班级：________装________班内序号：________订________姓名：________线

北京邮电大学 2019——2020 学年第二学期

Discrete Mathematics – Final Exam 9

考试注意事项	一、学生参加考试须带学生证或学院证明，未带者不准进入考场。学生必须按照监考教师指定座位就坐。 二、书本、参考资料、书包等与考试无关的东西一律放到考场指定位置。 三、学生不得另行携带、使用稿纸，要遵守《北京邮电大学考场规则》，有考场违纪或作弊行为者，按相应规定严肃处理。 四、学生必须将答题内容做在试题答卷上，做在草稿纸上一律无效。

考试课程	离散数学	考试时间	2020 年 6 月 23 日

题号	一	二	三	四	五	六	七	八	九	十	十一	十二	十三	十四	总分
满分	5	10	10	10	10	5	6	6	6	6	6	6	10	4	
得分															
阅卷教师															

1. [5 points]

a) Which of these sentences are propositions? What are the truth values of those that are propositions?

i) $x + y = 100$. ________

ii) 80 is a perfect square. ________

iii) If you use a wrong test paper, then you will get an invalid score. ________

iv) Birds can fly, unless pigs can not fly. ________

v) To eliminate poverty in all poor counties and regions of China by 2020. ________

b) Let L(x, y) be the statement "x loves y," and H(x,y) be the statement " x hates y", where the domain for both x and y consists of all people in the world. Translate each of these (1),(2) nested quantifications into a statement. And use quantifiers to express each of these statements (3),(4),(5).

(1) $\neg\forall y\, \exists x\, H(y,x)$

(2) $\forall x\, \exists y L(x,y) \rightarrow \forall x\, \exists y H(x,y)$

(3) Everybody loves somebody and hates somebody

(4) Nobody loves everybody.

(5) There is somebody whom everybody loves and there is no one whom e

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2. [10 points] Show that $t\vee((r\to w)\wedge(r\to\neg s))$ and $(w\to s)\to(r\to t)$ are logically equivalent.

3. [10 points] Find the principal disjunctive normal form of (a) and (b).

(a) $(\neg p\vee\neg q)\wedge(p\to\neg q)$

(b) $(p\to(q\vee r))\wedge(\neg p\to(\neg q\wedge\neg r))$

4. [10 points] Put the statement (a) and (b) in prenex normal form.

(a) $(\forall xP(x)\wedge\exists yQ(y))\to\forall zW(z)$

(b) $\neg\exists x\exists y\,Q(x,y)\to(\exists zF(z)\vee R(x))$

5. [10 points] Show that the premises "There is someone in this class who has been to Guangdong," and " Everyone who goes to Guangdong visits Shenzhen" imply the conclusion "Someone in this class has visited Shenzhen."

6. [5 points] Prove or disprove that the equation $2x^3+y^2=16$ has positive integer solution and explain the proof method you use.

7. [6 points]Let $A=\begin{bmatrix}1&0&0\\1&0&1\\0&1&0\end{bmatrix}$

Find $A^{[3]}$.

8. [6 points]Let f and g be functions from {1, 2, 3, 4} to {a, b, c, d} and from {a, b, c, d} to {1, 2, 3, 4}, respectively, with f (1) = d, f (2) = c, f (3) = a, and f (4) = b, and g(a) = 2, g(b) = 1, g(c) = 3, and g(d) = 2.

a) Is *f* one-to-one? Is *g* one-to-one?

b) Is *f* onto? Is g onto?

c) Does either *f* or *g* have an inverse? If so, find this inverse.

9. [6 points]Use Fermat's little theorem to evaluate 9^{20000} mod 19.

10. [6 points] Find all solutions, if any, to the system of congruences $x\equiv 5(mod\ 7), x\equiv 4(mod\ 5)$.

11. [6 points]List these functions so that each function is big-O of the next function in the list: $(\log n)^3$, $n^3/1000000$, $n^{1/2}$, $100n+101$, 3^n, $n!$, $2^n n^2$.

12. [6 points] Prove that the distributive law $A_1\cap(A_2\cup\cdots\cup A_n)=(A_1\cap A_2)\cup\cdots\cup(A_1\cap A_n)$ is true for all $n\geq 3$.

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