



判断題

0/3

共 6 分

1

2

3

A. 单选题

0/4

共 10 分

1

2

3

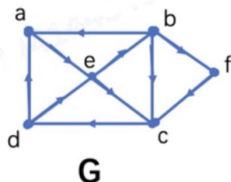
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A. 多选题

0/9

R1-1 分数 2

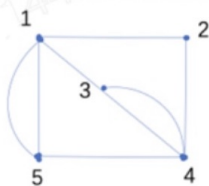
Is the graph G a strongly connected ?



☐ T ☐ F

R1-2 分数 2

Determine whether the given graph G1 has a Hamilton circuit.



G1

☐ T ☐ F

R1-3 分数 2

Let $(G, *)$ be a group and define $f: G \rightarrow G$ by $f(a) = a^{-1}$. Is f a homomorphism?

☐ T ☐ F

Use generating functions $G(x) = \sum_{k=0}^n a_k x^k$ to find the number of 2-combinations of a set with 6 elements when repetition of elements is allowed. We obtain the generating function as

- ☐ A. $G(x) = (1+x)^6$
- ☐ B. $G(x) = (x^0 + x^1 + x^2 + x^3 + x^4 + x^5 + x^6)^2$
- ☐ C. $G(x) = (x^0 + x^1 + x^2)^6$
- ☐ D. $G(x) = (1+x)^2$

A string that contains only letters of "a","b","c","d","e","f". Find a recurrence relation a_n for the number of such strings of length $n(n \geq 3)$ that do not contain consecutive letters that are the same.

- ☐ A. $a_n = 5a_{n-1} + 6^{n-2}$
- ☐ B. $a_n = a_{n-1} + 5a_{n-2}$
- ☐ C. $a_n = 5a_{n-1}$
- ☐ D. $a_n = 5a_{n-1} + a_{n-2}$
- ☐ E. $a_n = 6a_{n-1}$

判断題

0/3

共 6 分

1 2 3

A. 单选题

0/4

共 10 分

1 2 3 4

A*. 多选题

0/9

How many strongly connected components of G has?



- ☐ A. 3
- ☐ B. 2
- ☐ C. 1
- ☐ D. 4

判断題

0/3

共 6 分

1 2 3

A. 单选题

0/4

共 10 分

1 2 3 4

Let A be a set with m elements. How many binary operations can be defined on A ?

- ☐ A. m^{m^2}
- ☐ B. $m^{\frac{m(m-1)}{2}}$
- ☐ C. m^m
- ☐ D. 2^m

A* 多选题

0/9

共 27 分

1	A	3	4	5
6	7	8	9	

填空题

0/11

共 57 分

1	2	3	4	5
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R3-1 分数 3

For the relation $\{(1, 1), (2, 2), (2, 3), (2, 4), (3, 3), (3, 2), (4, 2), (4, 4), (5, 5)\}$ on the set $\{1, 2, 3, 4, 5\}$, decide whether it is reflexive, whether it is symmetric, whether it is antisymmetric, and whether it is transitive.

- ☐ A. Reflexive
- ☐ B. Antisymmetric
- ☐ C. Symmetric
- ☐ D. Transitive

A+ 多选题

0/9

共 27 分

1	2	3	4	5
6	7	8	9	

A 填空题

0/11

做对得全分，少选得一半分，多选不得分

R3-3 分数 3

Determine whether the posets are lattices.

- ☐ A. $(\{1, 4, 12, 16, 32, 64\}, |)$
- ☐ B. $(\{1, 2, 4, 5, 10, 20\}, |)$
- ☐ C. (\mathbb{Z}, \leq)

A+ 多选题

0/9

共 27 分

1	2	3	4	5
6	7	8	9	

A 填空题

0/11

共 57 分

1	2	3	4	5
6	7	8	9	10
11				

R3-4 分数 3

Find all of the normal subgroups of $Z_2 \times Z_2$.

- ☐ A. $\{([0],[0])\}$
- ☒ B. $\{([0],[0]),([1],[1])\}$
- ☐ C. $\{([0],[0]),([0],[1])\}$
- ☐ D. $\{([1],[0]),([0],[1])\}$
- ☐ E. $Z_2 \times Z_2$
- ☐ F. $\{([0],[0]),([1],[0])\}$

共 27 分

1	2	3	4	5
6	7	8	9	

A 填空题

0/11

R3-5 分数 3

Determine whether each of these degree sequences is graphic.

☐ A. 6,5,5,4,2,1

☐ B. 5,5,4,3,2,1

☐ C. 6,4,3,3,2,2,2

A. 多选题

0/9

共 27 分

1	2	3	4	5
6	7	8	9	

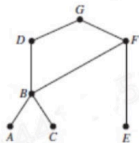
A. 填空题

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共 57 分

1	2	3	4	5
6	7	8	9	10
11				

The Hasse diagram for the seven tasks, with respect to this partial ordering, is shown in below Figure.



Determine whether the orders in which these tasks can be carried out to complete the project.

- ☐ A. $A < C < B < E < F < D < G$
- ☐ B. $A < C < B < D < E < F < G$
- ☐ C. $A < B < C < D < E < F < G$
- ☐ D. $E < C < A < B < F < D < G$

A+ 多选题

0/9

共 27 分

1

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A 填空题

0/11

共 57 分

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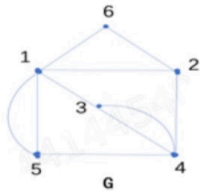
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11

Determine whether the given graph G has a Hamilton path. If it exists, construct such path.



- ☐ A. Yes, 3-1-5-4-2-6
- ☐ B. Yes, 2-6-1-5-4-3
- ☐ C. No
- ☐ D. Yes, 4-2-6-1-5-4-3

A+ 多选题

0/9

共 27 分

- | | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | |

A 填空题

0/11

共 57 分

- | | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

做对得全分，少选得一半分，多选不得分

R3-8 分数 3



Let $G = Z_6$. Determine all the left cosets of $H = \{[0], [2], [4]\}$ in G .

- ☐ A. $\{[1], [5]\}$
- ☐ B. $\{[2], [4]\}$
- ☐ C. $\{[0], [2], [4]\}$
- ☐ D. $\{[1], [3], [5]\}$

A+ 多选题

0/9

共 27 分

1	2	3	4	5
6	7	8	9	

A 填空题

0/11

共 57 分

For the relations $\{(1, 1), (2, 2), (3, 3), (4, 4), (2, 4)\}$ on the set $\{1, 2, 3, 4, 5\}$, decide whether it is reflexive, whether it is symmetric, whether it is antisymmetric, and whether it is transitive.

- ☐ A. Reflexive
- ☐ B. Transitive
- ☐ C. Antisymmetric
- ☐ D. Symmetric

A+ 多选题

0/9

共 27 分

1 2 3 4 5

6 7 8 9

A 填空题

0/11

共 57 分

1 2 3 4 5

Let $H = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ be a parity check matrix.

Determine the (2,5) group code $e_H : B^2 \rightarrow B^5$. (填空时勿加空格)

$e(00)=00000$ $e(01)=$ 1分 $e(10)=$ 1分 $e(11)=$ 1分

Let d be a maximum likelihood decoding function associated with e_H . Then $d(11011)=$ 1分, $d(10110)=$

1分 .

Suppose $x_t=00001$, compute the syndrome of x_t . 1分

1	2	3	4	5
6	7	8	9	

R4-2 分数 2

Suppose that a connected planar graph has 8 vertices, each of degree 4.

The planar representation of this graph splits the plane into 2 分 regions.

 填空题

0/11

共 57 分

1	2	3	4	5
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1 2 3 4 5
6 7 8 9

📄 填空题

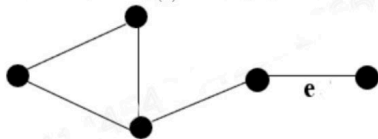
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共 57 分

1 2 3 4 5
6 7 8 9 10
11

共 100 分

Let us compute $P_{G(x)}$ for the graph G using the edge e . (填空只填小写字母的选项,勿加空格,勿加括号)



Graph G

1. $P_{G_e}(x) =$ 2 分 .

a. x^5

b. $x^2 * (x - 1)^2 * (x - 2)$

c. $x + x * (x - 1)^2 * (x - 2)$

c. $x * (x - 1) * (x - 2) * (x - 3) * (x - 4)$

2. $P_{G^e}(x) =$ 2 分 .

a. x^4

b. $x * (x - 1) * (x - 2)$

c. $x * (x - 1)^2 * (x - 2)$

d. $x * (x - 1)^3$

3. $\chi(G) =$ 1 分 .

A 填空题

0/11

共 57 分

1	2	3	4	5
6	7	8	9	10
11				

We try to find the solution of the recurrence relation is $a_n = 3a_{n-1} + 10a_{n-2}$.

First we obtain the characteristic equation $r^2 + C_1r + C_2 = 0$,

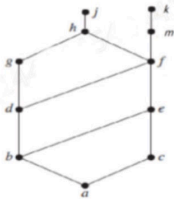
while $C_1 =$ 1分, $C_2 =$ 1分.

Then we obtain the characteristic roots $r_1 =$ 1分, $r_2 =$ 1分.

If $a_0=0$; $a_1=28$; Then the solution is $a_n = \alpha r_1^n + \beta r_2^n$,

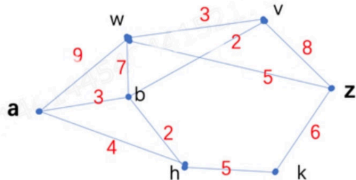
While $\alpha =$ 1分, $\beta =$ 1分.

Find the bounds of the subsets in the poset with the Hasse diagram shown in below Figure.(只填元素名-例c, 多个元素之间用逗号分隔-例c,d, 勿加空格)



- The lower bounds of the subsets $\{a, b, c, d\}$ in the poset be 1分 .
- The greatest lower bounds of the subsets $\{g, d, m\}$ in the poset be 1分 .
- The lower bounds of the subsets $\{c, f, h, j\}$ in the poset be 1分 .
- The upper bounds of the subsets $\{a, b, c, j, h\}$ in the poset 1分 .
- The least upper bounds of the subsets $\{a, c, d, f\}$ in the poset be 1分 .
- The upper bounds of the subsets $\{a, b, c, m\}$ in the poset be 1分 .

Using Dijkstra's algorithm to find a shortest path from a to z in the weighted graph shown below.



Step1: $S=\{a\}$, add vertex b(填写小写字母的顶点标号, 勿加空格) to the set S ($S=\{a,b\}$). the label of this vertex is (distance) 3.(这里的数字3表示路径 a-b的距离, 下面填空的数字请填写顶点a到最新顶点的距离)

Step2: add vertex 1分 to the set S. The label of this vertex is (distance) 1分 .

Step3: add vertex 1分 to the set S. The label of this vertex is (distance) 1分 .

Step4: add vertex 1分 to the set S. The label of this vertex is (distance) 1分 .

Step5: add vertex 1分 to the set S. The label of this vertex is (distance) 1分 .

Step6: add vertex 1分 to the set S. The label of this vertex is (distance) 1分 .

填空题

0/11

共 57 分

1	2	3	4	5
6	7	8	9	10
11				

共 100 分

R4-7 分数 4

(只填数值, 勿加空格)

- a) A full 3-ary tree with 7 vertices has $i =$ 1 分 internal vertices and $l =$ 1 分 leaves.
- b) A full 3-ary tree with 6 internal vertices has $n =$ 1 分 vertices and $l =$ 1 分 leaves.

📄 填空题

0/11

共 57 分

1	2	3	4	5
6	7	8	9	10



R4-8 分数 4

Consider the following group code e .

$$e(000)=000000 \quad e(100)=100011$$

$$e(001)=001110 \quad e(101)=101101$$

$$e(010)=010101 \quad e(110)=110110$$

$$e(011)=011011 \quad e(111)=111000$$

and let d be an associated maximum likelihood function.(填空只填阿拉伯数字)

(1) The minimal distance of e is 2 分 .

(2) How many errors will e detect ? 1 分 .

(3) How many errors will (e, d) correct? 1 分 .

填空题

0/11

共 57 分

1	2	3	4	5
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11				

Step2: From nodes N1 to reach nodes, so N2= { 1 分 }。(只填顶点序号,英文逗号分隔,勿加空格,参考N1)

Proceeding as before. We can get the second path 1 分, the third path 1 分, the fourth path

1分。

Its maximum flow is 2 分

0/11

1 2 3 4 5

6 7 8 9 10

11

共 100 分

1 2 3 4 5
6 7 8 9

R4-10 分数 2

How many nonisomorphic simple graphs are there with four vertices?

2 分

📄 填空题

0/11

共 57 分

1 2 3 4 5
6 7 8 9 10
11

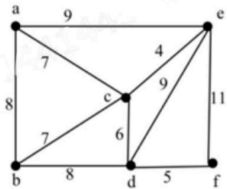
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1 2 3 4 5

6 7 8 9

R4-11 分数 4

Find a minimum spanning tree for the given weighted graph.(只填顶点标记, 勿加空格)



The minimum spanning trees is { (d,f),(c,d), (a, 1分), (b, 1分), (e, 1分) } , the sum of the weights of its edges is 1分 .

A 填空题

0/11

共 57 分

1 2 3 4 5

6 7 8 9 10

11