

## Естественные координаты

Точка движется по плоской кривой  $y = y(x)$  с постоянной скоростью  $v$ . Определить ускорение точки, радиус кривизны траектории и косинус угла наклона касательной к траектории с осью  $ox$  при заданном значении  $x$ .

Кирсанов М.Н. **Решебник. Теоретическая механика**/Под ред. А. И. Кириллова.– М.: ФИЗМАТЛИТ, 2008. – 384 с. (с.140.)

### Задача К3.1.

3

$$y = 15x \cos \frac{x+1}{8},$$
$$v = 2 \text{ м/с}, x = 6 \text{ м.}$$

### Задача К3.2.

3

$$y = \frac{x(4 + \sin(x/3))}{5},$$
$$v = 17 \text{ м/с}, x = 3 \text{ м.}$$

### Задача К3.3.

3

$$y = 3e^{x/7} - 3x,$$
$$v = 9 \text{ м/с}, x = 5 \text{ м.}$$

### Задача К3.4.

3

$$y = \frac{x(6 + \cos(x/4))}{7},$$
$$v = 13 \text{ м/с}, x = 1 \text{ м.}$$

### Задача К3.5.

3

$$y = 4x \cos \frac{x+2}{10},$$
$$v = 2 \text{ м/с}, x = 6 \text{ м.}$$

### Задача К3.6.

3

$$y = \frac{83}{x+3},$$
$$v = 6 \text{ м/с}, x = 5 \text{ м.}$$

### Задача К3.7.

3

$$y = \frac{x}{18} (e^{x+1} + 3),$$
$$v = 2 \text{ м/с}, x = 1 \text{ м.}$$

### Задача К3.8.

3

$$y = \frac{1}{6} (e^{x/2} + 5e^{-x/2}),$$
$$v = 4 \text{ м/с}, x = 5 \text{ м.}$$

### Задача К3.9.

3

$$y = \frac{21}{x+3},$$
$$v = 5 \text{ м/с}, x = 1 \text{ м.}$$

### Задача К3.10.

3

$$y = 6x \cos \frac{x+1}{6},$$
$$v = 2 \text{ м/с}, x = 4 \text{ м.}$$

### Задача К3.11.

3

$$y = 5 \sin^2(x/2) + 4x,$$
$$v = 3 \text{ м/с}, x = 2 \text{ м.}$$

### Задача К3.12.

3

$$y = -2x^2 + 6x + 3,$$
$$v = 1 \text{ м/с}, x = 1 \text{ м.}$$

### Задача К3.13.

3

$$y = 4 \ln(x/2 + 1),$$
$$v = 5 \text{ м/с}, x = 2 \text{ м.}$$

### Задача К3.14.

3

$$y = 2e^{x/10} - 2x,$$
$$v = 17 \text{ м/с}, x = 6 \text{ м.}$$

### Задача К3.15.

3

$$y = \frac{x^2}{2} + \sin \frac{x}{4},$$
$$v = 4 \text{ м/с}, x = 1 \text{ м.}$$

### Задача К3.16.

3

$$y = \frac{x^2}{2} + \sin \frac{x}{4},$$
$$v = 4 \text{ м/с}, x = 1 \text{ м.}$$

### Задача К3.17.

3

$$y = 5 \sin^2 \frac{x}{3} + \cos \frac{x}{3},$$
$$v = 3 \text{ м/с}, x = 4 \text{ м.}$$

### Задача К3.18.

3

$$y = 15 \ln(x/3 + 1),$$
$$v = 4 \text{ м/с}, x = 2 \text{ м.}$$

### Задача К3.19.

3

$$y = \frac{x(5 + \sin^2(4x))}{4},$$
$$v = 2 \text{ м/с}, x = 2 \text{ м.}$$

### Задача К3.20.

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$$y = 4x \cos \frac{x+1}{9},$$
$$v = 2 \text{ м/с}, x = 6 \text{ м.}$$

### Задача К3.21.

3

$$y = 10 \ln(x/2 + 1),$$
$$v = 4 \text{ м/с}, x = 3 \text{ м.}$$

**Задача К3.22.**

3

$$y = 3\sqrt{4x+2},$$
$$v = 11 \text{ м/с}, x = 6 \text{ м.}$$

**Задача К3.23.**

3

$$y = \frac{x}{17} (e^{x+1} + 2),$$
$$v = 2 \text{ м/с}, x = 1 \text{ м.}$$

**Задача К3.24.**

3

$$y = x(\sqrt{x+2} + 6)/5,$$
$$v = 18 \text{ м/с}, x = 6 \text{ м.}$$

**Задача К3.25.**

3

$$y = 21 \cos \frac{x}{9} + \frac{x^2}{5},$$
$$v = 6 \text{ м/с}, x = 6 \text{ м.}$$

**Задача К3.26.**

3

$$y = 3\sqrt{4x+3},$$
$$v = 5 \text{ м/с}, x = 1 \text{ м.}$$

**Задача К3.27.**

3

$$y = 2 \sin^2 \frac{x}{3} + \cos \frac{x}{3},$$
$$v = 4 \text{ м/с}, x = 5 \text{ м.}$$

**Задача К3.28.**

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$$y = \frac{71}{\sin(x/5) + 3},$$
$$v = 3 \text{ м/с}, x = 4 \text{ м.}$$

**Задача К3.29.**

3

$$y = 3\sqrt{6x+4},$$
$$v = 9 \text{ м/с}, x = 5 \text{ м.}$$

**Задача К3.30.**

3

$$y = \frac{x}{4}(\ln(x+3) + 2),$$
$$v = 4 \text{ м/с}, x = 1 \text{ м.}$$

**Задача К3.31.**

3

$$y = 3\sqrt{5x+3},$$
$$v = 4 \text{ м/с}, x = 1 \text{ м.}$$

**Задача К3.32.**

3

$$y = 15 \frac{x}{x+3},$$
$$v = 5 \text{ м/с}, x = 4 \text{ м.}$$

**Задача К3.33.**

3

$$y = 3\sqrt{5x+3},$$
$$v = 11 \text{ м/с}, x = 6 \text{ м.}$$

**КЗ Ответы.**  
**Естественные координаты**

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| №  | $y'$   | $y''$   | $v_x$  | $v_y$   | $\cos(\alpha)$ | $a_x$  | $a_y$   | $a$    | $R$     |
|----|--------|---------|--------|---------|----------------|--------|---------|--------|---------|
| 1  | 0.980  | -3.780  | 1.428  | 1.400   | 0.714          | 3.855  | -3.933  | 5.507  | 0.726   |
| 2  | 1.076  | 0.016   | 11.571 | 12.454  | 0.681          | -1.064 | 0.989   | 1.453  | 198.926 |
| 3  | -2.125 | 0.125   | 3.833  | -8.143  | 0.426          | 0.708  | 0.333   | 0.782  | 103.521 |
| 4  | 0.987  | -0.026  | 9.254  | 9.131   | 0.712          | 1.127  | -1.142  | 1.604  | 105.333 |
| 5  | 1.065  | -0.741  | 1.369  | 1.458   | 0.684          | 0.693  | -0.651  | 0.951  | 4.208   |
| 6  | -1.297 | 0.324   | 3.664  | -4.751  | 0.611          | 2.105  | 1.623   | 2.658  | 13.546  |
| 7  | 0.988  | 1.232   | 1.423  | 1.405   | 0.711          | -1.247 | 1.262   | 1.774  | 2.255   |
| 8  | 0.981  | 0.525   | 2.855  | 2.801   | 0.714          | -2.139 | 2.180   | 3.054  | 5.239   |
| 9  | -1.313 | 0.656   | 3.030  | -3.977  | 0.606          | 2.905  | 2.213   | 3.652  | 6.846   |
| 10 | 1.074  | -1.929  | 1.363  | 1.464   | 0.682          | 1.787  | -1.664  | 2.442  | 1.638   |
| 11 | 6.273  | -1.040  | 0.472  | 2.963   | 0.157          | 0.036  | -0.006  | 0.037  | 246.398 |
| 12 | 2.000  | -4.000  | 0.447  | 0.894   | 0.447          | 0.320  | -0.160  | 0.358  | 2.795   |
| 13 | 1.000  | -0.250  | 3.536  | 3.536   | 0.707          | 1.563  | -1.563  | 2.210  | 11.314  |
| 14 | -1.636 | 0.036   | 8.868  | -14.504 | 0.522          | 1.275  | 0.780   | 1.495  | 193.330 |
| 15 | 1.242  | 0.985   | 2.508  | 3.116   | 0.627          | -3.026 | 2.436   | 3.884  | 4.119   |
| 16 | 1.242  | 0.985   | 2.508  | 3.116   | 0.627          | -3.026 | 2.436   | 3.884  | 4.119   |
| 17 | 0.438  | -1.014  | 2.748  | 1.204   | 0.916          | 2.815  | -6.425  | 7.015  | 1.283   |
| 18 | 3.000  | -0.600  | 1.265  | 3.795   | 0.316          | 0.288  | -0.096  | 0.304  | 52.705  |
| 19 | 0.919  | -15.898 | 1.473  | 1.353   | 0.736          | 17.178 | -18.694 | 25.389 | 0.158   |
| 20 | 0.979  | -0.835  | 1.429  | 1.399   | 0.715          | 0.853  | -0.871  | 1.219  | 3.281   |
| 21 | 2.000  | -0.400  | 1.789  | 3.578   | 0.447          | 0.512  | -0.256  | 0.572  | 27.951  |
| 22 | 1.177  | -0.091  | 7.123  | 8.382   | 0.648          | 2.266  | -1.926  | 2.974  | 40.682  |
| 23 | 0.987  | 1.304   | 1.423  | 1.405   | 0.712          | -1.321 | 1.338   | 1.881  | 2.127   |
| 24 | 1.978  | 0.057   | 8.122  | 16.063  | 0.451          | -1.526 | 0.772   | 1.710  | 189.473 |
| 25 | 0.957  | 0.196   | 4.335  | 4.149   | 0.722          | -1.842 | 1.924   | 2.664  | 13.515  |
| 26 | 2.268  | -0.648  | 2.017  | 4.575   | 0.403          | 0.973  | -0.429  | 1.064  | 23.497  |
| 27 | -0.459 | -0.426  | 3.636  | -1.668  | 0.909          | -2.133 | -4.648  | 5.113  | 3.129   |
| 28 | -0.716 | 0.201   | 2.439  | -1.746  | 0.813          | 0.566  | 0.791   | 0.973  | 9.250   |
| 29 | 1.543  | -0.136  | 4.894  | 7.553   | 0.544          | 1.488  | -0.964  | 1.773  | 45.675  |
| 30 | 0.909  | 0.109   | 2.960  | 2.691   | 0.740          | -0.477 | 0.525   | 0.709  | 22.567  |
| 31 | 2.652  | -0.829  | 1.411  | 3.743   | 0.353          | 0.545  | -0.206  | 0.583  | 27.467  |
| 32 | 0.918  | -0.262  | 3.683  | 3.382   | 0.737          | 1.773  | -1.930  | 2.621  | 9.539   |
| 33 | 1.306  | -0.099  | 6.689  | 8.733   | 0.608          | 2.136  | -1.636  | 2.691  | 44.969  |

КЗ файл оЗкЗА