

Ensure that you follow submission guidelines as specified in the study guide regarding naming of the document, font size etc.

**Question 1****(8)****1.1 Epp Exercise 1.2 9c, d, e, h (4)**

9c No; it is a subset, not an element

9d Yes

9e Yes

9h No; it does not appear in the set (in the set 1 is in brackets), i.e. a set

**1.2 Epp Exercise 1.2 12a and b (4)**

$S = \{2, 4, 6\}$ ,  $T = \{1, 3, 5\}$

12a.  $S \times T = \{(2,1), (2,3), (2,5), (4,1), (4,3), (4,5), (6,1), (6,3), (6,5)\}$  ( 9 elements)

$T \times S = \{(1,2), (1,4), (1,6), (3,2), (3,4), (3,6), (5,2), (5,4), (5,6)\}$  (also 9 elements)

**Note that  $S \times T$  is NOT the same as  $T \times S$  since the ordering in the pairs is NB**

**Question 2****(12)****2.1 Epp Exercise 1.3 2 (7)**

2a.

$C = D = \{-3, -2, -1, 0, 1, 2, 3\}$

$2 \leq 2$  true;  $\frac{1}{2} - \frac{1}{2} = 0$  and 0 is an integer (½)

$-1 \leq -1$  true;  $\frac{1}{-1} - \frac{1}{-1} = 0$  (½)

$(3,3) \in S$  true; since  $\frac{1}{3} - \frac{1}{3} = 0$  (½)

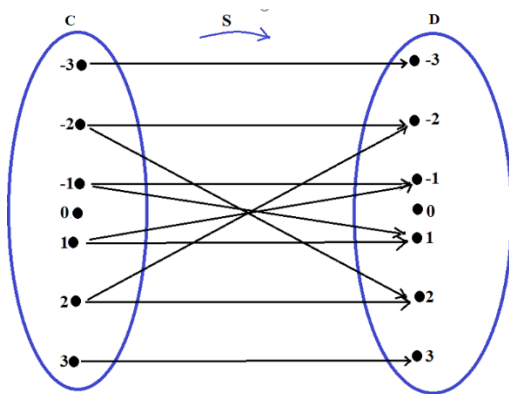
$(3,-3) \in S$  false; since  $\frac{1}{3} - \frac{1}{-3} = \frac{2}{3}$  which is not an integer (½)

2b. Note that each of the combinations where  $x=y$  would give a 0, except for  $x=0$  which is not allowed. Further, the  $(1,-1)$  and  $(-1,1)$  combinations added up to 2 and -2 respectively. The last interesting one is the combination of  $(2,-2)$  and  $(-2,2)$  which gave  $\frac{1}{2} - \frac{1}{-2}$  giving 1 and  $\frac{1}{-2} - \frac{1}{2}$  giving -1

$$S = \{ (-3,-3), (-2,-2), (-1,-1), (1,1), (2,2), (3,3), (-1,1), (1,-1), (2,-2), (-2,2) \} \quad (2)$$

$$2c \text{ Domain} = \{-3, -2, -1, 0, 1, 2, 3\}; \text{co-domain} = \{-3, -2, -1, 0, 1, 2, 3\} \quad (1)$$

2d Arrow diagram (2)



(not asked, but this is not a function – can you say why?)

## 2.2 Epp Exercise 1.3 12 (2)

$$(x,y) \in T \text{ means that } y^2 - x^2 = 1$$

**Not a function**, for example  $x = -1$  can map to  $y = \sqrt{2}$  and  $-\sqrt{2}$

OR

$$y^2 = x^2 + 1$$

$$\Rightarrow y = \pm \sqrt{x^2 + 1} \quad \text{taking square root both sides}$$

(substitute for example  $x = 1$  in this equation; this then gives two values for  $y$ )

OR

Draw graph of function; note that vertical line will cross graph in more than one place.

## 2.3 Epp Exercise 1.3 14 (3)

$$14a \text{ Domain of } G = \{1, 2, 3, 4\} \quad (1); \text{co-domain of } G = \{a, b, c, d\} \quad (1)$$

$$G(1) = c; G(2) = c; G(3) = c; G(4) = c \quad (1)$$

(Note this **is a function**, even though all values in domain map to same value  $c$  in codomain)

**Question 3****(10)****3.1 Epp Exercise 6.1 12a-e and i****(6)**

$$12a \ A \cup B = \{x \in R \mid -3 \leq x < 2\}$$

$$12b \ A \cap B = \{x \in R \mid -1 < x \leq 0\}$$

$$12c \ A^c = \{x \in R \mid x < -3 \text{ or } x > 0\}$$

$$12d \ A \cup C = \{x \in R \mid -3 \leq x \leq 0 \text{ or } 6 < x \leq 8\}$$

$$12e \ A \cap C = \emptyset$$

$$12i \ (A \cap B)^c = \{x \in R \mid x \leq -1 \text{ or } x > 0\}$$

**3.2 Epp Exercise 6.1 20****(4)**

$$20a \ \{x \in R \mid 0 \leq x \leq 4\} \quad (1)$$

$$20b \ \{x \in R \mid 0 \leq x \leq 1\} \quad (2)$$

20c No – they have overlapping elements, as indicated by the intersection that is not empty (Mutually disjoint means there are no common elements) (1)

**Question 4****(15)**

Study the following set of tables (for which only a small subset of records are shown):

| Table 1 Cellphone |            |                   |
|-------------------|------------|-------------------|
| Cellno            | CustomerId | ContractStartDate |
| 0829996113        | 22222      | 2021-01-12        |
| 0842346455        | 33333      | 2020-03-18        |
| 0829996113        | 55555      | 2019-04-18        |

| Table 2 Cellphone_Call |            |            |       |          |
|------------------------|------------|------------|-------|----------|
| Cellno                 | To         | Date       | Time  | Duration |
| 0829996113             | 0125672566 | 2021-02-02 | 08:00 | 45       |
| 0829996113             | 0125672566 | 2021-02-02 | 09:15 | 50       |
| 0829996113             | 0125672566 | 2021-02-02 | 14:35 | 23       |
| 0842346455             | 0841752345 | 2021-02-04 | 14:30 | 30       |

**4.1 Use set notation and write down the records (tuples) of each table as elements in a set. Use set names C for the table CellPhone and A for the table CellPhone\_call. (2)**

$C = \{(0829996113, 22222, 2021-01-12), (0842346455, 33333, 2020-03-18), (0829996113, 55555, 2019-04-18)\}$

$A = \{(0829996113, 0125672566, 2021-02-02, 08:00, 45), (0829996113, 0125672566, 2021-02-02, 09:15, 50), (0829996113, 0125672566, 2021-02-02, 14:35, 23), (0842346455, 0841752345, 2021-02-04, 14:30, 30)\}$

**4.2 Identify a suitable Primary Key or Composite key for Cellphone\_Call. Motivate your answer.**

**PK** Duration or Time (both of these are unique (not a very good question!))

**OR** (Composite Key)

Cellno x To x Date x Time (in set theory, this is correct notation)

**OR**

In Database theory (cellno, to, date, time)

Reason: We need all four of these attributes to arrive at a unique combination (1)

**4.3 Write down the contents of the set  $C \times A$ . Call this new set  $CA$ . (3)**

$CA = \{$

((0829996113,22222, 2021-01-12), (0829996113,0125672566, 2021-02-02, 08:00, 45)),  
((0829996113,22222, 2021-01-12) (0829996113,0125672566, 2021-02-02, 09:15, 50)),  
((0829996113,22222, 2021-01-12) (0829996113,0125672566, 2021-02-02, 14:35, 23)),  
((0829996113,22222, 2021-01-12) (0842346455, 0841752345, 2021-02-04, 14:30, 30)),  
(( 0842346455,33333, 2020-03-18), (0829996113,0125672566, 2021-02-02, 08:00, 45)),  
((0842346455,33333, 2020-03-18), (0829996113,0125672566, 2021-02-02, 09:15, 50)),  
((0842346455,33333, 2020-03-18), (0829996113,0125672566, 2021-02-02, 14:35, 23)),  
((0842346455,33333, 2020-03-18), (0842346455, 0841752345, 2021-02-04, 14:30, 30)),  
((0829996113,55555, 2019-04-18), (0829996113,0125672566, 2021-02-02, 08:00, 45)),  
((0829996113,55555, 2019-04-18), (0829996113,0125672566, 2021-02-02, 09:15, 50)),  
((0829996113,55555, 2019-04-18), (0829996113,0125672566, 2021-02-02, 14:35, 23)),  
((0829996113,55555, 2019-04-18), (0842346455, 0841752345, 2021-02-04, 14:30, 30))  
 $\}$

**4.4 Write down the contents of the resulting set when the projection  $P_{1,5}$  is applied to  $A$ . (2)**

$P_{1,5}$  of  $A = \{(0829996113, 45), (0829996113, 50), (0829996113, 23), (0842346455,30)\}$

**4.5 Assume  $C_1$  is the condition "Cellno = '0829996113' ". Write down the resulting set (call it  $F$ ) when  $S_{C_1}$  is applied to  $A$ . (2)**

$F = \{(0829996113,0125672566, 2021-02-02, 08:00, 45), (0829996113,0125672566, 2021-02-02, 09:15, 50), (0829996113,0125672566, 2021-02-02, 14:35, 23)\}$

**4.6 Write down the resulting set  $CC$  when the Join operator  $J_1$  is applied to  $C$  and  $A$ . (2)**

*Remark: The original sets are not in the correct format to apply the Join operator. According to the definition, Cellno should be the last column in the first set, and the first column in the second set.*

BUT here is a solution that satisfies the J condition (**ordering of elements as always not important**)

```
CC = {(0829996113,22222, 2021-01-12, 0125672566, 2021-02-02, 08:00, 45),  
(0829996113, 22222, 2021-01-12, 0125672566, 2021-02-02, 09:15, 50),  
(0829996113,22222, 2021-01-12,0125672566, 2021-02-02, 14:35, 23),  
( 0842346455,33333, 2020-03-18, 0841752345, 2021-02-04, 14:30, 30),  
(0829996113,55555, 2019-04-18,0125672566, 2021-02-02, 08:00, 45),  
(0829996113,55555, 2019-04-18, 0125672566, 2021-02-02, 09:15, 50),  
(0829996113,55555, 2019-04-18, 0125672566, 2021-02-02, 14:35, 23)  
}
```

**4.7 What is the difference between CC and CA? Give at least two differences. (2)**

CA contains 12 tuples (elements), whereas CC contains only 7.

CA contains 2 sets of ordered attributes (3 and 5) in each tuple, whereas CC contains only 7.