

Полярные координаты

Задан закон движения точки в полярных координатах: $\rho = \rho(t)$ (в метрах), $\varphi = \varphi(t)$. В указанный момент времени найти скорость и ускорение точки в полярных, декартовых и естественных координатах.

Кирсанов М.Н. **Решбник. Теоретическая механика**/Под ред. А. И. Кириллова.– М.: ФИЗМАТЛИТ, 2008. — 384 с. (с.144.)

Задача К4.1.

3

$$r = \frac{28}{1 + 0.4 \cos(t/6)},$$
$$\varphi = \frac{t}{6}, t = 4 \text{ с.}$$

Задача К4.2.

3

$$r = \frac{29}{1 + 3 \cos(t/4)},$$
$$\varphi = \frac{t}{4}, t = 3 \text{ с.}$$

Задача К4.3.

3

$$r = \frac{29}{1 + 0.8 \cos(t/10)},$$
$$\varphi = \frac{t}{10}, t = 6 \text{ с.}$$

Задача К4.4.

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$$r = \frac{4}{3}t - \frac{96}{t},$$
$$\varphi = \arccos(t/12), t = 9 \text{ с.}$$

Задача К4.5.

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$$r = 5 + 5t\text{g}^2(\pi t/18),$$
$$\varphi = \cos^2(\pi t/18), t = 5 \text{ с.}$$

Задача К4.6.

3

$$r = 11 + 11t\text{g}^2(\pi t/18),$$
$$\varphi = \cos^2(\pi t/18), t = 5 \text{ с.}$$

Задача К4.7.

3

$$r = 16 \cos^2(\pi t/8),$$
$$\varphi = \cos^2(\pi t/8), t = 2 \text{ с.}$$

Задача К4.8.

3

$$r = 10(t/5)^3,$$
$$\varphi = (t/5)^3, t = 4 \text{ с.}$$

Задача К4.9.

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$$r = 21(1 - (t/3)^2)/t,$$
$$\varphi = \arccos(t/3), t = 1 \text{ с.}$$

Задача К4.10.

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$$r = \frac{26}{1 + \cos(t/8)},$$
$$\varphi = \frac{t}{8}, t = 4 \text{ с.}$$

Задача К4.11.

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$$r = 60(1 - (t/10)^2)/t,$$
$$\varphi = \arccos(t/10), t = 5 \text{ с.}$$

Задача К4.12.

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$$r = 8e^{-t/8},$$
$$\varphi = e^{t/8}, t = 5 \text{ с.}$$

Задача К4.13.

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$$r = \frac{1}{3}t - \frac{24}{t},$$
$$\varphi = \arccos(t/12), t = 8 \text{ с.}$$

Задача К4.14.

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$$r = 21 \cos^2(\pi t/14),$$
$$\varphi = \cos^2(\pi t/14), t = 8 \text{ с.}$$

Задача К4.15.

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$$r = 29/(1 + t/4),$$
$$\varphi = \arccos(t/4), t = 1 \text{ c.}$$

Задача К4.16.

3

$$r = 2 \cos(t/7) + 2,$$
$$\varphi = t/7, t = 6 \text{ c.}$$

Задача К4.17.

3

$$r = 17(t/5)^2,$$
$$\varphi = (t/5)^2, t = 4 \text{ c.}$$

Задача К4.18.

3

$$r = \frac{14 \sin^2(t/6)}{\cos(t/6)},$$
$$\varphi = \frac{t}{6}, t = 2 \text{ c.}$$

Задача К4.19.

3

$$r = \frac{21}{1 + 5 \cos(t/7)},$$
$$\varphi = \frac{t}{7}, t = 6 \text{ c.}$$

Задача К4.20.

3

$$r = 17 \cos^2(\pi t/11),$$
$$\varphi = \cos^2(\pi t/11), t = 7 \text{ c.}$$

Задача К4.21.

3

$$r = \frac{21}{1 + 0.8 \cos(t/10)},$$
$$\varphi = \frac{t}{10}, t = 6 \text{ c.}$$

Задача К4.22.

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$$r = 25/(1 + \frac{4}{11}t),$$
$$\varphi = \arccos(t/11), t = 10 \text{ c.}$$

Задача К4.23.

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$$r = 23/(1 + 2t/25),$$
$$\varphi = \arccos(t/10), t = 6 \text{ c.}$$

Задача К4.24.

3

$$r = 21/(1 + t/4),$$
$$\varphi = \arccos(t/4), t = 1 \text{ c.}$$

Задача К4.25.

3

$$r = \frac{28}{1 + 0.2 \cos(t/2)},$$
$$\varphi = \frac{t}{2}, t = 1 \text{ c.}$$

Задача К4.26.

3

$$r = 25/(1 + t/4),$$
$$\varphi = \arccos(t/4), t = 3 \text{ c.}$$

Задача К4.27.

3

$$r = 7(t/4 + 0.5)^{-2},$$
$$\varphi = (t/4 + 0.5)^2, t = 2 \text{ c.}$$

Задача К4.28.

3

$$r = \frac{14 \sin^2(t/11)}{\cos(t/11)},$$
$$\varphi = \frac{t}{11}, t = 7 \text{ c.}$$

К4 Ответы.
Полярные координаты

07.04.2012

| № | ρ | $\dot{\rho}$ | φ | $\dot{\varphi}$ | v_ρ | v_φ | v | v_x | v_y | Кривая |
|----|--------|--------------|-----------|-----------------|----------|-------------|--------|--------|---------|-------------------------|
| 1 | 21.303 | 0.668 | 0.667 | 0.167 | 0.668 | 3.551 | 3.613 | -1.670 | 3.204 | Эллипс |
| 2 | 9.076 | 1.452 | 0.750 | 0.250 | 1.452 | 2.269 | 2.694 | -0.484 | 2.650 | Гипербола |
| 3 | 17.467 | 0.475 | 0.600 | 0.100 | 0.475 | 1.747 | 1.810 | -0.594 | 1.710 | Эллипс |
| 4 | 1.333 | 2.519 | 0.723 | -0.126 | 2.519 | -0.168 | 2.524 | 2.000 | 1.540 | Строфоида |
| 5 | 12.101 | 5.034 | 0.413 | -0.172 | 5.034 | -2.080 | 5.447 | 5.446 | 0.116 | Гиперболическая спираль |
| 6 | 26.623 | 11.075 | 0.413 | -0.172 | 11.075 | -4.576 | 11.983 | 11.981 | 0.256 | Гиперболическая спираль |
| 7 | 8.000 | -6.283 | 0.500 | -0.393 | -6.283 | -3.142 | 7.025 | -4.008 | -5.769 | Архимедова спираль |
| 8 | 5.120 | 3.840 | 0.512 | 0.384 | 3.840 | 1.966 | 4.314 | 2.384 | 3.595 | Архимедова спираль |
| 9 | 18.667 | -23.333 | 1.231 | -0.354 | -23.333 | -6.600 | 24.249 | -1.556 | -24.199 | Циссоида |
| 10 | 13.848 | 0.442 | 0.500 | 0.125 | 0.442 | 1.731 | 1.786 | -0.442 | 1.731 | Парабола |
| 11 | 9.000 | -3.000 | 1.047 | -0.115 | -3.000 | -1.039 | 3.175 | -0.600 | -3.118 | Циссоида |
| 12 | 4.282 | -0.535 | 1.868 | 0.234 | -0.535 | 1.000 | 1.134 | -0.799 | -0.805 | Гиперболическая спираль |
| 13 | -0.333 | 0.708 | 0.841 | -0.112 | 0.708 | 0.037 | 0.709 | 0.444 | 0.553 | Строфоида |
| 14 | 1.040 | 2.045 | 0.050 | 0.097 | 2.045 | 0.101 | 2.047 | 2.037 | 0.202 | Архимедова спираль |
| 15 | 23.200 | -4.640 | 1.318 | -0.258 | -4.640 | -5.990 | 7.577 | 4.640 | -5.990 | Парабола |
| 16 | 3.309 | -0.216 | 0.857 | 0.143 | -0.216 | 0.473 | 0.520 | -0.499 | 0.146 | Кардиоида |
| 17 | 10.880 | 5.440 | 0.640 | 0.320 | 5.440 | 3.482 | 6.459 | 2.284 | 6.041 | Архимедова спираль |
| 18 | 1.586 | 1.618 | 0.333 | 0.167 | 1.618 | 0.264 | 1.640 | 1.443 | 0.779 | Циссоида |
| 19 | 4.915 | 0.621 | 0.857 | 0.143 | 0.621 | 0.702 | 0.937 | -0.124 | 0.929 | Гипербола |
| 20 | 2.934 | 3.669 | 0.173 | 0.216 | 3.669 | 0.633 | 3.724 | 3.506 | 1.254 | Архимедова спираль |
| 21 | 12.649 | 0.344 | 0.600 | 0.100 | 0.344 | 1.265 | 1.311 | -0.430 | 1.238 | Эллипс |
| 22 | 5.392 | -0.423 | 0.430 | -0.218 | -0.423 | -1.177 | 1.250 | 0.106 | -1.246 | Гипербола |
| 23 | 15.541 | -0.840 | 0.927 | -0.125 | -0.840 | -1.943 | 2.116 | 1.050 | -1.838 | Эллипс |
| 24 | 16.800 | -3.360 | 1.318 | -0.258 | -3.360 | -4.338 | 5.487 | 3.360 | -4.338 | Парабола |
| 25 | 23.819 | 0.971 | 0.500 | 0.500 | 0.971 | 11.910 | 11.949 | -4.857 | 10.917 | Эллипс |
| 26 | 14.286 | -2.041 | 0.723 | -0.378 | -2.041 | -5.399 | 5.772 | 2.041 | -5.399 | Парабола |
| 27 | 7.000 | -3.500 | 1.000 | 0.500 | -3.500 | 3.500 | 4.950 | -4.836 | -1.054 | Гиперболическая спираль |
| 28 | 6.148 | 1.926 | 0.636 | 0.091 | 1.926 | 0.559 | 2.005 | 1.217 | 1.594 | Циссоида |

К4 файл о4к3А

| № | $\ddot{\rho}$ | $\ddot{\varphi}$ | a_ρ | a_φ | a | a_x | a_y | $ a_\tau $ | a_n |
|----|---------------|------------------|----------|-------------|--------|--------|--------|------------|-------|
| 1 | 0.183 | 0.000 | -0.408 | 0.223 | 0.465 | -0.459 | -0.077 | 0.143 | 0.442 |
| 2 | 0.854 | 0.000 | 0.287 | 0.726 | 0.781 | -0.285 | 0.727 | 0.766 | 0.150 |
| 3 | 0.095 | 0.000 | -0.079 | 0.095 | 0.124 | -0.119 | 0.034 | 0.071 | 0.102 |
| 4 | -0.263 | -0.018 | -0.285 | -0.659 | 0.717 | 0.222 | -0.682 | -0.240 | 0.676 |
| 5 | 3.879 | 0.011 | 3.521 | -1.603 | 3.869 | 3.868 | -0.054 | 3.866 | 0.137 |
| 6 | 8.533 | 0.011 | 7.746 | -3.526 | 8.511 | 8.510 | -0.119 | 8.506 | 0.300 |
| 7 | -0.000 | -0.000 | -1.234 | 4.935 | 5.087 | -3.449 | 3.739 | -1.103 | 4.966 |
| 8 | 1.920 | 0.192 | 1.165 | 3.932 | 4.101 | -0.911 | 3.999 | 2.829 | 2.969 |
| 9 | 42.000 | -0.044 | 39.667 | 15.674 | 42.651 | -1.556 | 42.623 | -42.435 | 4.287 |
| 10 | 0.129 | 0.000 | -0.087 | 0.110 | 0.141 | -0.129 | 0.055 | 0.086 | 0.112 |
| 11 | 0.960 | -0.008 | 0.840 | 0.624 | 1.046 | -0.120 | 1.039 | -0.998 | 0.314 |
| 12 | 0.067 | 0.029 | -0.167 | -0.125 | 0.208 | 0.168 | -0.123 | -0.032 | 0.206 |
| 13 | -0.094 | -0.011 | -0.090 | -0.155 | 0.179 | 0.056 | -0.170 | -0.098 | 0.150 |
| 14 | 1.905 | 0.091 | 1.896 | 0.492 | 1.959 | 1.869 | 0.586 | 1.918 | 0.398 |
| 15 | 1.856 | -0.017 | 0.309 | 1.997 | 2.021 | -1.856 | 0.799 | -1.768 | 0.978 |
| 16 | -0.027 | 0.000 | -0.094 | -0.062 | 0.113 | -0.015 | -0.112 | -0.017 | 0.111 |
| 17 | 1.360 | 0.080 | 0.246 | 4.352 | 4.359 | -2.402 | 3.638 | 2.553 | 3.533 |
| 18 | 0.878 | 0.000 | 0.834 | 0.539 | 0.993 | 0.611 | 0.783 | 0.910 | 0.398 |
| 19 | 0.234 | 0.000 | 0.133 | 0.177 | 0.222 | -0.047 | 0.217 | 0.221 | 0.018 |
| 20 | 1.816 | 0.107 | 1.679 | 1.897 | 2.534 | 1.329 | 2.158 | 1.978 | 1.584 |
| 21 | 0.069 | 0.000 | -0.057 | 0.069 | 0.090 | -0.086 | 0.024 | 0.051 | 0.074 |
| 22 | 0.066 | -0.104 | -0.190 | -0.376 | 0.421 | -0.017 | -0.421 | 0.418 | 0.052 |
| 23 | 0.091 | -0.012 | -0.152 | 0.028 | 0.155 | -0.114 | -0.105 | 0.035 | 0.151 |
| 24 | 1.344 | -0.017 | 0.224 | 1.446 | 1.463 | -1.344 | 0.578 | -1.280 | 0.708 |
| 25 | 0.968 | 0.000 | -4.986 | 0.971 | 5.080 | -4.842 | -1.538 | 0.563 | 5.049 |
| 26 | 0.583 | -0.162 | -1.458 | -0.771 | 1.649 | -0.583 | -1.543 | 1.237 | 1.091 |
| 27 | 2.625 | 0.125 | 0.875 | -2.625 | 2.767 | 2.682 | -0.682 | -2.475 | 1.237 |
| 28 | 0.394 | 0.000 | 0.343 | 0.350 | 0.490 | 0.068 | 0.486 | 0.427 | 0.241 |