In [27]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

In [28]:
```
df = pd.read_csv('D3.csv')
X1 = df.values[:, 0]
X2 = df.values[:, 1]
X3 = df.values[:, 2]
y = df.values[:, 3]
m = len(y)
print('X1 = ', X1[: 5])
print('X2 = ', X2[: 5])
print('X3 = ', X3[: 5])
print('y = ', y[: 5])
print('m = ', m)
```

```
X1 =  [0.         0.04040404 0.08080808 0.12121212 0.16161616]
X2 =  [3.44       0.1349495  0.82989899 1.52484848 2.21979798]
X3 =  [0.44       0.88818485 1.33369697 1.78545454 2.23393939]
y =  [4.38754501 2.6796499  2.96848981 3.25406475 3.53637472]
m =  100
```

In [29]:
```
X_0 = np.ones((m, 1))
X_0[:5]
```

Out[29]:
```
array([[1.],
       [1.],
       [1.],
       [1.],
       [1.]])
```

In [30]:
```
X_1 = X1.reshape(m, 1)
X_2 = X2.reshape(m, 1)
X_3 = X3.reshape(m, 1)
print('X_1 = ', X_1[: 5])
print('X_2 = ', X_2[: 5])
print('X_3 = ', X_3[: 5])
```

```
X_1 =  [[0.        ]
 [0.04040404]
 [0.08080808]
 [0.12121212]
 [0.16161616]]
X_2 =  [[3.44      ]
 [0.1349495 ]
 [0.82989899]
 [1.52484848]
 [2.21979798]]
X_3 =  [[0.44      ]
 [0.88818485]
 [1.33369697]
 [1.78545454]
 [2.23393939]]
```

In [31]:
```
X = np.hstack((X_0, X_1, X_2, X_3))
X [: 5]
```

Out[31]:
```
array([[1.        , 0.        , 3.44      , 0.44      ],
       [1.        , 0.04040404, 0.1349495 , 0.88818485],
       [1.        , 0.08080808, 0.82989899, 1.33369697],
       [1.        , 0.12121212, 1.52484848, 1.78545454],
       [1.        , 0.16161616, 2.21979798, 2.23393939]])
```

In [32]:
```
theta = np.zeros(4)
theta
```

Out[32]:
```
array([0., 0., 0., 0.])
```

In [33]:
```
def compute_cost(X, y, theta):
    predictions = X.dot(theta)
    errors = np.subtract(predictions, y)
    sqrErrors = np.square(errors)
    J = 1 / (2 * m) * np.sum(sqrErrors)
    return J
```

In [34]:
```
def gradient_descent(X, y, theta, alpha, iterations):
    cost_history = np.zeros(iterations)
    for i in range(iterations):
        predictions = X.dot(theta)
        errors = np.subtract(predictions, y)
        sum_delta = (alpha / m) * X.transpose().dot(errors);
        theta = theta - sum_delta;
        cost_history[i] = compute_cost(X, y, theta)

    return theta, cost_history
```

In [35]:
```
cost = compute_cost(X, y, theta)
cost
```

Out[35]:
```
5.524438459196242
```

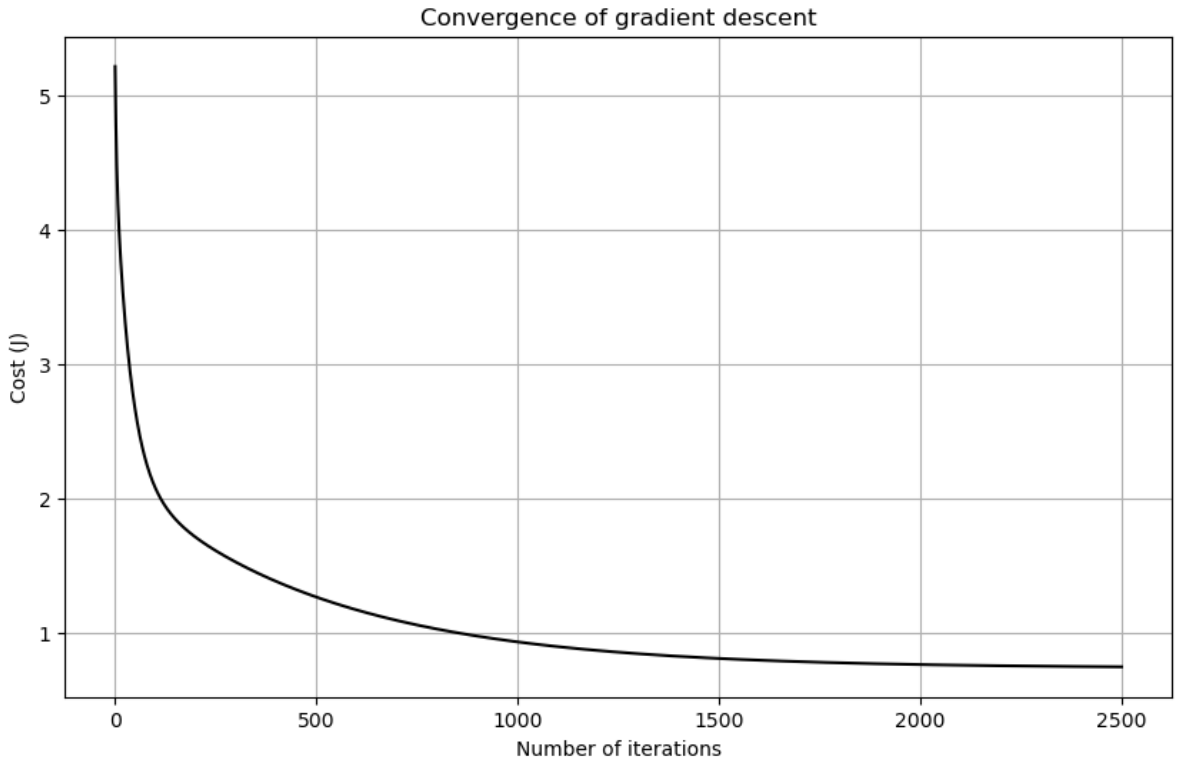
In [36]:
```
theta = [0., 0., 0., 0.]
iterations = 2500;
alpha = 0.01
```

In [37]:
```
theta, cost_history = gradient_descent(X, y, theta, alpha, iterations)
print('Final value of theta=', theta)
print('cost_history =', cost_history)
```

```
Final value of theta= [ 4.88618623 -1.94311861  0.60344978 -0.20272198]
cost_history = [5.21542243 4.97171977 4.7765543  ... 0.74830606 0.74828645
 0.74826683]
```

In [38]:
```
plt.plot(range(1, iterations + 1),cost_history, color='black')
plt.rcParams["figure.figsize"] = (10,6)
plt.grid()
plt.xlabel('Number of iterations')
plt.ylabel('Cost (J)')
plt.title('Convergence of gradient descent')
```

Out[38]:
```
Text(0.5, 1.0, 'Convergence of gradient descent')
```



In [39]:
```
X_new = ([1, 1, 1, 1],
         [1, 2, 0, 4],
         [1, 3, 2, 1])

Predictions_new = np.dot(X_new, theta)
Predictions_new
```

Out[39]: