

Math 330 - 03 Homework (Fall 2018)

- LaTeX-ed solutions are encouraged and appreciated.
 - If you use LaTeX, hand-in a printed version of your homework.
 - You are encouraged to discuss homework problems with classmates, but such discussions should NOT include the exchange of any written material.
 - Writing of homework problems should be done on an individual basis.
 - References to results from the textbook and/or class notes should be included.
 - The following lists should be considered partial and tentative lists until the word complete appears next to it.
 - Use 8.5in x 11in paper with smooth borders. Write your **name** on top of **each page**. Staple all pages.
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$\newcommand{\aut}{\text{Aut}} \newcommand{\sub}{\text{Sub}} \newcommand{\join}{\vee}
\newcommand{\bigjoin}{\bigvee} \newcommand{\meet}{\wedge} \newcommand{\bigmeet}{\bigwedge}
\newcommand{\normaleq}{\unlhd} \newcommand{\normal}{\lhd} \newcommand{\union}{\cup}
\newcommand{\intersection}{\cap} \newcommand{\bigunion}{\bigcup}
\newcommand{\bigintersection}{\bigcap} \newcommand{\sq}[2][\ ]{\sqrt{\#1}{\#2\,}}
\newcommand{\pbr}[1]{\angle \#1\angle} \newcommand{\ds}{\displaystyle} \newcommand{\C}{\mathbb{C}}
\newcommand{\R}{\mathbb{R}} \newcommand{\Q}{\mathbb{Q}} \newcommand{\Z}{\mathbb{Z}}
\newcommand{\N}{\mathbb{N}} \newcommand{\A}{\mathbb{A}} \newcommand{\F}{\mathbb{F}}
\newcommand{\T}{\mathbb{T}} \newcommand{\ol}[1]{\overline{\#1}} \newcommand{\imp}{\rightarrow}
\newcommand{\rimp}{\leftarrow} \newcommand{\pinfty}{1/p^{\infty}} \newcommand{\power}{\mathcal{P}}
\newcommand{\calL}{\mathcal{L}} \newcommand{\calC}{\mathcal{C}} \newcommand{\calN}{\mathcal{N}}
\newcommand{\calB}{\mathcal{B}} \newcommand{\calF}{\mathcal{F}} \newcommand{\calR}{\mathcal{R}}
\newcommand{\calS}{\mathcal{S}} \newcommand{\calU}{\mathcal{U}} \newcommand{\calT}{\mathcal{T}}
\newcommand{\gal}{\text{Gal}} \newcommand{\isom}{\approx} \newcommand{\glb}{\text{glb}} $

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Problem Set 11 (complete) Due: 11/12/2018. Board presentation: 11/16/2018

1. Prove the following corollary to Prop. 10.4
Corollary: $\text{glb}(\mathbb{R}^+) = 0$.
2. Prove Prop. 10.7
3. Prove Prop. 10.10.iii
4. Prove Prop. 10.13.ii

Problem Set 10 (complete) Due: 11/05/2018. Board presentation: 11/14/2018

1. Let $f: A \rightarrow B$ and $g: B \rightarrow C$ be functions.
 - I. If $g \circ f$ is injective, then f is injective.
 - II. If $g \circ f$ is surjective, then g is surjective.
2. Construct examples of functions $f: A \rightarrow B$ and $g: B \rightarrow C$ such that:
 - I. $g \circ f$ is injective, but g is not injective.
 - II. $g \circ f$ is surjective, but f is not surjective.
3. Prove Prop. 9.15 (Hint: induction)
4. Prove Prop. 9.18

Problem Set 09 (complete) Due: 10/29/2018. Board presentation: 11/05/2018

1. Prove Prop. 8.40.ii
2. Prove Prop. 8.41
3. Prove Prop. 8.50
4. Give examples of subsets of \mathbb{R} which are:
 - I. bounded below and above,
 - II. bounded below, but not bounded above,
 - III. bounded above, but not bounded below,
 - IV. not bounded above or below.

Problem Set 08 (complete) Due: 10/22/2018. Board presentation: 10/31/2018

1. Prove Prop. 6.16
2. Prove Prop. 6.17
3. Prove Prop. 6.25 (first part)
4. Use Euclid's Lemma to prove the following corollary. Let p be a prime, $k \in \mathbb{N}$, $m_1, m_2, \dots, m_k \in \mathbb{N}$. If $p \mid (m_1 m_2 \cdots m_k)$ then there is some i with $1 \leq i \leq k$ such that $p \mid m_i$. (Hint: Use induction on k).

Problem Set 07 (complete) Due: 10/15/2018. Board presentation: 10/31/2018

1. Let A be a set, and \sim an equivalence relation on A . Let A/\sim be the partition consisting of all equivalence classes of \sim . Let $\Theta_{(A/\sim)}$ be the equivalence relation induced by the partition A/\sim . Prove that $\Theta_{(A/\sim)} = \sim$.
2. Do Project 6.8.iv.

Problem Set 06 (complete) Due: 10/08/2018. Board presentation: 10/31/2018

1. Prove that set union is associative.
2. Show, by counterexample, that set difference is not associative.
3. Prove Prop. 5.20.ii
4. Let X and Y be sets. Let $\mathcal{P}(X)$ denote the power set of X . Prove that: $[X \subseteq Y \iff \mathcal{P}(X) \subseteq \mathcal{P}(Y)]$
5. (challenge) Prove that symmetric difference is associative.

Problem Set 05 (complete) Due: 10/01/2018. Board presentation: 10/05/2018

1. Prove Prop. 4.6.iii
2. Prove Prop. 4.11.ii
3. Prove Prop. 4.15.i
4. Prove Prop. 4.16.ii

Problem Set 04 (complete) Due: 09/17/2018. Board presentation: 09/21/2018

1. Prove Prop. 2.38 (appendix)
2. Prove Prop. 2.41.iii (appendix)

Problem Set 03 (complete) Due: 09/12/2018. Board presentation: 09/17/2018

1. Prove that for all $k \in \mathbb{N}$, $k^2 + k$ is divisible by 2.
2. Prove Prop. 2.18.iii
3. Prove Prop. 2.21. Hint: use proof by contradiction.
4. Prove Prop. 2.23. Show, by counterexample, that the statement is not true if the hypothesis $m, n \in \mathbb{N}$ is removed.
5. Fill-in the blank and prove that for all $k \geq \underline{\quad}$, $k^2 < 2^k$.

Problem Set 02 (complete) Due: 09/05/2018. Board presentation: 09/10/2018

1. Prove Prop. 1.24
2. Prove Prop. 1.27.ii,iv
3. Prove Prop. 2.7.i,ii
4. Prove Prop. 2.12.iii

Problem Set 01 (complete) Due: 08/27/2018. Board presentation: 08/31/2018

1. Prove Prop. 1.7
2. Prove Prop. 1.11.iv
3. Prove Prop. 1.14
4. Prove that $1 + 1 \neq 1$. (Hint: assume otherwise, and get a contradiction).
Can you prove that $1 + 1 \neq 0$?

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