

# MATH1081 Lab Test 1

Click on a question number to see how your answer was marked and, where available, full solutions.

Question Number	Score	Success
Question 1	2	/
Question 2	3	/
Question 3	2	/
Question 4	3	/
Question 5	2	/
Question 6	2	/
Question 7	4	/
Question 8	2	/
Total	20	/

## Performance Summary

Exam Name:	MATH1081 Lab Test
Session ID:	16
Student's Name:	Zehan Li
Exam Start:	Fri Mar 01 20:00
Exam Stop:	Sat Mar 02 20:00
Time Spent:	

# Question 1

In a class of 42 students:

- 20 study French,
- 23 study Physics,
- 11 study both French and Maths,
- 14 study both French and Physics,
- 10 study both Maths and Physics,
- 7 study all three subjects, and
- 7 study none of these subjects.

a)

How many students study Maths?



Expected answer: 20

b)

Writing  $F$ ,  $M$ , and  $P$  for the sets of students studying French, Maths, and Physics



Expected answer: 26

## Question 2

For any integer  $k$ , let  $S_k$  be the set defined by:

$$S_k = \left\{ n \in \mathbb{Z} : 2k + 5 \leq n \leq \frac{5}{2}k + 13 \right\}.$$

Recall that the Numbas syntax for the set  $\{a, b, c\}$  is `set(a,b,c)`.

a)

What is  $S_1 - S_3$ ?

`set(7,8,9,10)` {7, 8, 9, 10} ✓

Expected answer: set(7,8,9,10)

b)

Find  $|\mathcal{P}(S_1) \times \mathcal{P}(S_3)|$ .

`2^19`  $2^{19}$  ✓

Expected answer:  $2^{19}$   $2^{19}$

c)

Find  $|\mathcal{P}(S_1) \cap \mathcal{P}(S_3)|$ . $2^5$ Expected answer: 2^5  $2^5$ 

## Question 3

In this question, we use the notation  $\mathbb{R}_0^+ = \{x \in \mathbb{R} : x \geq 0\}$ .

---

a)

Consider the function

$$f : \mathbb{R}_0^+ \rightarrow \mathbb{R}, f(x) = (x - 2)^3.$$

Complete the following to make a true statement:

Since the equation  $f(x) =$   ✓

Expected answer: -500004.000001

no solutions. / *exactly one solution.* / *more than one solution.* ✓

Exp

that  $f$  is injective / *surjective* / *not injective* / not surjective ✓

Exp

b)

Consider the function

$$g : \mathbb{R}_0^+ \rightarrow \mathbb{R}_0^+, \quad g(x) = x(x-2)^2.$$

Complete the following to make a true statement:

Since the equation  $g(x) =$   ✓

Expected answer: 0.5925925926

no solutions. / *exactly one solution.* / more than one solution. ✓

Exp

conclude that  $g$  is injective / *surjective* / not injective / *not surjective*

## Advice

Notice that the "Expected answer" for the numeric value in each case is not the only correct answer you might have picked.

Some simpler answers for the numeric parts of the above questions are  $f(x) = -9$  a

## Question 4

Suppose  $S = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$  and that the function  $f : S \rightarrow S$  is given by:

$$f(x) = (6x^2 + x + 2) \bmod 9.$$

Let  $T = \{6, 7\}$ .

Recall that the Numbas syntax for the set  $\{a, b, c\}$  is `set(a,b,c)`.

a)

What is  $f(T)$ ?

`set(8,6)` {8,6} ✓

b)

What is  $f^{-1}(T)$ ?

`set(8,7)` {8,7} ✓

Expected answer: `set(7,8)` {7,8}

c)

Complete the sentence:

 $f$  is

neither injective nor surjective.	/	injective but not surjective.	/	surjective but not injective.
-----------------------------------	---	-------------------------------	---	-------------------------------

Expected answer: <i>bijjective.</i>
-------------------------------------

## Question 5

Two positive integers  $x$  and  $y$  are chosen, and their GCD and LCM are found to be the

$$\gcd(x, y) = 1188 = 2^2 \times 3^3 \times 11, \text{ and}$$

$$\text{lcm}(x, y) = 44823240 = 2^3 \times 3^3 \times 5 \times 7^3 \times 11^2.$$

a)

You are told that  $x \neq \text{lcm}(x, y)$ .

Given only this information, what is the largest possible value of  $x$ ?

$$2^2 * 3^3 * 11^2 * 7^3 * 5$$

$$2^2 \times 3^3 \times 11^2 \times 7^3 \times 5 \quad \checkmark$$

Expected answer: .

b)

You are now told that  $x = 4482324 = 2^2 \times 3^3 \times 7^3 \times 11^2$ .

What is the value of  $y$ ?

$$11880 \quad 11880 \quad \checkmark$$

Expected answer: 11880 11880

## Question 6

When evaluating a number modulo  $m$ , be sure to give your answer in its lowest non-negative form, i.e. in the set  $\{0, 1, 2, \dots, m-1\}$ .

a)

Evaluate  $5^{262} \bmod 19$ .



Expected answer: 5

b)

Evaluate  $8^{262} \bmod 88$ .Expected answer: 64

## Question 7

Solve each of the following modular arithmetic equations, giving your answer as a set

- If there are no solutions, enter `set()` .
- If there is one solution, say 1, enter `set(1)` .
- If there are multiple solutions, say 1 and 2, enter `set(1,2)` .

When evaluating in modulo  $m$ , give each answer in its lowest non-negative form - that

---

a)

Solve  $335x \equiv 15 \pmod{1110}$ .

`set(63,285,507,729,951)` {63, 285, 507, 729, 951} ✓

Expected answer: set(63,285,507,729,951) {63, 285, 507, 729, 951}

b)

Solve  $173x \equiv 4 \pmod{234}$ .

`set(92)` {92} ✓

Expected answer: set(92) {92}

c)

Solve  $161x \equiv 3 \pmod{782}$ .

`set()` {} ✓

Expected answer: set() {}

d)

Solve  $240x \equiv 2 \pmod{646}$ .

set(35,358)

{35,358}

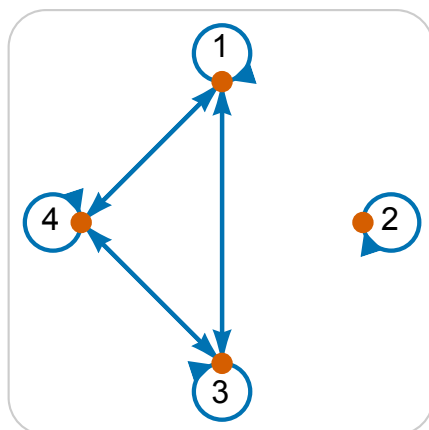


Expected answer: set(35,358) {35

## Question 8

For each of the arrow diagrams below, indicate whether they represent reflexive, symr

Marks will be deducted for each incorrect selection, but the minimum possible total ma



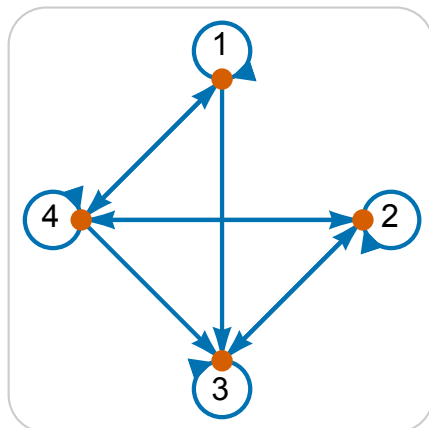
Reflexive

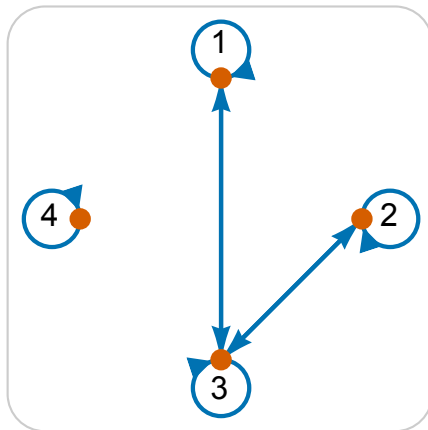
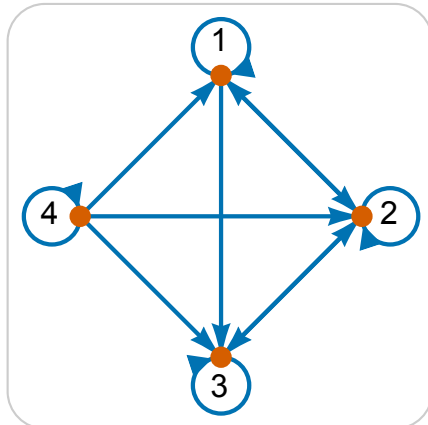
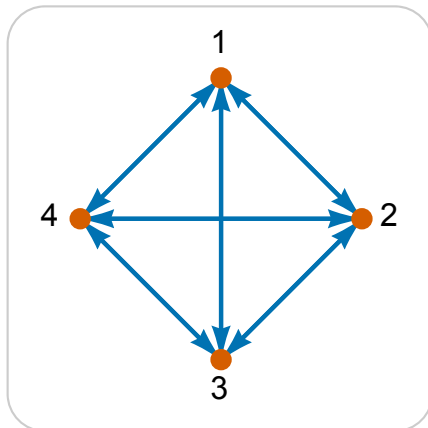


Symmetric

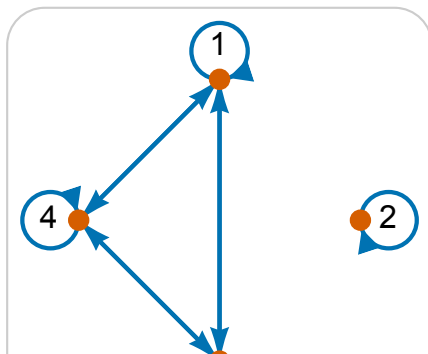


Transitive




☒
☒
☐

☒
☐
☐

☐
☒
☐


Expected answer:



Reflexive

Symmetric

Transitive

☒
☒
☒

	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

---

Created using Numbas (<https://www.numbas.org.uk>), developed by Newcastle I