

UD: all people	Bx: x is a bouncer.	Ixyz: x introduced y to z.
a: Alice	Mx: x is a merchant	Kxy: x knows y.
b: Betty	Px: x is a plumber.	Lxy: x likes y.
c: Chris	Tx: x is tall.	Oxy: x is older than y.

46. Betty is the only person Chris likes.

47. Chris doesn't like anyone other than Betty.

48. Every merchant likes someone whom Betty doesn't know.

49. If anyone doesn't know themselves, it's Alice.

50. No tall merchants other than Chris are older than Betty.

51. Not every plumber who knows at least one merchant is tall.

52. Even though he's a tall merchant, Chris doesn't know any other tall merchants.

53. Chris only likes plumbers who like Betty.

54. Alice doesn't like anyone other than Chris and Betty.

55. Chris is a merchant, and the only tall person Betty knows.

56. Unless Betty knows a plumber, everyone other than her is tall.

57. If any bouncer likes Chris, it's either Alice or Betty.

58. Not every plumber introduced someone to Alice.

59. Someone older than Betty knows and doesn't like every merchant.

60. Only people who've been introduced to someone by Betty like Alice.

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c: Chris	Tx: x is tall.	Oxy: x is older than y.

61. The only merchant Betty likes is tall.

62. Alice doesn't know anyone other than Betty and Chris.

63. No merchant knows anyone older than Alice.

64. Chris likes every merchant, unless they're Betty.

65. Everyone younger than Alice knows a plumber.

66. Chris is a bouncer who's been introduced to everyone he knows by Alice.

67. No one who's not tall likes Alice.

68. Every merchant knows Chris, unless they're older than Alice.

69. Anyone who's older than Alice is a tall bouncer.

70. No tall merchants like anyone Betty likes.

71. Alice likes the only person who likes her.

72. Everyone other than Betty likes Chris.

73. If anyone likes every plumber, Chris knows Betty.

74. Unless they're also tall, no plumber is older than Alice.

75. Alice and Chris both like everyone older than Betty.

## Answers

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46. Betty is the only person Chris likes.  
 $\forall x(Lcx \leftrightarrow x = b)$
47. Chris doesn't like anyone other than Betty.  
 $\forall x(Lcx \rightarrow x = b)$   
 $\neg \exists x(Lcx \ \& \ \neg x = b)$
48. Every merchant likes someone whom Betty doesn't know.  
 $\forall x(Mx \rightarrow (x \text{ likes someone whom Betty doesn't know}))$   
 $\forall x(Mx \rightarrow \exists y(Lxy \ \& \ \neg Kby))$
49. If anyone doesn't know themselves, it's Alice.  
 If a person doesn't themselves, that person is Alice.  
 $\forall x(\neg Kxx \rightarrow x = a)$
50. No tall merchants other than Chris are older than Betty.  
 $\neg \exists x(Tx \ \& \ Mx \ \& \ \neg x = c \ \& \ Oxb)$   
 If a person is a tall merchant who is older than Betty, that person is Chris.  
 $\forall x((Tx \ \& \ Mx \ \& \ Oxb) \rightarrow x = c)$   
 If a person is a tall merchant other than Chris, they're not older than Betty.  
 $\forall x((Tx \ \& \ Mx \ \& \ \neg x = c) \rightarrow \neg Oxb)$
51. Not every plumber who knows at least one merchant is tall.  
 $\neg \forall x([Px \ \& \ (x \text{ knows at least one merchant})] \rightarrow Tx)$   
 $\neg \forall x([Px \ \& \ \exists y(Kxy \ \& \ My)] \rightarrow Tx)$
52. Even though he's a tall merchant, Chris doesn't know any other tall merchants.  
 $Tc \ \& \ Mc \ \& \ \neg \exists x(Kcx \ \& \ Tx \ \& \ Mx \ \& \ \neg x = c)$   
 $Tc \ \& \ Mc \ \& \ \forall x[(Kcx \ \& \ Tx \ \& \ Mx) \rightarrow x = c]$
53. Chris only likes plumbers who like Betty.  
 $\forall x(Lcx \rightarrow (Px \ \& \ Lxb))$
54. Alice doesn't like anyone other than Chris and Betty.  
 $\neg \exists x(Lax \ \& \ \neg x = c \ \& \ \neg x = b)$
55. Chris is a merchant, and the only tall person Betty knows.  
 $Mc \ \& \ \forall x((Tx \ \& \ Kbx) \leftrightarrow x = c)$
56. Unless Betty knows a plumber, everyone other than her is tall.  
 $\exists x(Px \ \& \ Kbx) \vee \forall x(\neg x = b \rightarrow Tx)$
57. If any bouncer likes Chris, it's either Alice or Betty.  
 $\forall x((Bx \ \& \ Lxc) \rightarrow (x = a \vee x = b))$
58. Not every plumber introduced someone to Alice.  
 $\neg \forall x(Px \rightarrow (x \text{ introduced someone to Alice}))$   
 $\neg \forall x(Px \rightarrow \exists y(Ixya))$

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59. Someone older than Betty knows and doesn't like every merchant.  
 $\exists x[Oxb \ \& \ (x \text{ knows and doesn't like every merchant})]$   
 $\exists x[Oxb \ \& \ \forall y(My \rightarrow (Kxy \ \& \ \neg Lxy))]$
60. Only people who've been introduced to someone by Betty like Alice.  
 $\forall x(Lxa \rightarrow (x \text{ has been introduced to someone by Betty}))$   
 $\forall x(Lxa \rightarrow \exists y(Ibxy))$
61. The only merchant Betty likes is tall.  
 $\exists x((x \text{ is the only merchant Betty likes}) \ \& \ Tx)$   
 $\exists x(\forall y[(My \ \& \ Lby) \leftrightarrow y = x] \ \& \ Tx)$
62. Alice doesn't know anyone other than Betty and Chris.  
 $\neg \exists x(Kax \ \& \ \neg x = b \ \& \ \neg x = c)$   
 $\forall x(Kax \rightarrow (x = b \vee x = c))$
63. No merchant knows anyone older than Alice.  
 $\neg \exists x(Mx \ \& \ (x \text{ knows someone older than Alice}))$   
 $\neg \exists x(Mx \ \& \ \exists y(Kxy \ \& \ Oya))$
64. Chris likes every merchant, unless they're Betty.  
 $\forall x(Mx \rightarrow (Lcx \vee x = b))$
65. Everyone younger than Alice knows a plumber.  
 $\forall x(Oax \rightarrow (x \text{ knows a plumber}))$   
 $\forall x(Oax \rightarrow \exists y(Py \ \& \ Kxy))$
66. Chris is a bouncer who's been introduced to everyone he knows by Alice.  
 $Bc \ \& \ \forall x(Kcx \rightarrow Iacx)$
67. No one who's not tall likes Alice.  
 $\neg \exists x(\neg Tx \ \& \ Lxa)$   
 $\forall x(Lxa \rightarrow Tx)$
68. Every merchant knows Chris, unless they're older than Alice.  
 $\forall x(Mx \rightarrow (Kxc \vee Oxa))$
69. Anyone who's older than Alice is a tall bouncer.  
 $\forall x(Oxa \rightarrow (Tx \ \& \ Bx))$
70. No tall merchants like anyone Betty likes.  
 $\neg \exists x(Tx \ \& \ Mx \ \& \ (x \text{ likes someone Betty likes}))$   
 $\neg \exists x(Tx \ \& \ Mx \ \& \ \exists y(Lxy \ \& \ Lby))$
71. Alice likes the only person who likes her.  
 There's only one person who likes Alice, and Alice likes them.  
 $\exists x((x \text{ is the only person who likes Alice}) \ \& \ Lax)$   
 $\exists x(\forall y(Lya \leftrightarrow y = x) \ \& \ Lax)$
72. Everyone other than Betty likes Chris.  
 $\forall x(\neg x = b \rightarrow Lxc)$

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c: Chris	Tx: x is tall.	Oxy: x is older than y.

73. If anyone likes every plumber, Chris knows Betty.

$\exists x(x \text{ likes every plumber}) \rightarrow Kcb$

$\exists x(\forall y(Py \rightarrow Lxy)) \rightarrow Kcb$

74. Unless they're also tall, no plumber is older than Alice.

There's no plumber who's older than Alice and isn't tall.

$\neg \exists x(Px \ \& \ Oxa \ \& \ \neg Tx)$

75. Alice and Chris both like everyone older than Betty.

$\forall x(Oxb \rightarrow (Lax \ \& \ Lcx))$