MTH4113 / MTH4213 - NUMBERS, SETS AND FUNCTIONS - 2021/22

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QUESTION 2

Not yet answered Marked out of 10

Suppose A,B and $C\,$ are finite sets of real numbers.

Decide whether each of the following is a set, a number, a statement or meaningless.

A + C	\$			
$A\cup (B\cap C)$		\$		
$B=\{n\in\mathbb{N}:r$	$n+1\in A\}$			¢
$A\cap B$ is disjoint	t	¢		
$((A \cup B) \cup C)$			÷	

QUESTI	ON 3		
True or fa	ilse?		
$25\mathrm{is}\mathrm{a}\mathrm{fa}$	ctor of 5. 🔶		
4 0.	\$		
If a, b, c	$\in \mathbb{Z}$ and $a \mid b$ and $b \mid c$,	then $c \mid a$.	\$
If $a\in\mathbb{Z}$:	and $6 mid a$, then $3 mid a$.	\$	
If $a,b\in \mathbb{R}$	$\mathbb N$, then $\operatorname{lcm}(a^2,b^2)=1$	$\operatorname{lcm}(a,b)^2$.	\$

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QUESTION 5 Not yet answered Marked out of 15 Decide whether each of the following functions is injective and/or surjective. f is injective but not surjective f is surjective but not injective f is nother injective and surjective f is nother injective nor surjective. g is injective but not surjective g is injective but not surjective g is injective but not surjective g is injective but not injective g is surjective but not injective g is neither injective and surjective g is neither injective on surjective. h : $\mathbb{N} \to \mathbb{N}$ defined by h : $\mathbb{N} = \mathbb{N}$ defined by h : $\mathbb{N} = \mathbb{N}$ defined by h : \mathbb{N} is s	Let A and B be finite sets satisfying $ A = 6$, $ B = 7$ and $ A \cap B = 2$. Calculate the following: $\binom{ A }{3} =$ $ A \cup B =$ The number of non-empty subsets of B is $ \{S : S \subseteq A, S = 3 \text{ and } S \cap B = \emptyset\} =$ $\max \{ S : S \subseteq A \cup B, S \cap A \text{ is even and } S \cap B \text{ is even}\} =$				
Decide whether each of the following functions is injective and/or surjective. $f: \mathbb{N} \to \mathbb{N} \text{ defined by } f(n) = 2n.$ $\bigcirc f \text{ is injective but not surjective}$ $\bigcirc f \text{ is surjective but not surjective}$ $\bigcirc f \text{ is subin higher or surjective}$ $g: \mathbb{R} \times \mathbb{R} \to \mathbb{R} \times \mathbb{R} \text{ defined by } f(m, n) = (m^2, m + n).$ $\bigcirc g \text{ is injective but not surjective}$ $\bigcirc g \text{ is surjective but not surjective}$ $\bigcirc g \text{ is surjective but not surjective}$ $\bigcirc g \text{ is injective and surjective}$ $\bigcirc g \text{ is neither injective and surjective}$ $h: \mathbb{N} \to \mathbb{N} \text{ defined by}$ $h(n) = \text{the number of digits of } n^2.$ $\bigcirc h \text{ is neither injective and surjective}$ $\bigcirc h \text{ is neither injective and surjective}$	QUESTION 5		Not yet answered	d Marked o	ut of 15
$\begin{array}{l} f:\mathbb{N}\to\mathbb{N}\ defined\ by\ f(n)=2n.\\ \bigcirc\ f\ is\ surjective\ but\ not\ surjective\\ \bigcirc\ f\ is\ surjective\ but\ not\ surjective\\ \bigcirc\ f\ is\ sub\ injective\ nor\ surjective.\\ \end{array}$	Decide whether each of the following functions is injective and/or surjective.				
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○ <i>f</i> is surjective but not injective ○ <i>f</i> is both injective and surjective. 9 : $\mathbb{R} \times \mathbb{R} \to \mathbb{R} \times \mathbb{R}$ defined by $f(m, n) = (m^2, m + n)$. ○ <i>g</i> is injective but not surjective ○ <i>g</i> is surjective but not injective ○ <i>g</i> is surjective but not injective ○ <i>g</i> is both injective and surjective. <i>h</i> : $\mathbb{N} \to \mathbb{N}$ defined by <i>h</i> (<i>n</i>) = the number of digits of n^2 . ○ <i>h</i> is injective but not surjective ○ <i>h</i> is surjective but not surjective ○ <i>h</i> is surjective but not surjective ○ <i>h</i> is neither injective and surjective ○ <i>h</i> is neither injective nor surjective.	$\circ f$ is injective but not surjective				
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	h is both injective and surjective				

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QUESTION 6				Not yet answered Marked out of 15
Find the supremum of each of the following $\{4, 1, 2, 3\}$ $\{(x-1)^2 : x \in \mathbb{R}, \ 0 \leqslant x < 2\}$ $\left\{\frac{n^2}{4} : n \in \mathbb{Z}\right\}$ $\left\{\frac{n+1}{n} : n \in \mathbb{N}\right\}$	sets. (If the supremum is infinite, enter the word "infinity	'. If it is a real number, round it to 1 o	decimal place.)	
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Use Euclid's algorithm to find the greatest common divisor of 52 and 80. Hence find the lowest common multiple of 52 and 80.	
Upload a PDF of your solution. Show your working clearly as well as giving the answer.	
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QUESTION 8	Not yet answered Marked out of 1
Give a proof by induction of the following statement.	
f n is a positive integer, then $m = m(2m + 7)$	
$\sum_{n=1}^{\infty} (3n+2) = \frac{n(3n+1)}{2}.$	
(Upload your written proof in PDF format.)	
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$QM_{\text{Su}}^{\text{Priss}}$

QUESTION 9

Here's an incorrect theorem with an incorrect proof.

Not yet answered Marked out of 5

Theorem: There is no rational number x such that 1 < x <

Proof: We use proof by contradiction. So su	ppose there are rational numbers between 1 and 2, and let x be the smallest one. Because x is rational, we can write $x = \frac{a}{b}$ where a and b are integers.
Now let $y = \frac{1}{2}$. Then $y = \frac{1}{2b}$, so y is rational that $x > 1$ gives $x + 1 > 1$	ional. 2. which implies that $y > 1$. The assumption that $x > 1$ also gives $2x > x + 1$, which implies that $y < x$.
But now y is a rational number between 1 a	id 2 which is smaller than x . This contradicts the assumption that x was the smallest one. So the theorem is true using proof by commtradiction. \Box .
Explain in a few sentences what's wrong wit	the proof. (You can either type your answer in the box or upload a scan of your written answer as a PDF.)
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