diet.
6	0.5	Each bread is brown or bad for diet (but both at different times).

using only the given predicates

- Bread(x): x is a bread
- Brown(x): x is brown
- Shop(x): x is a bakery shop
- Baguette is a constant
- Diet(x): x is good for diet
- Sells(x, y): x sells y

1.  $\text{Bread}(\text{Baguette}) \wedge \neg \text{Brown}(\text{Baguette}) \wedge \neg \text{Diet}(\text{Baguette})$  .....

2.  $\forall x \text{ Shop}(x) \rightarrow [\exists y \text{ Bread}(y) \wedge \text{Sells}(x, y)]$  .....

3.  $\exists x \text{ Shop}(x) \wedge [\forall y \text{ Bread}(y) \wedge \text{Brown}(y) \rightarrow \neg \text{Sells}(x, y)]$  .....

4.  $\neg \exists x \text{ Bread}(x) \wedge [\forall y \text{ Shop}(y) \rightarrow \text{Sells}(y, x)]$  .....

5.  $\exists x \text{ Bread}(x) \wedge \text{Diet}(x) \wedge [\forall y \text{ Bread}(y) \wedge \neg (x = y) \rightarrow \neg \text{Diet}(y)]$  .....

6.  $\forall x \text{ Bread}(x) \rightarrow \text{Brown}(x) \leftrightarrow \text{Diet}(x)$  .....



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- a.  $S(x, G(x), x)$  and  $S(G(u), G(G(z)), z)$

No MGU. We cannot unify  $x$  with both  $z$  and  $G(z)$ , which are not unifiable. ....

- b.  $S(A, B, B)$  and  $S(x, y, z)$

where  $A$  and  $B$  are constant symbols

$\theta = \{x/A, y/B, z/B\}$  .....

**Question 2 (2pts)** Translate the following sentences from English to First-order logic.

No.	Score (pt)	Sentence
1	0.25	Sunflower seed is healthy or fatty.
2	0.25	Each seed is included in some bread.
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4	0.25	No bread includes all seeds.
5	0.5	There are at least two lean seeds.
6	0.5	Some seed is healthy or fatty (but both at different times).

using only the given predicates

- Bread(x): x is a bread
- Seed(x): x is a seed
- Lean(x): x is lean (not fatty)
- Sunflower is a constant
- Healthy(x): x is healthy
- Includes(x, y): x includes y

1.  $\text{Seed}(\text{Sunflower}) \wedge [\neg \text{Lean}(\text{Sunflower}) \vee \text{Healthy}(\text{Sunflower})]$  .....

2.  $\forall x \text{ Seed}(x) \rightarrow [\exists y \text{ Bread}(y) \wedge \text{Include}(y, x)]$  .....

3.  $\exists x \text{ Bread}(x) \wedge [\forall y \text{ Lean}(y) \wedge \text{Seed}(y) \rightarrow \neg \text{Contains}(x, y)]$  .....

4.  $\neg \exists x \text{ Bread}(x) \wedge [\forall y \text{ Seed}(y) \rightarrow \text{Contains}(x, y)]$  .....

5.  $\exists x \text{ Seed}(x) \wedge \text{Seed}(y) \wedge \neg (x = y) \wedge \text{Lean}(x) \wedge \text{Lean}(y)$  .....

.....

6.  $\exists x \text{ Seed}(x) \wedge [\text{Healthy}(x) \leftrightarrow \text{Lean}(x)]$  .....

.....