

CSE 015: Discrete Mathematics  
Fall 2021  
Homework #2  
Solution

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**1. Question 1:**

- (a)  $P(2)$  True ( $2 < 2^3$ )
- (b)  $P(-1)$  False ( $-1 < -1$ )
- (c) False  $\forall x P(x)$  ( $-1 < -1$ ), ( $1 < 1$ )
- (d)  $\exists x P(x)$  True for any number  $x > 1$  and  $x < -1$
- (e)  $\exists! x P(x)$  False, there is more than one value of  $x$  that makes the statement true

**2. Question 2:**

- (a)  $\neg \forall x (S(x) \wedge M(x))$
- (b)  $\exists x (S(x) \vee M(x)) \wedge \neg \exists x (S(x) \wedge M(x))$
- (c)  $\exists x (S(x) \wedge \neg M(x))$

**3. Question 3:**

$$\forall x (A(x) \wedge B(x)) \equiv \forall x (A(x) \rightarrow B(x))$$

No, this is not a logical equivalence.

$A(x)$	$B(x)$	$A(x) \wedge B(x)$	$A(x) \rightarrow B(x)$
F	F	F	T
F	T	F	T
T	F	F	F
T	T	T	T

**4. Question 4:**

- (a) True. When  $x = 0$  and any value of  $y$ .
- (b) True. When  $x = 0$  and  $y = 0$ .
- (c) True. When  $x = R$  and  $y = 0$ .
- (d) False.  $A(x,y)$  is true from the formula from a) but  $B(x,y)$  is only true when  $x$  and  $y$  equal zero.

- (e) True. For  $A(x,y)$ ,  $x$  or  $y$  can equal zero and the statement be true. For  $\neg B(x,y)$ , there exists multiple value for  $x$  and  $y$  that does not equal zero.

**Question 5:**

(a)  $\exists x \exists y (P(x) \rightarrow Q(y))$

Negation:  $\forall x \forall y (P(x) \wedge \neg Q(y))$

(b)  $\exists y (\exists x A(x,y) \vee \forall x B(x,y))$

Negation:  $\forall y (\forall x \neg A(x,y) \wedge \exists x \neg B(x,y))$