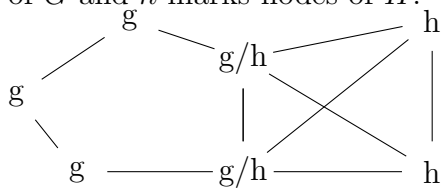
CS 173, Spring 19 Examlet 7, white

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (11 points) If G is a graph, recall that $\chi(G)$ is its chromatic number. Suppose that G is a graph with at least one edge and H is another graph with at least one edge, not connected to G. Now, pick a specific edge e from G and an edge f from H and merge the two edges, creating a combined graph T. For example, suppose that G is C_5 and H is K_4. Then T might look as follows, where g marks nodes of G and h marks nodes of H.



Describe how $\chi(T)$ is related to $\chi(G)$ and $\chi(H)$, justifying your answer. Your answer should handle any choice for G and H.

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{i=1}^{p-1} i$ $\frac{p(p-1)}{2}$ ☐ $\frac{(p-1)^2}{2}$ ☐ $\frac{p(p+1)}{2}$ ☐ $\frac{(p-1)(p+1)}{2}$ ☐

Leal team's bridge held 100 pounds without collapsing. 100 pounds is ____ on how much the bridge can hold.

an upper bound on ☐ exactly ☐

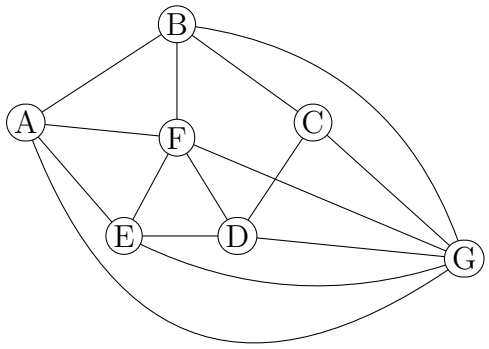
a lower bound on ☐ not a bound on ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a graph containing a C_7. ≥ 2 ☐ ≥ 3 ☐ ≤ 3 ☐ can't tell ☐

$\sum_{i=1}^{p-1} i$ $\frac{(p-1)^2}{2}$ ☐ $\frac{(p-1)(p+1)}{2}$ ☐ $\frac{p(p+1)}{2}$ ☐ $\frac{p(p-1)}{2}$ ☐

$\tau \leq 1.3$ an upper bound on τ ☐ exactly τ ☐

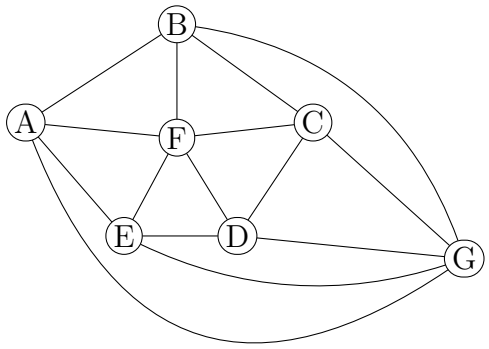
a lower bound on τ ☐ not a bound on τ ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a graph containing a W_n. ≤ 3 ☐ ≥ 3 ☐ $\geq n$ ☐ can't tell ☐

$\sum_{i=1}^{p-1} \frac{i}{p}$ $\frac{p(p-1)}{2}$ ☐ $\frac{p(p+1)}{2}$ ☐ $\frac{(p+1)}{2}$ ☐ $\frac{(p-1)}{2}$ ☐

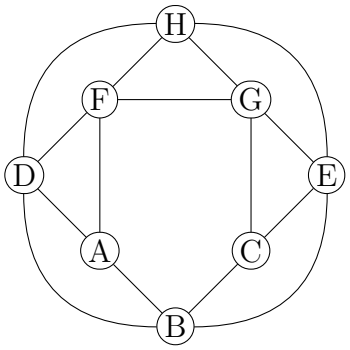
Putting 10 people in the canoe caused it to sink. 10 is ____ how many people the canoe can carry. an upper bound on ☐ exactly ☐ a lower bound on ☐ not a bound on ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of an connected acyclic graph with 5 nodes. ≤ 2 ☐ $= 2$ ☐ ≤ 5 ☐ can't tell ☐

$\sum_{i=0}^{k-1}(k \cdot i + 2)$

$\frac{k^2(k+1)}{2} + 2k$ ☐ $\frac{k(k+1)}{2} + 2(k-1)$ ☐

$\frac{k^2(k-1)}{2} + 2k$ ☐ $\frac{k(k-1)}{2} + 2(k-1)$ ☐

$\pi \geq 1.3$

an upper bound on π ☐ exactly π ☐

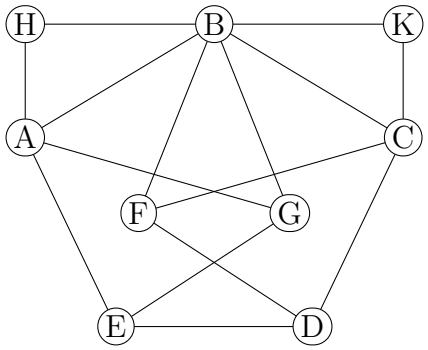
a lower bound on π ☐ not a bound on π ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a connected graph with 10 nodes. ≤ 2 ☐ $= 2$ ☐ ≥ 2 ☐ can't tell ☐

$\sum_{k=-2}^{n} k^2$ $\sum_{p=0}^{n+2}(p+2)^2$ ☐ $\sum_{p=0}^{n-2}(p-2)^2$ ☐ $\sum_{p=0}^{n+2}(p-2)^2$ ☐ $\sum_{p=0}^{n+2} p^2$ ☐

We have 30 tablespoons of filling. Each bun requires exactly one tablespoon of filling. 30 is ____ on how many buns we can make.

an upper bound on ☐ exactly ☐

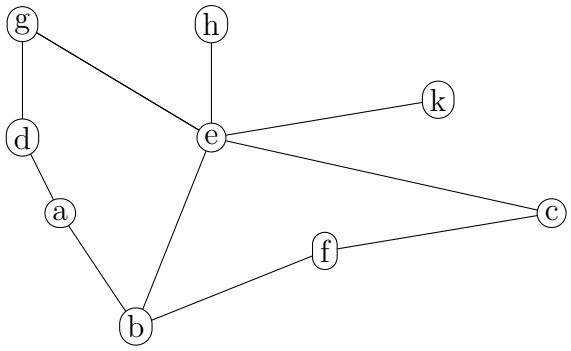
a lower bound on ☐ not a bound on ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a graph containing a W_7. ≥ 3 ☐ ≥ 4 ☐ ≥ 7 ☐ can't tell ☐

$\sum_{k=1}^{n} k!$ $\sum_{p=0}^{n+1}(p+1)!$ ☐ $\sum_{k=0}^{n+1}(k-1)!$ ☐ $\sum_{k=0}^{n-1}(k+1)!$ ☐ $\sum_{p=0}^{n+1} k!$ ☐

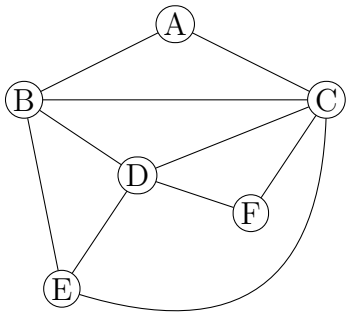
10 people rowed across Lake Tahoe in my canoe. 10 is ____ how many people the canoe can carry. an upper bound on ☐ exactly ☐ a lower bound on ☐ not a bound on ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a graph containing a K_n. $\leq n$ ☐ $= n$ ☐ $\geq n$ ☐ can't tell ☐

$\sum_{k=0}^{n} k!$ $\sum_{p=1}^{n+1}(p+1)!$ ☐ $\sum_{k=1}^{n+1}(k-1)!$ ☐ $\sum_{k=1}^{n-1}(k+1)!$ ☐ $\sum_{p=1}^{n+1} k!$ ☐

I heated 2 liters of milk in my big pot. 2 liters is ____ how much the pot holds.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (11 points) Let's define two sets as follows:

$$A = \{(x, y) \in \mathbb{R}^2 : y = x^2 - 4x + 3\}$$
$$B = \{(t + 2, t^2 - 1) : t \in \mathbb{R}\}$$

Prove that $A = B$ by proving two subset inclusions.

2. (4 points) Check the (single) box that best characterizes each item.

Chromatic number of $K_{m,n}$. (Assume $m \geq 1$, $n \geq 1$.) 2 ☐ 3 ☐ 4 ☐ can't tell ☐

$\pi \leq 10$ an upper bound on π ☐ exactly π ☐ a lower bound on π ☐ not a bound on π ☐

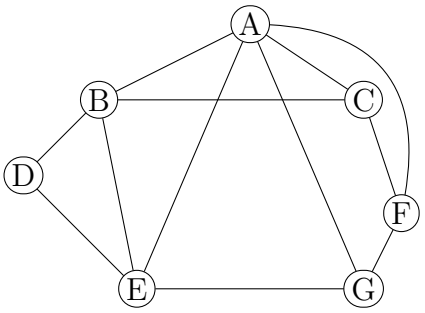
CS 173, Fall 18 Examlet 7, Part B

Name: _____

NetID: _____ **Lecture: B**

Discussion: Friday 11 12 1 2 3 4

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a bipartite graph with at least one edge: 1 ☐ 2 ☐ 3 ☐ can't tell ☐

Suppose I want to estimate $\frac{103}{20}$. 3 is ____: an upper bound ☐ an exact answer ☐ a lower bound ☐ not a bound on ☐

$\sum_{k=3}^{n} k^7$ $\sum_{p=1}^{n-2} p^9$ ☐ $\sum_{p=1}^{n-2} k^7$ ☐ $\sum_{p=1}^{n-2} k^9$ ☐ $\sum_{p=1}^{n-2} (p+2)^7$ ☐

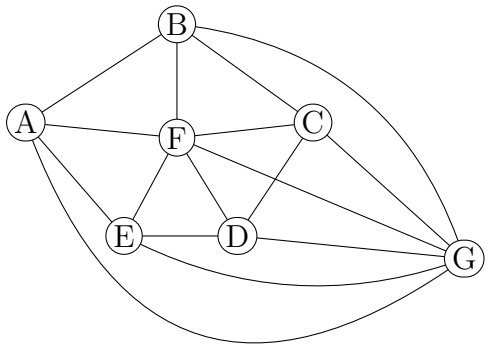
CS 173, Fall 18 Examlet 7, Part B

Name:_____

NetID:_____ **Lecture: B**

Discussion: Friday 11 12 1 2 3 4

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of W_n. 2 ☐ 3 ☐ ≤ 3 ☐ ≤ 4 ☐

All elements of M are also elements of X. $M = X$ ☐ $M \subseteq X$ ☐ $X \subseteq M$ ☐

$\sum_{k=0}^{n} \frac{1}{2^k}$ $1 - (\frac{1}{2})^{n-1}$ ☐ $2 - (\frac{1}{2})^{n}$ ☐ $1 - (\frac{1}{2})^{n}$ ☐ $2 - (\frac{1}{2})^{n-1}$ ☐

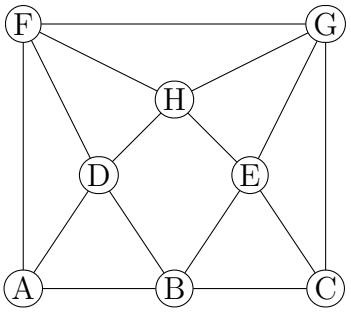
CS 173, Spring 18 Examlet 7, Part B

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a graph with no cycles and at least one edge — 1 ☐ 2 ☐ 3 ☐ can't tell ☐

15 guests are invited to brunch. Each guest will eat at least two buns. 20 is ____ on how many buns we will need. — an upper bound on ☐ exactly ☐ a lower bound on ☐ not a bound on ☐

$\sum_{k=0}^{n-1} \frac{1}{2^k}$ — $1-(\frac{1}{2})^{n-1}$ ☐ $2-(\frac{1}{2})^{n}$ ☐ $1-(\frac{1}{2})^{n}$ ☐ $2-(\frac{1}{2})^{n-1}$ ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (11 points) Let's define two sets as follows:

$$A = \{x \in \mathbb{R} \ : \ |x+1| \leq 2\}$$
$$B = \{w \in \mathbb{R} \ : \ w^2 + 2w - 3 \leq 0\}$$

Prove that $A = B$ by proving two subset inclusions.

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{i=1}^{p} i$ $\frac{p(p-1)}{2}$ ☐ $\frac{(p-1)^2}{2}$ ☐ $\frac{p(p+1)}{2}$ ☐ $\frac{(p-1)(p+1)}{2}$ ☐

Chromatic number of C_n. 2 ☐ 3 ☐ ≤ 3 ☐ ≤ 4 ☐

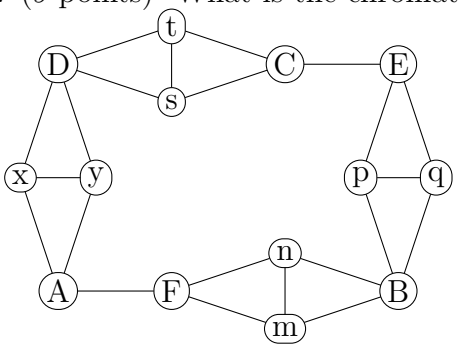
CS 173, Spring 18 Examlet 7, Part B

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{k=1}^{n-1} \frac{1}{2^k}$ $1-(\frac{1}{2})^n$ ☐ $2-(\frac{1}{2})^n$ ☐ $1-(\frac{1}{2})^{n-1}$ ☐ $2-(\frac{1}{2})^{n-1}$ ☐

10 guests are invited to brunch. Each guest will eat at least two buns. 30 is ____ on how many buns we will need.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

Chromatic number of a graph with maximum vertex degree D

$= D$ ☐ $= D+1$ ☐

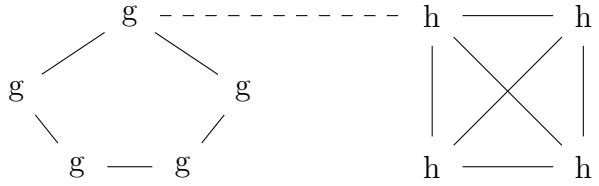
$\leq D+1$ ☐ $\geq D+1$ ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (11 points) If G is a graph, recall that $\chi(G)$ is its chromatic number. Suppose that G is a graph and H is another graph, not connected to G. Now, create a new graph T which consists of a copy of G, a copy of H, and a new edge that connects some node of G to some node of H. For example, suppose that G is C_5 and H is K_4. Then T might look as follows, where g marks nodes of G and h marks nodes of H, and the new edge is the dashed line.



Describe how $\chi(T)$ is related to $\chi(G)$ and $\chi(H)$, justifying your answer. Your answer should handle any choice for G and H.

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{k=0}^{n-1} 2^k$ $2^n - 2$ ☐ $2^n - 1$ ☐ $2^{n-1} - 1$ ☐ $2^{n+1} - 1$ ☐

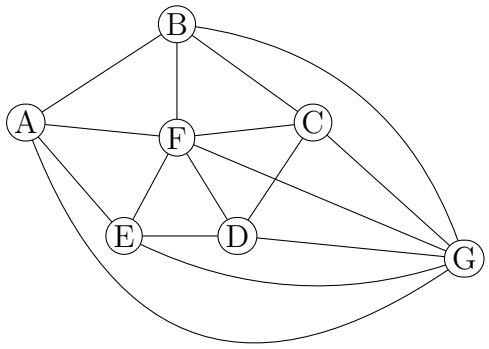
All elements of X are also elements of M. $M = X$ ☐ $M \subseteq X$ ☐ $X \subseteq M$ ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{k=1}^{n} \frac{1}{2^k}$ $1-(\frac{1}{2})^{n-1}$ ☐ $2-(\frac{1}{2})^{n}$ ☐ $1-(\frac{1}{2})^{n}$ ☐ $2-(\frac{1}{2})^{n-1}$ ☐

Graph H has 6 nodes. 7 is ____ the chromatic number of H. an upper bound on ☐ exactly ☐ a lower bound on ☐ not a bound on ☐

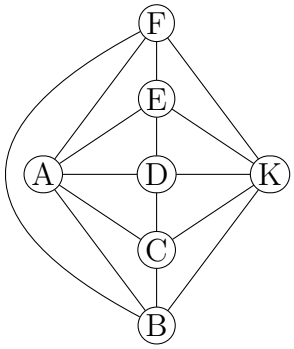
Chromatic number of G $\mathcal{C}(G)$ ☐ $\phi(G)$ ☐ $\chi(G)$ ☐ $\| G \|$ ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{k=1}^{n} k$ $\sum_{p=1}^{n}(n-p+1)$ ☐ $\sum_{p=1}^{n}(n-p)$ ☐ $\sum_{p=0}^{n}(n-p)$ ☐ $\sum_{p=1}^{n+1}(n-p)$ ☐

10 students drove home in John's van. 10 is ____ how many students the van can carry.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

Chromatic number of a graph (with at least one node) and no edges.

1 ☐ 2 ☐ 3 ☐ can't tell ☐

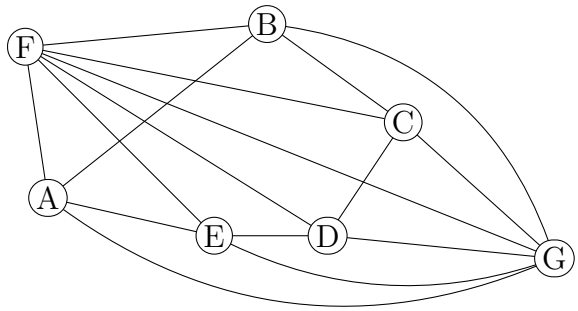
CS 173, Fall 17 Examlet 7, Part B

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

Chromatic number of a graph with maximum vertex degree D

$= D$ ☐ $= D+1$ ☐

$\geq D+1$ ☐ $\leq D+1$ ☐

We have 30 tablespoons of filling and each bun will require one tablespoon. 30 is ____ on how many buns we can make.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

$\sum_{k=0}^{n+1} 2^k$

$2^{n+1}+1$ ☐ $2^{n+2}-1$ ☐ $2^{n+2}-2$ ☐ $2^{n+1}-1$ ☐

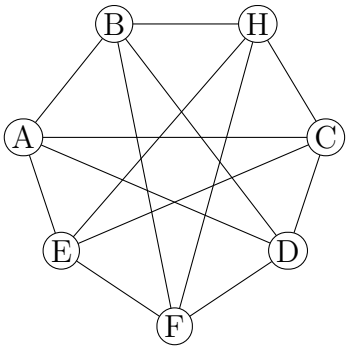
CS 173, Fall 17 Examlet 7, Part B

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{i=1}^{p-1} \frac{i}{p}$ $\frac{p(p-1)}{2}$ ☐ $\frac{p(p+1)}{2}$ ☐ $\frac{(p+1)}{2}$ ☐ $\frac{(p-1)}{2}$ ☐

10 people rowed across Lake Tahoe in my canoe. 10 is ____ how many people the canoe can carry.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

Chromatic number of a graph containing a W_7.

≥ 3 ☐ ≥ 4 ☐ ≥ 7 ☐ can't tell ☐

CS 173, Fall 17 Examlet 7, Part B

Name: _____

NetID: _____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) Tomas wants to plant his tomatoes so that plants are more than 1 foot apart. His garden bed is an an equilateral triangle with each side 2 feet long. Prove that four is the maximum number of tomatoes he can plant.

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{i=1}^{p-1} i$ $\frac{(p-1)^2}{2}$ ☐ $\frac{(p-1)(p+1)}{2}$ ☐ $\frac{p(p+1)}{2}$ ☐ $\frac{p(p-1)}{2}$ ☐

Putting 10 people in the canoe caused it to sink. 10 is ____ how many people the canoe can carry.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

Chromatic number of a connected graph with 10 nodes. ≤ 2 ☐ $= 2$ ☐ ≥ 2 ☐ can't tell ☐

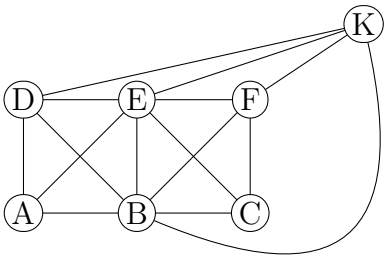
CS 173, Fall 17 Examlet 7, Part B

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{k=0}^{n-1} 2^k$ $2^n - 2$ ☐ $2^n - 1$ ☐ $2^{n-1} - 1$ ☐ $2^{n+1} - 1$ ☐

C_5 is a subgraph of graph H. 3 is ____ the chromatic number of H.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

Exactly 40 books fit in my suitcase by volume, but I haven't checked their total weight. 40 is ____ how many books the suitcase can hold.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

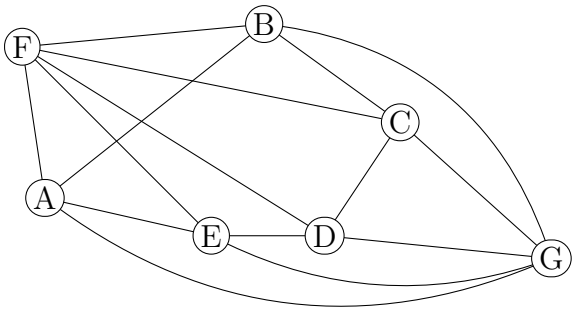
CS 173, Fall 17 Examlet 7, Part B

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of the graph below? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{k=1}^{n} 2^k$ $2^{n+1}-1$ ☐ $2^{n+1}-2$ ☐ $2^{n+1}-3$ ☐ 2^n-1 ☐

C_5 is a subgraph of graph H. 5 is ____ the chromatic number of H. an upper bound on ☐ exactly ☐ a lower bound on ☐ not a bound on ☐

Chromatic number of a bipartite graph with at least one edge 1 ☐ 2 ☐ 3 ☐ can't tell ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (11 points) Let's define two sets as follows:

$$A = \{(4 - t^2, t + 1) : t \in \mathbb{R}\}$$

$$B = \{(x, y) \in \mathbb{R}^2 : x = 3 + 2y - y^2\}$$

Prove that $A = B$ by proving two subset inclusions.

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{k=3}^{n} k^7$ $\sum_{p=1}^{n-2} p^9$ ☐ $\sum_{p=1}^{n-2} k^7$ ☐ $\sum_{p=1}^{n-2} k^9$ ☐ $\sum_{p=1}^{n-2} (p+2)^7$ ☐

Chromatic number of $K_{m,n}$. 2 ☐ 3 ☐ 4 ☐ can't tell ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

1. (11 points) Let's define two sets as follows:

$$A = \{(x, y) \in \mathbb{R}^2 : y = 3x + 7\}$$

$$B = \{\lambda(-2, 1) + (1 - \lambda)(1, 10) : \lambda \in \mathbb{R}\}$$

Prove that $A = B$ by proving two subset inclusions.

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{k=0}^{n} \frac{1}{2^k}$ $1 - (\frac{1}{2})^{n-1}$ ☐ $2 - (\frac{1}{2})^{n}$ ☐ $1 - (\frac{1}{2})^{n}$ ☐ $2 - (\frac{1}{2})^{n-1}$ ☐

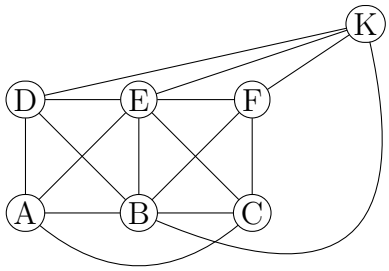
Chromatic number of C_n. 2 ☐ 3 ☐ ≤ 3 ☐ ≤ 4 ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of graph G (below)? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{k=1}^{n} k!$ $\sum_{p=0}^{n+1}(p+1)!$ ☐ $\sum_{k=0}^{n+1}(k-1)!$ ☐ $\sum_{k=0}^{n-1}(k+1)!$ ☐ $\sum_{p=0}^{n+1} k!$ ☐

All elements of M are also elements of X. $M = X$ ☐ $M \subseteq X$ ☐ $X \subseteq M$ ☐

Chromatic number of G $\mathcal{C}(G)$ ☐ $\phi(G)$ ☐ $\chi(G)$ ☐ $\| G \|$ ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

1. (11 points) Recall that if G is a graph, then $\chi(G)$ is its chromatic number. Suppose that G is a graph and H is another graph not connected to G. Suppose G and H each have at least two nodes and at least one edge. Dr. Evil picks two adjacent nodes a and b from G, and also two adjacent nodes c and d from H. He merges G and H into a single graph T by merging b and d into a single node, and adding an edge connecting a and c. So, if G and H are as shown on the left, then T might look as shown on the right.

Describe how $\chi(T)$ is related to $\chi(G)$ and $\chi(H)$, justifying your answer.

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{k=-2}^{n} k^2$ $\sum_{p=0}^{n+2}(p+2)^2$ ☐ $\sum_{p=0}^{n-2}(p-2)^2$ ☐ $\sum_{p=0}^{n+2}(p-2)^2$ ☐ $\sum_{p=0}^{n+2} p^2$ ☐

W_7 is a subgraph of graph H. 4 is ____ the chromatic number of H.

an upper bound on ☐ exactly ☐

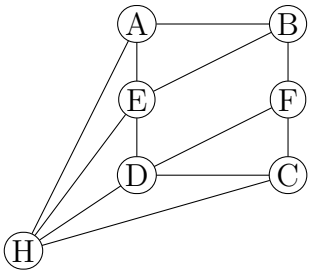
a lower bound on ☐ not a bound on ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of graph G (below)? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{i=0}^{k-1}(k \cdot i + 2)$

$\frac{k^2(k+1)}{2} + 2k$ ☐ $\frac{k(k+1)}{2} + 2(k-1)$ ☐

$\frac{k^2(k-1)}{2} + 2k$ ☐ $\frac{k(k-1)}{2} + 2(k-1)$ ☐

When I poured 5 gallons of water into the bucket, some spilled over the top. 5 gallons is ____ how much the bucket holds.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

Chromatic number of a bipartite graph with at least two vertices.

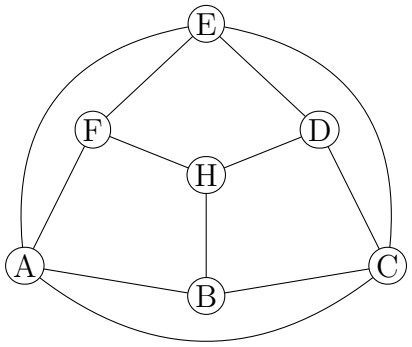
1 ☐ 2 ☐ 3 ☐ can't tell ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

1. (9 points) What is the chromatic number of graph G (below)? Justify your answer.



2. (6 points) Check the (single) box that best characterizes each item.

$\sum_{i=1}^{p-1} i$ $\frac{p(p-1)}{2}$ ☐ $\frac{(p-1)^2}{2}$ ☐ $\frac{p(p+1)}{2}$ ☐ $\frac{(p-1)(p+1)}{2}$ ☐

I heated 2 liters of milk in my big pot. 2 liters is _____ how much the pot holds.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐

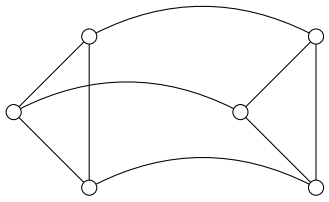
Chromatic number of a graph containing a W_n. ≥ 2 ☐ ≤ 3 ☐ $\geq n$ ☐ can't tell ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

1. (11 points) Recall that if G is a graph, then $\chi(G)$ is its chromatic number. Let's define the "doubled" version of a graph G as follows: make two copies of G and add an edge joining each pair of corresponding nodes. For example, the doubled version of C_3 looks like:



Suppose that T is the doubled version of a graph G. Describe how $\chi(T)$ is related to $\chi(G)$, justifying your answer. Your answer should handle any choice for G, not just C_3.

2. (4 points) Check the (single) box that best characterizes each item.

Chromatic number of W_n. 2 ☐ 3 ☐ ≤ 3 ☐ ≤ 4 ☐

10 people can row the canoe but 11 people caused it to sink. 10 is ____ how many people the canoe can carry.

an upper bound on ☐ exactly ☐

a lower bound on ☐ not a bound on ☐