МИНОБРНАУКИ РОССИИ

Бугульминский филиал

Федерального государственного бюджетного образовательного учреждения высшего профессионального образования

«Казанский национальный исследовательский технологический университет»

**Хакимова А.А.**

**МЕТОДЫ ФИЗИЧЕСКОГО И МАТЕМАТИЧЕСКОГО МОДЕЛИРОВАНИЯ**

 **Контрольная работа**

**4 семестр**

*Для бакалавриатов направления 15.03.02 «Технологические машины и оборудование» заочной формы обучения*

Бугульма, 2023

**Указания по выполнению контрольной работы**

1.**Номер варианта контрольной работы определяются двумя последними цифрами зачетной книжки.**

**2. Задания выбираются согласно Приложению 1.**

**3. Титульный лист оформляется согласно образцу.**

**3. Работа оформляется** в тетради в клетку (оформление решений производить аккуратно, с минимальным количеством исправлений, оставить поля для замечаний) или напечатанной на листах формата А4.

**4. Правила оформления решения задач**:

- располагать в порядке номеров, указанных в заданиях, сохраняя их номер

- перед решением каждой задачи выписывать полностью условие

-решение каждой задачи сопровождать объяснением и заканчивать ответом.

На четыре базы $A\_{1}, A\_{2}, A\_{3}, A\_{4}$поступил однородный груз в следующем количестве: $α\_{1}$т – на базу $A\_{1};α\_{2}$т – на базу $A\_{2};α\_{3}$т – на базу $A\_{3};α\_{4}$т – на базу $A\_{4}.$ Полученный груз требуется перевезти в пять пунктов: $β\_{1}$т – в пункт $B\_{1};β\_{2}$т – в пункт $B\_{2};β\_{3}$т – в пункт $B\_{3};β\_{4}$т – в пункт $B\_{4};β\_{5}$т – в пункт $B\_{5}.$

Расстояние между пунктами указаны в следующей таблице (матрице расстояний):

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | $$d\_{11}$$ | $$d\_{12}$$ | $$d\_{13}$$ | $$d\_{14}$$ | $$d\_{15}$$ | $$α\_{1}$$ |
| $$A\_{2}$$ | $$d\_{21}$$ | $$d\_{22}$$ | $$d\_{23}$$ | $$d\_{24}$$ | $$d\_{25}$$ | $$α\_{2}$$ |
| $$A\_{3}$$ | $$d\_{31}$$ | $$d\_{32}$$ | $$d\_{33}$$ | $$d\_{34}$$ | $$d\_{35}$$ | $$α\_{3}$$ |
| $$A\_{4}$$ | $$d\_{41}$$ | $$d\_{42}$$ | $$d\_{43}$$ | $$d\_{44}$$ | $$d\_{45}$$ | $$α\_{4}$$ |
| Потребности | $$β\_{1}$$ | $$β\_{2}$$ | $$β\_{3}$$ | $$β\_{4}$$ | $$β\_{5}$$ |  |

   Стоимость перевозок пропорциональна количеству груза и расстоянию, на которое этот груз перевозится. Начальный опорный план найти тремя способами. Спланировать перевозки так, чтобы их общая стоимость была минимальной.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 16 | 30 | 17 | 10 | 16 | 4 |
| $$A\_{2}$$ | 30 | 27 | 26 | 9 | 23 | 6 |
| $$A\_{3}$$ | 13 | 4 | 22 | 3 | 1 | 10 |
| $$A\_{4}$$ | 3 | 1 | 5 | 4 | 24 | 10 |
| Потребности | 7 | 7 | 7 | 7 | 2 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 15 | 1 | 22 | 19 | 1 | 20 |
| $$A\_{2}$$ | 21 | 18 | 11 | 4 | 3 | 20 |
| $$A\_{3}$$ | 26 | 29 | 23 | 26 | 24 | 20 |
| $$A\_{4}$$ | 21 | 20 | 3 | 19 | 27 | 20 |
| Потребности | 19 | 19 | 19 | 19 | 4 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 17 | 20 | 29 | 26 | 25 | 15 |
| $$A\_{2}$$ | 3 | 4 | 5 | 15 | 24 | 15 |
| $$A\_{3}$$ | 19 | 2 | 22 | 4 | 13 | 15 |
| $$A\_{4}$$ | 20 | 27 | 1 | 17 | 19 | 15 |
| Потребности | 11 | 11 | 11 | 11 | 16 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 21 | 22 | 2 | 13 | 7 | 18 |
| $$A\_{2}$$ | 27 | 10 | 4 | 24 | 9 | 12 |
| $$A\_{3}$$ | 3 | 16 | 25 | 5 | 4 | 17 |
| $$A\_{4}$$ | 28 | 11 | 17 | 10 | 29 | 13 |
| Потребности | 8 | 8 | 8 | 8 | 28 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 30 | 24 | 11 | 12 | 25 | 21 |
| $$A\_{2}$$ | 26 | 4 | 29 | 20 | 24 | 19 |
| $$A\_{3}$$ | 27 | 14 | 14 | 10 | 18 | 15 |
| $$A\_{4}$$ | 6 | 14 | 28 | 8 | 2 | 25 |
| Потребности | 15 | 15 | 15 | 15 | 20 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 5 | 15 | 3 | 6 | 10 | 9 |
| $$A\_{2}$$ | 23 | 8 | 13 | 27 | 12 | 11 |
| $$A\_{3}$$ | 30 | 1 | 5 | 24 | 25 | 14 |
| $$A\_{4}$$ | 8 | 26 | 7 | 28 | 9 | 16 |
| Потребности | 8 | 9 | 13 | 8 | 12 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 9 | 17 | 29 | 28 | 8 | 22 |
| $$A\_{2}$$ | 13 | 21 | 27 | 16 | 29 | 13 |
| $$A\_{3}$$ | 20 | 30 | 24 | 7 | 26 | 17 |
| $$A\_{4}$$ | 11 | 19 | 30 | 6 | 2 | 18 |
| Потребности | 7 | 7 | 7 | 7 | 42 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 30 | 2 | 5 | 6 | 15 | 16 |
| $$A\_{2}$$ | 5 | 29 | 9 | 5 | 7 | 15 |
| $$A\_{3}$$ | 16 | 24 | 14 | 6 | 26 | 14 |
| $$A\_{4}$$ | 13 | 28 | 4 | 25 | 8 | 15 |
| Потребности | 6 | 6 | 13 | 20 | 15 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 12 | 11 | 25 | 17 | 21 | 17 |
| $$A\_{2}$$ | 22 | 18 | 14 | 8 | 1 | 14 |
| $$A\_{3}$$ | 9 | 13 | 2 | 28 | 15 | 21 |
| $$A\_{4}$$ | 26 | 21 | 3 | 4 | 27 | 43 |
| Потребности | 19 | 22 | 23 | 17 | 14 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 2 | 24 | 4 | 2 | 3 | 28 |
| $$A\_{2}$$ | 20 | 10 | 15 | 27 | 7 | 13 |
| $$A\_{3}$$ | 15 | 15 | 12 | 25 | 19 | 15 |
| $$A\_{4}$$ | 2 | 6 | 3 | 5 | 5 | 30 |
| Потребности | 27 | 16 | 25 | 11 | 7 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 6 | 11 | 20 | 17 | 8 | 12 |
| $$A\_{2}$$ | 1 | 25 | 3 | 18 | 17 | 17 |
| $$A\_{3}$$ | 9 | 39 | 16 | 30 | 31 | 18 |
| $$A\_{4}$$ | 23 | 15 | 4 | 3 | 28 | 13 |
| Потребности | 10 | 8 | 12 | 14 | 14 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 7 | 10 | 16 | 27 | 19 | 17 |
| $$A\_{2}$$ | 30 | 18 | 8 | 29 | 15 | 19 |
| $$A\_{3}$$ | 3 | 18 | 28 | 19 | 13 | 11 |
| $$A\_{4}$$ | 9 | 12 | 2 | 25 | 21 | 13 |
| Потребности | 5 | 15 | 11 | 9 | 20 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 4 | 21 | 12 | 8 | 1 | 21 |
| $$A\_{2}$$ | 20 | 8 | 25 | 15 | 23 | 21 |
| $$A\_{3}$$ | 17 | 1 | 11 | 5 | 3 | 23 |
| $$A\_{4}$$ | 23 | 10 | 24 | 6 | 5 | 23 |
| Потребности | 22 | 22 | 22 | 11 | 11 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 5 | 3 | 24 | 10 | 25 | 24 |
| $$A\_{2}$$ | 30 | 2 | 22 | 16 | 7 | 15 |
| $$A\_{3}$$ | 30 | 24 | 27 | 29 | 10 | 16 |
| $$A\_{4}$$ | 15 | 17 | 21 | 2 | 3 | 24 |
| Потребности | 12 | 13 | 14 | 31 | 9 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 25 | 28 | 20 | 15 | 7 | 16 |
| $$A\_{2}$$ | 27 | 5 | 11 | 23 | 10 | 10 |
| $$A\_{3}$$ | 1 | 25 | 14 | 16 | 16 | 14 |
| $$A\_{4}$$ | 8 | 6 | 4 | 16 | 18 | 20 |
| Потребности | 7 | 8 | 4 | 11 | 30 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты наначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 14 | 25 | 18 | 19 | 23 | 33 |
| $$A\_{2}$$ | 2 | 17 | 16 | 24 | 2 | 25 |
| $$A\_{3}$$ | 29 | 3 | 7 | 15 | 22 | 25 |
| $$A\_{4}$$ | 5 | 20 | 17 | 23 | 10 | 17 |
| Потребности | 33 | 11 | 11 | 11 | 34 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 8 | 1 | 19 | 1 | 15 | 18 |
| $$A\_{2}$$ | 8 | 27 | 30 | 7 | 7 | 23 |
| $$A\_{3}$$ | 10 | 20 | 19 | 26 | 20 | 17 |
| $$A\_{4}$$ | 18 | 28 | 25 | 7 | 22 | 22 |
| Потребности | 21 | 21 | 9 | 9 | 20 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 11 | 10 | 15 | 8 | 7 | 16 |
| $$A\_{2}$$ | 12 | 14 | 29 | 20 | 20 | 15 |
| $$A\_{3}$$ | 18 | 7 | 5 | 25 | 28 | 24 |
| $$A\_{4}$$ | 24 | 4 | 30 | 24 | 26 | 15 |
| Потребности | 15 | 15 | 15 | 15 | 10 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 12 | 6 | 29 | 19 | 21 | 13 |
| $$A\_{2}$$ | 14 | 3 | 30 | 10 | 10 | 27 |
| $$A\_{3}$$ | 15 | 27 | 28 | 11 | 24 | 16 |
| $$A\_{4}$$ | 1 | 23 | 25 | 15 | 13 | 14 |
| Потребности | 14 | 14 | 14 | 14 | 14 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 28 | 26 | 12 | 22 | 11 | 24 |
| $$A\_{2}$$ | 20 | 23 | 25 | 22 | 9 | 27 |
| $$A\_{3}$$ | 23 | 15 | 11 | 22 | 7 | 16 |
| $$A\_{4}$$ | 1 | 26 | 10 | 11 | 19 | 13 |
| Потребности | 16 | 16 | 16 | 16 | 16 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 29 | 4 | 7 | 6 | 16 | 14 |
| $$A\_{2}$$ | 21 | 13 | 25 | 21 | 7 | 14 |
| $$A\_{3}$$ | 20 | 10 | 12 | 6 | 2 | 14 |
| $$A\_{4}$$ | 17 | 7 | 4 | 6 | 19 | 18 |
| Потребности | 12 | 12 | 12 | 12 | 12 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты наначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 50 | 5 | 27 | 10 | 26 | 15 |
| $$A\_{2}$$ | 7 | 17 | 18 | 21 | 28 | 25 |
| $$A\_{3}$$ | 27 | 21 | 9 | 23 | 26 | 5 |
| $$A\_{4}$$ | 1 | 13 | 17 | 23 | 7 | 15 |
| Потребности | 7 | 8 | 13 | 12 | 20 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 17 | 29 | 2 | 8 | 19 | 32 |
| $$A\_{2}$$ | 14 | 8 | 25 | 15 | 21 | 8 |
| $$A\_{3}$$ | 29 | 11 | 15 | 13 | 20 | 13 |
| $$A\_{4}$$ | 27 | 15 | 19 | 8 | 14 | 27 |
| Потрености | 15 | 15 | 15 | 15 | 20 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 14 | 5 | 27 | 29 | 23 | 18 |
| $$A\_{2}$$ | 17 | 7 | 16 | 19 | 2 | 14 |
| $$A\_{3}$$ | 20 | 12 | 15 | 29 | 5 | 16 |
| $$A\_{4}$$ | 14 | 24 | 18 | 7 | 13 | 12 |
| Потребности | 8 | 11 | 11 | 9 | 21 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 30 | 17 | 26 | 14 | 3 | 24 |
| $$A\_{2}$$ | 18 | 14 | 27 | 6 | 20 | 8 |
| $$A\_{3}$$ | 8 | 24 | 17 | 17 | 26 | 12 |
| $$A\_{4}$$ | 1 | 18 | 21 | 16 | 12 | 16 |
| Потребности | 11 | 11 | 11 | 11 | 16 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 17 | 10 | 7 | 5 | 13 | 34 |
| $$A\_{2}$$ | 12 | 28 | 25 | 9 | 10 | 18 |
| $$A\_{3}$$ | 14 | 15 | 18 | 9 | 28 | 6 |
| $$A\_{4}$$ | 25 | 16 | 21 | 12 | 8 | 12 |
| Потребности | 10 | 10 | 10 | 10 | 30 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 19 | 9 | 14 | 17 | 9 | 17 |
| $$A\_{2}$$ | 4 | 21 | 27 | 8 | 29 | 17 |
| $$A\_{3}$$ | 22 | 30 | 4 | 1 | 24 | 16 |
| $$A\_{4}$$ | 10 | 22 | 8 | 5 | 27 | 10 |
| Потребности | 9 | 9 | 9 | 9 | 24 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 12 | 21 | 19 | 29 | 4 | 23 |
| $$A\_{2}$$ | 27 | 13 | 22 | 19 | 4 | 23 |
| $$A\_{3}$$ | 20 | 27 | 18 | 2 | 23 | 23 |
| $$A\_{4}$$ | 30 | 12 | 3 | 20 | 24 | 23 |
| Потребности | 22 | 22 | 22 | 22 | 4 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 10 | 15 | 14 | 28 | 1 | 14 |
| $$A\_{2}$$ | 16 | 7 | 30 | 8 | 29 | 14 |
| $$A\_{3}$$ | 1 | 21 | 22 | 19 | 12 | 12 |
| $$A\_{4}$$ | 8 | 25 | 28 | 5 | 19 | 16 |
| Потребности | 11 | 11 | 11 | 8 | 15 |  |

 |
|  |

|  |  |  |
| --- | --- | --- |
| Пункты отправлений | Пункты назначения | Запасы |
| $$B\_{1}$$ | $$B\_{2}$$ | $$B\_{3}$$ | $$B\_{4}$$ | $$B\_{5}$$ |
| $$A\_{1}$$ | 17 | 16 | 15 | 29 | 9 | 25 |
| $$A\_{2}$$ | 6 | 27 | 20 | 25 | 20 | 25 |
| $$A\_{3}$$ | 6 | 15 | 12 | 8 | 14 | 15 |
| $$A\_{4}$$ | 10 | 24 | 23 | 5 | 22 | 15 |
| Потребности | 16 | 16 | 16 | 16 | 16 |  |

 |

Для изготовления различных изделий $A$ и $B$ используются три вида сырья. На производство единицы изделия $A$ его требуется затратить: первого вида –$ a\_{1}$ кг, второго вида – $a\_{2}$ кг, третьего вида – $a\_{3}$ кг. На производство единицы изделия $B$требуется затратить: сырья первого вида –$b\_{1}$ кг, второго –$b\_{2}$ кг, третьего –$b\_{3}$ кг. Производство обеспечено сырьем первого вида в количестве $p\_{1}$кг, второго – $p\_{2}$кг, третьего – $p\_{3}$кг. Прибыль от реализации единицы готового изделия $A$ составляет $α$ руб., изделия$B$ – $β$руб. Составить план производства изделий $A$ и $B$, обеспечивающий максимальную прибыль от их реализации.

1.Решить задачу: а) симплексным методом;

б) графическим методом.

2. Составить двойственную задачу. Используя решение исходной задачи, записать оптимальное решение двойственной задачи.

3. Дать экономическую интерпретацию прямой и двойственной задач.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | $$ a\_{1}$$ | $$a\_{2}$$ | $$a\_{3}$$ | $$b\_{1}$$ | $$b\_{2}$$ | $$b\_{3}$$ | $$p\_{1}$$ | $$p\_{2}$$ | $$p\_{3}$$ | $$α$$ | $$β$$ |
|  | 16 | 8 | 5 | 4 | 6 | 9 | 784 | 552 | 567 | 6 | 4 |
|  | 12 | 10 | 3 | 3 | 5 | 6 | 684 | 650 | 558 | 6 | 2 |
|  | 8 | 6 | 4 | 3 | 6 | 9 | 862 | 864 | 945 | 3 | 2 |
|  | 11 | 8 | 3 | 5 | 4 | 5 | 671 | 588 | 423 | 3 | 4 |
|  | 15 | 11 | 9 | 4 | 5 | 10 | 1095 | 865 | 1080 | 3 | 2 |
|  | 4 | 6 | 2 | 5 | 3 | 0 | 600 | 540 | 120 | 3 | 7 |
|  | 6 | 5 | 3 | 3 | 10 | 12 | 714 | 910 | 948 | 3 | 9 |
|  | 9 | 6 | 3 | 4 | 7 | 8 | 801 | 807 | 768 | 3 | 2 |
|  | 3 | 4 | 3 | 5 | 8 | 11 | 453 | 616 | 627 | 1 | 3 |
|  | 10 | 5 | 4 | 9 | 11 | 15 | 1870 | 1455 | 1815 | 7 | 9 |
|  | 5 | 3 | 2 | 2 | 3 | 3 | 505 | 393 | 348 | 7 | 4 |
|  | 7 | 6 | 1 | 3 | 3 | 2 | 1365 | 1245 | 650 | 6 | 5 |
|  | 6 | 4 | 3 | 2 | 3 | 4 | 600 | 510 | 600 | 6 | 3 |
|  | 5 | 4 | 3 | 3 | 3 | 4 | 750 | 631 | 720 | 5 | 6 |
|  | 8 | 6 | 3 | 2 | 3 | 2 | 840 | 870 | 540 | 6 | 2 |
|  | 3 | 3 | 2 | 2 | 3 | 5 | 273 | 300 | 380 | 4 | 5 |
|  | 9 | 6 | 4 | 5 | 8 | 16 | 1431 | 1224 | 1256 | 3 | 2 |
|  | 4 | 3 | 2 | 3 | 4 | 6 | 480 | 444 | 546 | 2 | 4 |
|  | 4 | 3 | 3 | 3 | 4 | 5 | 540 | 393 | 450 | 5 | 6 |
|  | 2 | 3 | 2 | 3 | 6 | 8 | 438 | 672 | 372 | 3 | 8 |
|  | 20 | 15 | 14 | 28 | 9 | 1 | 780 | 465 | 546 | 10 | 7 |
|  | 2 | 4 | 6 | 3 | 1 | 7 | 180 | 240 | 426 | 16 | 12 |
|  | 11 | 13 | 12 | 21 | 15 | 3 | 735 | 741 | 822 | 3 | 5 |
|  | 2 | 4 | 5 | 3 | 2 | 4 | 36 | 50 | 55 | 40 | 50 |
|  | 9 | 15 | 15 | 27 | 15 | 3 | 603 | 705 | 840 | 6 | 11 |
|  | 14 | 15 | 20 | 40 | 27 | 4 | 1200 | 1032 | 1096 | 5 | 13 |
|  | 19 | 16 | 19 | 23 | 12 | 8 | 884 | 656 | 855 | 5 | 4 |
|  | 13 | 13 | 11 | 23 | 15 | 1 | 598 | 494 | 572 | 2 | 3 |
|  | 8 | 14 | 14 | 7 | 8 | 1413 | 574 | 577 | 6 | 5 |  |
|  | 12 | 4 | 3 | 4 | 4 | 12 | 300 | 120 | 252 | 3 | 4 |

Найти максимум целевой функции при заданной системе ограничений. Во всех задачах $x\_{i}\geq 0 $и$x\_{i}$ – целые числа ($i=1,2, …$). Решить задачу одним из методов Гомори и ветвей и границ. Сравнить полученные результаты.

Решить задачу коммивояжера методом ветвей и границ

|  |  |
| --- | --- |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image002.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image002.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image006.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image008.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image010.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image012.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image014.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image016.gif
 |
| 1. .http://math.mrsu.ru/text/courses/method/zadacha_9.files/image020.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image018.gif
 |
| 1. . http://math.mrsu.ru/text/courses/method/zadacha_9.files/image022.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image024.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image026.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image028.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image030.gif.
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image032.gif.
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image034.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image036.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image038.gif.
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image040.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image042.gif.
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image044.gif.
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image046.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image048.gif.
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image060.gif.
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image058.gif.
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image056.gif.
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image054.gif.
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image052.gif.
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_9.files/image050.gif.
 |

Решить задачу об оптимальном назначении

|  |  |
| --- | --- |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image020.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image018.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image016.gif
 | 1. . http://math.mrsu.ru/text/courses/method/zadacha_10.files/image014.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image012.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image010.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image008.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image006.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image004.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image002.gif
 |
| 1. .http://math.mrsu.ru/text/courses/method/zadacha_10.files/image040.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image038.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image036.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image034.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image032.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image030.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image028.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image026.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image024.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image022.gif
 |
| 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image060.gif
 | 1. . http://math.mrsu.ru/text/courses/method/zadacha_10.files/image058.gif
 |
| 1. .http://math.mrsu.ru/text/courses/method/zadacha_10.files/image056.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image054.gif
 |
| 1. .http://math.mrsu.ru/text/courses/method/zadacha_10.files/image052.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image050.gif
 |
| 1. .http://math.mrsu.ru/text/courses/method/zadacha_10.files/image048.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image046.gif
 |
| 1. .http://math.mrsu.ru/text/courses/method/zadacha_10.files/image044.gif
 | 1. http://math.mrsu.ru/text/courses/method/zadacha_10.files/image042.gif
 |

 Для развития трех предприятий выделено 5 млн. руб. Известна эффективность капитальных вложений в каждое предприятие, заданная функцией полезности $g\_{i}\left(x\right)(i=1,2,3)$. Составить оптимальный план распределения средств между предприятиями, предположив, что оно производится в целых числах $\left(0,1,2,3,4,5 млн.руб.\right).$

Исходные данные задачи приведены в таблице.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,4 | 3,5 | 4,0 | 5,1 | 5,7 |
| $$g\_{2}(x)$$ | 0 | 2,0 | 3,0 | 4,1 | 5,3 | 6,0 |
| $$g\_{3}(x)$$ | 0 | 3,1 | 3,4 | 4,4 | 6,0 | 6,2 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,0 | 1,5 | 3,5 | 4,0 | 5,1 |
| $$g\_{2}(x)$$ | 0 | 0,8 | 1,4 | 2,0 | 3,6 | 4,9 |
| $$g\_{3}(x)$$ | 0 | 0,3 | 1,0 | 2,3 | 2,9 | 4,1 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 3,2 | 3,4 | 4,0 | 4,5 | 5,3 |
| $$g\_{2}(x)$$ | 0 | 3,5 | 4,0 | 4,6 | 5,0 | 5,9 |
| $$g\_{3}(x)$$ | 0 | 4,3 | 4,5 | 5,1 | 6,0 | 6,8 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,0 | 2,4 | 3,0 | 3,6 | 4,4 |
| $$g\_{2}(x)$$ | 0 | 1,5 | 2,0 | 2,8 | 4,0 | 5,1 |
| $$g\_{3}(x)$$ | 0 | 2,3 | 2,8 | 3,4 | 4,8 | 5,6 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 4,4 | 4,6 | 4,8 | 4,9 | 5,2 |
| $$g\_{2}(x)$$ | 0 | 4,6 | 4,8 | 5,3 | 5,8 | 6,3 |
| $$g\_{3}(x)$$ | 0 | 4,0 | 4,5 | 5,1 | 6,0 | 6,6 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 4,1 | 4,8 | 5,7 | 6,3 | 7,9 |
| $$g\_{2}(x)$$ | 0 | 3,2 | 3,9 | 5,0 | 7,0 | 8,8 |
| $$g\_{3}(x)$$ | 0 | 4,0 | 6,0 | 6,8 | 9,0 | 11,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,1 | 4,2 | 6,0 | 8,2 | 9,8 |
| $$g\_{2}(x)$$ | 0 | 1,8 | 3,5 | 5,0 | 6,6 | 8,0 |
| $$g\_{3}(x)$$ | 0 | 4,0 | 5,0 | 5,7 | 7,3 | 10,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,0 | 2,2 | 3,0 | 3,4 | 4,0 |
| $$g\_{2}(x)$$ | 0 | 3,0 | 3,1 | 4,0 | 4,4 | 5,0 |
| $$g\_{3}(x)$$ | 0 | 3,1 | 4,0 | 4,7 | 5,0 | 6,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 0,2 | 0,6 | 1,6 | 2,4 | 4,4 |
| $$g\_{2}(x)$$ | 0 | 1,0 | 1,8 | 2,0 | 3,0 | 5,0 |
| $$g\_{3}(x)$$ | 0 | 1,3 | 2,4 | 3,4 | 4,0 | 5,4 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,0 | 2,3 | 3,4 | 3,5 | 4,3 |
| $$g\_{2}(x)$$ | 0 | 2,0 | 3,0 | 4,5 | 4,9 | 5,1 |
| $$g\_{3}(x)$$ | 0 | 3,1 | 3,5 | 4,0 | 4,6 | 5,5 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 3,6 | 4,0 | 4,6 | 5,0 | 7,4 |
| $$g\_{2}(x)$$ | 0 | 2,5 | 3,0 | 3,7 | 4,8 | 6,7 |
| $$g\_{3}(x)$$ | 0 | 3,4 | 3,5 | 4,8 | 5,7 | 7,8 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 0,5 | 1,2 | 1,7 | 2,0 | 2,9 |
| $$g\_{2}(x)$$ | 0 | 0,9 | 1,0 | 1,5 | 1,8 | 3,0 |
| $$g\_{3}(x)$$ | 0 | 1,5 | 1,8 | 2,5 | 2,9 | 3,5 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 3,3 | 3,8 | 4,5 | 5,0 | 5,3 |
| $$g\_{2}(x)$$ | 0 | 3,6 | 3,9 | 4,2 | 5,8 | 6,3 |
| $$g\_{3}(x)$$ | 0 | 2,6 | 2,9 | 3,8 | 4,5 | 4,9 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 0,8 | 1,4 | 2,0 | 3,0 | 4,9 |
| $$g\_{2}(x)$$ | 0 | 0,3 | 1,0 | 2,3 | 2,5 | 5,3 |
| $$g\_{3}(x)$$ | 0 | 2,0 | 4,0 | 4,5 | 5,2 | 5,8 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,9 | 2,5 | 2,9 | 3,3 | 4,4 |
| $$g\_{2}(x)$$ | 0 | 1,5 | 2,0 | 2,4 | 3,1 | 5,0 |
| $$g\_{3}(x)$$ | 0 | 2,0 | 3,2 | 3,9 | 4,0 | 6,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,5 | 2,7 | 3,0 | 3,1 | 3,3 |
| $$g\_{2}(x)$$ | 0 | 2,0 | 3,0 | 4,0 | 5,0 | 5,5 |
| $$g\_{3}(x)$$ | 0 | 2,0 | 3,4 | 4,9 | 5,3 | 6,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,0 | 3,0 | 4,8 | 5,5 | 7,0 |
| $$g\_{2}(x)$$ | 0 | 3,0 | 3,2 | 3,8 | 5,2 | 6,5 |
| $$g\_{3}(x)$$ | 0 | 1,0 | 2,2 | 3,0 | 5,0 | 6,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,4 | 2,1 | 2,5 | 2,7 | 3,0 |
| $$g\_{2}(x)$$ | 0 | 0,8 | 1,2 | 1,6 | 2,2 | 2,8 |
| $$g\_{3}(x)$$ | 0 | 1,2 | 1,8 | 2,2 | 2,6 | 3,2 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,5 | 3,2 | 4,0 | 5,0 | 6,2 |
| $$g\_{2}(x)$$ | 0 | 2,0 | 3,0 | 4,0 | 5,2 | 6,8 |
| $$g\_{3}(x)$$ | 0 | 2,0 | 3,5 | 5,0 | 6,1 | 7,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 3,4 | 4,5 | 5,0 | 6,1 | 6,7 |
| $$g\_{2}(x)$$ | 0 | 3,0 | 4,0 | 5,1 | 6,3 | 7,0 |
| $$g\_{3}(x)$$ | 0 | 4,1 | 4,4 | 5,4 | 7,0 | 7,2 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,3 | 1,5 | 2,0 | 2,8 | 3,4 |
| $$g\_{2}(x)$$ | 0 | 1,6 | 2,5 | 2,7 | 3,0 | 4,0 |
| $$g\_{3}(x)$$ | 0 | 3,0 | 3,5 | 3,8 | 4,0 | 5,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 2,3 | 3,1 | 3,5 | 4,5 | 5,0 |
| $$g\_{2}(x)$$ | 0 | 2,2 | 3,5 | 4,1 | 5,5 | 6,2 |
| $$g\_{3}(x)$$ | 0 | 3,4 | 3,8 | 4,1 | 5,7 | 6,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 4,0 | 4,6 | 4,9 | 5,2 | 5,5 |
| $$g\_{2}(x)$$ | 0 | 2,0 | 2,5 | 3,0 | 3,5 | 3,9 |
| $$g\_{3}(x)$$ | 0 | 3,0 | 3,6 | 3,8 | 4,0 | 5,8 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,2 | 2,3 | 3,4 | 4,5 | 5,6 |
| $$g\_{2}(x)$$ | 0 | 0,9 | 1,3 | 2,6 | 3,0 | 3,7 |
| $$g\_{3}(x)$$ | 0 | 2,1 | 3,2 | 4,3 | 5,4 | 6,5 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,9 | 2,2 | 3,4 | 5,1 | 5,0 |
| $$g\_{2}(x)$$ | 0 | 2,2 | 3,8 | 4,0 | 5,5 | 6,3 |
| $$g\_{3}(x)$$ | 0 | 3,3 | 3,9 | 4,6 | 5,7 | 6,6 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,3 | 2,4 | 3,5 | 4,6 | 5,7 |
| $$g\_{2}(x)$$ | 0 | 2,5 | 3,6 | 4,7 | 5,8 | 6,9 |
| $$g\_{3}(x)$$ | 0 | 3,7 | 4,8 | 5,9 | 7,0 | 7,2 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 1,3 | 1,7 | 2,1 | 2,3 | 2,7 |
| $$g\_{2}(x)$$ | 0 | 1,6 | 1,9 | 2,3 | 3,0 | 4,5 |
| $$g\_{3}(x)$$ | 0 | 2,3 | 2,5 | 3,2 | 4,0 | 5,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 4,6 | 5,0 | 5,8 | 6,0 | 6,3 |
| $$g\_{2}(x)$$ | 0 | 5,4 | 6,2 | 6,5 | 7,3 | 8,0 |
| $$g\_{3}(x)$$ | 0 | 3,1 | 4,0 | 5,4 | 6,7 | 9,0 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 0,5 | 1,0 | 1,5 | 2,0 | 2,5 |
| $$g\_{2}(x)$$ | 0 | 2,0 | 2,3 | 2,6 | 3,0 | 4,0 |
| $$g\_{3}(x)$$ | 0 | 1,4 | 2,1 | 2,4 | 3,2 | 3,5 |

 |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| $$x$$ | 0 | 1 | 2 | 3 | 4 | 5 |
| $$g\_{1}(x)$$ | 0 | 5,6 | 6,0 | 6,7 | 7,2 | 8,0 |
| $$g\_{2}(x)$$ | 0 | 6,3 | 7,1 | 7,8 | 8,2 | 8,8 |
| $$g\_{3}(x)$$ | 0 | 6,5 | 7,0 | 7,5 | 8,0 | 9,0 |

 |

Приложение 1

**Номера контрольных заданий по вариантам**

|  |  |
| --- | --- |
| **№ варианта** | **№ заданий** |
| 01 | 2 | 57 | 83 | 120 | 135 |
| 02 | 5 | 51 | 61 | 111 | 132 |
| 03 | 9 | 34 | 67 | 97 | 134 |
| 04 | 6 | 34 | 76 | 110 | 129 |
| 05 | 2 | 56 | 78 | 96 | 123 |
| 06 | 27 | 60 | 86 | 95 | 141 |
| 07 | 10 | 39 | 72 | 116 | 130 |
| 08 | 17 | 41 | 68 | 112 | 129 |
| 09 | 24 | 53 | 61 | 118 | 141 |
| 10 | 25 | 55 | 89 | 98 | 142 |
| 11 | 11 | 57 | 87 | 115 | 149 |
| 12 | 20 | 47 | 88 | 98 | 146 |
| 13 | 1 | 55 | 65 | 95 | 150 |
| 14 | 22 | 47 | 73 | 116 | 146 |
| 15 | 5 | 38 | 85 | 113 | 141 |
| 16 | 21 | 48 | 89 | 100 | 147 |
| 17 | 13 | 35 | 72 | 119 | 141 |
| 18 | 12 | 52 | 90 | 117 | 126 |
| 19 | 14 | 35 | 72 | 103 | 131 |
| 20 | 6 | 40 | 63 | 102 | 127 |
| 21 | 9 | 60 | 90 | 103 | 123 |
| 22 | 27 | 57 | 78 | 94 | 150 |
| 23 | 27 | 43 | 66 | 94 | 121 |
| 24 | 22 | 53 | 65 | 111 | 140 |
| 25 | 23 | 48 | 66 | 107 | 141 |
| 26 | 29 | 51 | 82 | 117 | 143 |
| 27 | 26 | 43 | 82 | 117 | 149 |
| 28 | 20 | 43 | 70 | 92 | 122 |
| 29 | 15 | 44 | 67 | 97 | 143 |
| 30 | 12 | 58 | 77 | 99 | 131 |
| 31 | 11 | 57 | 76 | 113 | 142 |
| 32 | 1 | 53 | 75 | 91 | 128 |
| 33 | 15 | 54 | 75 | 111 | 127 |
| 34 | 4 | 45 | 73 | 116 | 148 |
| 35 | 24 | 37 | 90 | 95 | 133 |
| 36 | 25 | 42 | 66 | 92 | 128 |
| 37 | 11 | 31 | 79 | 97 | 122 |
| 38 | 5 | 35 | 83 | 102 | 126 |
| 39 | 15 | 47 | 87 | 114 | 134 |
| 40 | 14 | 42 | 67 | 107 | 133 |
| 41 | 1 | 42 | 63 | 93 | 135 |
| 42 | 4 | 59 | 84 | 102 | 134 |
| 43 | 13 | 41 | 90 | 104 | 121 |
| 44 | 25 | 49 | 69 | 93 | 121 |
| 45 | 4 | 44 | 69 | 94 | 141 |
| 46 | 11 | 51 | 71 | 112 | 142 |
| 47 | 4 | 47 | 61 | 101 | 127 |
| 48 | 5 | 40 | 79 | 96 | 125 |
| 49 | 24 | 50 | 64 | 120 | 127 |
| 50 | 7 | 58 | 68 | 93 | 122 |
| 51 | 4 | 42 | 72 | 100 | 127 |
| 52 | 18 | 33 | 80 | 113 | 133 |
| 53 | 12 | 51 | 81 | 110 | 122 |
| 54 | 18 | 59 | 72 | 115 | 124 |
| 55 | 4 | 32 | 70 | 118 | 131 |
| 56 | 19 | 50 | 80 | 112 | 142 |
| 57 | 1 | 41 | 63 | 100 | 128 |
| 58 | 4 | 41 | 72 | 119 | 142 |
| 59 | 7 | 38 | 83 | 117 | 134 |
| 60 | 25 | 37 | 73 | 104 | 130 |
| 61 | 12 | 56 | 76 | 96 | 125 |
| 62 | 5 | 31 | 87 | 114 | 133 |
| 63 | 30 | 57 | 66 | 109 | 127 |
| 64 | 29 | 49 | 90 | 114 | 124 |
| 65 | 18 | 31 | 62 | 96 | 126 |
| 66 | 24 | 48 | 62 | 92 | 121 |
| 67 | 29 | 41 | 83 | 94 | 133 |
| 68 | 12 | 44 | 87 | 107 | 130 |
| 69 | 22 | 48 | 85 | 101 | 140 |
| 70 | 24 | 48 | 82 | 110 | 132 |
| 71 | 14 | 50 | 72 | 99 | 136 |
| 72 | 8 | 34 | 63 | 118 | 132 |
| 73 | 23 | 44 | 80 | 109 | 137 |
| 74 | 23 | 54 | 70 | 117 | 142 |
| 75 | 11 | 53 | 68 | 114 | 147 |
| 76 | 9 | 58 | 70 | 109 | 139 |
| 77 | 16 | 33 | 62 | 97 | 134 |
| 78 | 25 | 55 | 88 | 109 | 125 |
| 79 | 17 | 60 | 76 | 92 | 140 |
| 80 | 6 | 47 | 83 | 113 | 141 |
| 81 | 18 | 50 | 65 | 98 | 139 |
| 82 | 30 | 46 | 66 | 110 | 123 |
| 83 | 20 | 54 | 75 | 115 | 124 |
| 84 | 22 | 36 | 61 | 119 | 124 |
| 85 | 22 | 32 | 85 | 92 | 149 |
| 86 | 5 | 52 | 63 | 111 | 128 |
| 87 | 28 | 60 | 66 | 104 | 129 |
| 88 | 9 | 39 | 78 | 120 | 135 |
| 89 | 4 | 39 | 63 | 91 | 139 |
| 90 | 22 | 45 | 63 | 109 | 142 |
| 91 | 28 | 37 | 62 | 117 | 138 |
| 92 | 10 | 31 | 70 | 118 | 138 |
| 93 | 26 | 45 | 72 | 102 | 131 |
| 94 | 22 | 36 | 75 | 104 | 121 |
| 95 | 24 | 49 | 65 | 120 | 143 |
| 96 | 14 | 47 | 68 | 108 | 136 |
| 97 | 14 | 51 | 77 | 110 | 124 |
| 98 | 20 | 56 | 88 | 116 | 139 |
| 99 | 2 | 53 | 62 | 113 | 147 |
| 00 | 4 | 36 | 75 | 120 | 134 |