

中等专业学校试用教材

工科专业通用

# 数 学

第二册第二分册

人民教育出版社

封面设计: 乃洵

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中等专业学校试用教材

工科专业通用

数 学

第二册第二分册

工科中专数学教材编写组编

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## 内 容 提 要

本书主要内容为平面解析几何(包括二次曲线, 坐标变换, 极坐标和参数方程)和数列两部分; 并加计算尺作为附录。可供中等专业学校(招收初中毕业生的)工科各专业作为试用教材。

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## 答 案

### 习 题 9-1

5. (1)  $(3, 4), (4, 3)$ ; (2)  $(2, 1)$ .  
6.  $x_1 = 1$  或  $x_1 = 3$ . 7.  $\left(-\frac{5}{4}, -\frac{4}{5}\right)$ .  
8. (1)  $x = \pm 2$ ; (2)  $x = 5, x = -1$ ;  
(3)  $y = 3, y = -9$ ; (4)  $x^2 + y^2 = 225$ .  
9.  $y^2 - 8y - 10x + 11 = 0$ .  
10.  $2x - y + 3 = 0$ .  
11.  $3x^2 - 4y + 4 = 0$ .  
12.  $y = \pm \frac{1}{2}x$ .  
13.  $x^2 + y^2 = 100$ .  
14.  $x^2 + y^2 = 6$ .  
15.  $x = 3$ .  
16.  $64x^2 + 100y^2 = 1600$ .  
17.  $x^2 + y^2 - 6x - 10y + 24 = 0, x^2 + y^2 - 8x - 4y + 10 = 0$ .  
18.  $x^2 + y^2 = a^2$ .  
19.  $bx + ay - 2xy = 0$ .  
20.  $16x^2 - 8xy + y^2 + 6x + 24y - 9 = 0$ .

### 习 题 9-2

2.  $x^2 + y^2 - 6x + 10y + 18 = 0$ . 3.  $(0, \frac{3}{4}), r = \frac{5}{4}$ .  
4.  $x^2 + y^2 + 4x - 3y = 0$ .  
5.  $x^2 + y^2 - 4x + 4y + 4 = 0; x^2 + y^2 - 20x + 20y + 100 = 0$ .  
6.  $x^2 + y^2 \pm 2ax = 0$ . 7.  $5x^2 + 5y^2 \pm 9y - 80 = 0$ .  
8.  $y = 2x \pm 5$ . 9.  $y = \pm 2x + 5$ .  
11.  $y = -x + 1; y = -x + 9$ . 12.  $x^2 + y^2 - 10x + 2y + 1 = 0$ .

$$14. (x-8)^2 + (y-1)^2 = 4;$$

$$(x-8)^2 + (y-5)^2 = 4.$$

$$15. \left(x - \frac{1}{2}\right)^2 + (y+1)^2 = \frac{1}{4};$$

$$\left(x - \frac{1}{2}\right)^2 + \left(y + \frac{9}{4}\right)^2 = \frac{1}{4}.$$

### 习 题 9-3

$$3. (1) 10; 6; \frac{4}{5}; (\pm 5, 0); (0, \pm 3); (\pm 4, 0).$$

$$(2) \frac{2\sqrt{6}}{3}; \sqrt{2}; \frac{1}{2}; \left(\pm \frac{\sqrt{6}}{3}, 0\right); \left(0, \pm \frac{\sqrt{2}}{2}\right); \left(\pm \frac{\sqrt{6}}{6}, 0\right).$$

$$(3) 2; 1; \frac{\sqrt{3}}{2}; (\pm 1, 0); \left(0, \pm \frac{1}{2}\right); \left(\pm \frac{\sqrt{3}}{2}, 0\right).$$

$$(4) 2; \sqrt{2}; \frac{\sqrt{2}}{2}; \left(\pm \frac{\sqrt{2}}{2}, 0\right); (0, \pm 1); \left(0, \pm \frac{\sqrt{2}}{2}\right).$$

$$4. (1) (6, 0); \quad (2) (3, -3), \left(\frac{69}{13}, \frac{21}{13}\right);$$

$$(3) \left(\pm \frac{\sqrt{78}}{2}, \frac{\sqrt{22}}{2}\right); \left(\pm \frac{\sqrt{78}}{2}, -\frac{\sqrt{22}}{2}\right).$$

$$5. 3x^2 + 4y^2 = 48. \quad 6. \frac{\sqrt{599}}{300}.$$

$$7. x^2 + 10y^2 = 40; 10x^2 + 9y^2 = 360.$$

$$8. \frac{x^2}{100} + \frac{y^2}{25} = 1. \quad 9. x - 4y + 4 = 0.$$

$$10. x^2 + y^2 - 6x - 16 = 0. \quad 11. 8x^2 + 9y^2 = 162.$$

$$12. \frac{x^2}{100} + \frac{y^2}{64} = 1, \text{ 或 } \frac{x^2}{64} + \frac{y^2}{100} = 1.$$

$$13. 4x^2 + 9y^2 = 324, (x \neq 0).$$

$$14. \frac{x^2}{100} + \frac{y^2}{25} = 1 \text{ 或 } \frac{x^2}{25} + \frac{y^2}{100} = 1.$$

$$15. \frac{x^2}{9} + \frac{y^2}{16} = 1. \quad 16. \frac{x^2}{9} + \frac{y^2}{25} = 1.$$

$$17. \frac{x^2}{9} + y^2 = 1; \frac{x^2}{9} + \frac{y^2}{81} = 1.$$

$$18. 3x^2 + 4y^2 = 108.$$

## 习 题 9-4

3. (1)  $4; 10; (\pm 2, 0); (\pm\sqrt{29}, 0); \frac{\sqrt{29}}{2}; y = \pm \frac{5}{2}x$ .  
 (2)  $2; \sqrt{2}; (\pm 1, 0); \left(\pm \frac{\sqrt{6}}{2}, 0\right); \frac{\sqrt{6}}{2}; y = \pm \frac{\sqrt{2}}{2}x$ .  
 (3)  $6; 4; (0, \pm 3); (0, \pm\sqrt{13}); \frac{\sqrt{13}}{3}; y = \pm \frac{3}{2}x$ .
4.  $\frac{x^2}{9} - \frac{y^2}{7} = 1$ .                      5.  $3x^2 - y^2 = 36; 3y^2 - x^2 = 36$ .  
 6.  $153x^2 - 425y^2 = 450$ .            7.  $9x^2 - 16y^2 = 20$ .  
 8.  $x^2 - y^2 = 8$ .                      9.  $\frac{x^2}{9} - y^2 = 1$ .
10.  $\left(2\sqrt{3}, -\frac{4\sqrt{3}}{3}\right); \left(-2\sqrt{3}, \frac{4\sqrt{3}}{3}\right)$ .  
 11.  $\left(\frac{48}{5}, \pm \frac{3}{5}\sqrt{119}\right)$ .            12.  $x^2 - 9y^2 = 1$  或  $y^2 - 9x^2 = 1$ .  
 13.  $48^\circ 11'$ .                      14.  $60^\circ$  或  $120^\circ$ .  
 15.  $x^2 - 7y^2 = 25, (y \neq 0)$ .  
 16.  $\frac{2x^2}{45} - \frac{2y^2}{5} = 1$  或  $\frac{2y^2}{5} - \frac{2x^2}{45} = 1$ .  
 17.  $\frac{81}{4}y^2 - \frac{2025}{44}x^2 = 1$ .

## 习 题 9-5

4. (1)  $y^2 = \pm 24x$ ;                      (2)  $y^2 = -8x$ ;  
 (3)  $x^2 = 12y$ ;                      (4)  $x^2 = -12y$ .
5. (1)  $(0, 0); \left(0, \frac{1}{4}\right); x=0; y=-\frac{1}{4}$ .  
 (2)  $(0, 0); \left(0, -\frac{3}{8}\right); x=0; y=\frac{3}{8}$ .  
 (3)  $(0, 0); \left(-\frac{3}{4}, 0\right); y=0; x=\frac{3}{4}$ .

- (4)  $(0, 0)$ ;  $(1, 0)$ ;  $y=0$ ;  $x=-1$ .  
 6.  $x^2 = -24y$  (其中  $-6 \leq y \leq 0$ ).  
 7. 5.625 厘米. 8.  $y^2 = -12x$ .  
 9.  $(0, 0)$ ;  $(8, 8)$ . 10.  $\left(\frac{5}{2}, \pm 2\sqrt{15}\right)$ .  
 11.  $y^2 - 4y - 2x + 11 = 0$ . 12.  $3x - y - 1 = 0$ .  
 13.  $4\sqrt{3}p$ . 15.  $(9, 6)$ ;  $(9, -6)$ .  
 17.  $(1, 1), \frac{3\sqrt{5}}{5}$ . 18.  $y=6$ .

## 复 习 题 九

1. (1)  $k < -2$  或  $k > 2$ ; (2)  $k = \pm 2$ ;  
 (3)  $-2 < k < 2$ .  
 2. (1)  $x^2 + y^2 = 1, y = x \pm \sqrt{2}, y = -x \pm \sqrt{2}$ ;  
 (2)  $x^2 + y^2 = 1, y = -x^2 + 1$ ;  
 (3)  $\frac{x^2}{9} + \frac{y^2}{4} = 1, y^2 = 4\sqrt{5}x$ ;  
 (4)  $\frac{x^2}{25} + \frac{y^2}{9} = 1, \frac{x^2}{16} - \frac{y^2}{9} = 1$ .  
 3.  $x^2 + y^2 + 3x - 4y = 0$ . 4.  $x^2 + y^2 - 8x - 12y + 48 = 0$ .  
 5.  $x^2 + y^2 + 26x + 16y - 32 = 0$ . 7.  $2x^2 + 2y^2 - 21x + 8y + 60 = 0$ .  
 9.  $\frac{\pi}{2}$ . 11.  $x^2 + (y-6)^2 = 4$ .  
 12. (1)  $\frac{\sqrt{3}}{2}$ ; (2)  $\frac{\sqrt{2}}{2}$ ; (3)  $\frac{1}{2}$ ; (4)  $\frac{2\sqrt{3}}{3}$ ; (5) 2.  
 13.  $3x^2 + 4y^2 = 27$ . 14.  $36x^2 + 20y^2 = 1125$ .  
 15.  $7x^2 + 16y^2 = 112$ ;  $16x^2 + 7y^2 = 112$ .  
 16.  $x^2 + 4y^2 = 36$ . 17.  $\frac{4x^2}{9} + \frac{4y^2}{5} = 1$ .  
 18.  $\frac{1}{59}$ . 19. 2; 32.  
 21.  $9x^2 - 16y^2 = 144$ .

22. 当  $m = -1$  时为圆,  $m < 0$  时为椭圆;  
 $m > 0$  时为双曲线.
23. 当  $-\infty < m < 9$  时为椭圆;  $9 < m < 25$  时为双曲线.

## 习 题 10-1

2.  $A(-1, -7); B(2, 2);$   
 $C(2, -3); D(m, n+2).$
3. (1)  $x' = 4;$  (2)  $x' + 2y' = 0;$   
 (3)  $x'^2 + y'^2 = 16;$  (4)  $x'^2 = 12y';$   
 (5)  $4x'^2 + 9y'^2 = 36;$  (6)  $y'^2 - 4x'^2 = 45;$   
 (7)  $y' = 3.$
4. (1)  $O'(1, -3), x'^2 + y'^2 = 16;$   
 (2)  $O'(1, -2), \frac{x'^2}{4} + \frac{y'^2}{9} = 1;$   
 (3)  $O'(-3, 1), x'^2 = -\frac{5}{2}y';$   
 (4)  $O'(1, -3), y'^2 = 8x';$   
 (5)  $O'(2, -3), 4y'^2 - x'^2 = 16;$   
 (6)  $O'(-4, -7), x'^2 - y'^2 = 100.$
6.  $4x^2 + 9y^2 + 16x - 18y - 11 = 0.$
7.  $4x^2 - 5y^2 - 16x - 10y + 31 = 0.$
8.  $y^2 = \pm 2px + p^2.$
9.  $x^2 - 4x - 6y - 11 = 0.$
10. (1) 椭圆型; (2) 抛物线型;  
 (3) 双曲线型; (4) 椭圆型.

## 习 题 10-2

1.  $M\left(\frac{3}{2} - \sqrt{3}, -\frac{3\sqrt{3}}{2} - 1\right); N\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right).$
2. (1)  $9x'^2 + 4y'^2 = 36;$  (2)  $3x'^2 - 5y'^2 + 6 = 0.$

$$3. \frac{x'^2}{4} - \frac{y'^2}{6} = 1.$$

$$4. \frac{y'^2}{4} - x'^2 = 1.$$

$$5. x'^2 = \frac{4}{5} \sqrt{5} y'.$$

$$6. \frac{x'^2}{2} + \frac{y'^2}{3} = 1.$$

$$7. x'^2 - y'^2 = 1.$$

$$8. 2x'y' = -a^2.$$

$$9. y'^2 = \sqrt{2} x'.$$

$$10. \frac{x'^2}{24} + \frac{y'^2}{4} = 1.$$

## 复 习 题 十

1.  $33x^2 - 24xy + 40y^2 - 114x - 208y + 241 = 0$ ; 椭圆.

2.  $(-1, 2)$ ; 6; 4;  $\frac{\sqrt{5}}{3}$ ;  $(-1 \pm \sqrt{5}, 2)$ .

3.  $25x^2 + 16y^2 + 100x - 96y - 156 = 0$ .

4.  $20x^2 + 96xy + 48y^2 - 428x - 624y + 1601 = 0$ ; 双曲线.

5.  $(3, -4)$ ; 4; 6;  $\frac{\sqrt{13}}{2}$ ;  $(3 \pm \sqrt{13}, -4)$ ;

$$y = \frac{3}{2}x - \frac{17}{2}, \quad y = -\frac{3}{2}x + \frac{1}{2}.$$

6. 等轴双曲线.

7.  $x^2 - y^2 - 2x - 6y - 12 = 0$ .

8.  $144x^2 - 120xy + 25y^2 - 378x - 772y + 829 = 0$ ; 抛物线.

9. (1)  $(4, 1)$ ;  $(4, 5)$ ;  $x - 4 = 0$ ;  $y + 3 = 0$ .

(2)  $(4, 1)$ ;  $(4, -1)$ ;  $x - 4 = 0$ ;  $y - 3 = 0$ .

(3)  $(25, 5)$ ;  $(\frac{99}{4}, 5)$ ;  $y - 5 = 0$ ;  $4x - 101 = 0$ .

(4)  $(\frac{1}{2}, -2)$ ;  $(2, -2)$ ;  $y + 2 = 0$ ;  $x + 1 = 0$ .

10.  $x^2 - 10x - 8y + 9 = 0$ .

11.  $y = 0.002(6 + \sqrt{11})x^2 - 0.02(1 + \sqrt{11})x$ .

12.  $\begin{cases} x = \frac{4}{5}x' - \frac{3}{5}y' + 1, \\ y = \frac{3}{5}x' + \frac{4}{5}y' + 1, \end{cases}$  或  $\begin{cases} x' = \frac{4}{5}x + \frac{3}{5}y - \frac{7}{5}, \\ y' = -\frac{3}{5}x + \frac{4}{5}y - \frac{1}{5}. \end{cases}$

## 习 题 11-1

5. (1)  $(\sqrt{2}, \sqrt{2})$ ; (2)  $(2\sqrt{3}, -2)$ ;  
 (3)  $(\sqrt{2}, -\sqrt{2})$ ; (4)  $(-\frac{3}{2}, \frac{3\sqrt{3}}{2})$ .
6. (1)  $(2, \frac{\pi}{3})$ ; (2)  $(\sqrt{6}, \frac{3\pi}{4})$ ;  
 (3)  $(2, \frac{11\pi}{6})$ ; (4)  $(2, \frac{4\pi}{3})$ .
7. (1)  $x=a$ ; (2)  $y^2+8x-16=0$ ;  
 (3)  $xy=a^2$ ; (4)  $x+y=2a$ .
8. (1)  $\rho = a \cos \varphi$ ; (2)  $\rho^2 = a^2 \cos 2\varphi$ ;  
 (3)  $\rho = a \sin 2\varphi$ .
11.  $\rho = \frac{a}{\sin \varphi}$ . 12.  $\rho = \frac{3\sqrt{3}}{2 \sin \varphi}$ .
13.  $\rho = \frac{2\sqrt{2}}{\sin(45^\circ - \varphi)}$ . 14.  $\rho = 2a \sin \varphi$ .
15.  $\rho = -10 \sin \varphi$ .
16.  $\rho = R + \frac{2K}{3\pi} \varphi \quad (0 \leq \varphi < \frac{3\pi}{2})$ ;  $\rho = R + 4K - \frac{2K}{\pi} \varphi \quad (\frac{3\pi}{2} \leq \varphi < 2\pi)$
17.  $\rho = \frac{72}{\pi} \varphi + 60 \quad (0 \leq \varphi < \frac{5\pi}{6})$ ;  
 $\rho = 270 - \frac{180}{\pi} \varphi \quad (\frac{5\pi}{6} \leq \varphi < \frac{7\pi}{6})$ ;  
 $\rho = 60 \quad (\frac{7\pi}{6} \leq \varphi < 2\pi)$ .

## 习 题 11-2

2. (1)  $y^2 = 16x$ ; (2)  $x - 3y + 2 = 0$ ;  
 (3)  $x + y^2 - 1 = 0$ ; (4)  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ .
5. 8. 7.  $(-2, 2)$ ;  $(2, -2)$ .

$$8. \begin{cases} x = b \cos t, \\ y = a \sin t. \end{cases} \quad 9. \begin{cases} x = \frac{2}{t^2}, \\ y = \frac{2}{t}. \end{cases} \quad 10. \begin{cases} x = v_0 t, \\ y = h - \frac{1}{2} g t^2. \end{cases}$$

$$11. \begin{cases} x = 10\sqrt{2}t, \\ y = 10\sqrt{2}t - 4.9t^2; \end{cases} \quad 40.8 \text{ 米.}$$

$$12. \begin{cases} x = b \cos \theta + \sqrt{r^2 - (a+b)^2 \sin^2 \theta}, \\ y = a \sin \theta. \end{cases}$$

## 复 习 题 十 一

$$1. (1) y = \sqrt{3}x; \quad (2) \frac{(x-2)^2}{16} + \frac{y^2}{12} = 1;$$

$$(3) (x-2)^2 + y^2 = 4; \quad (4) \frac{(x-4)^2}{4} - \frac{y^2}{12} = 1;$$

$$(5) y^2 + 6x = 0.$$

$$3. \rho = a \cos \varphi.$$

$$4. \rho^4 - 2\rho^2 a^2 \cos 2\varphi = b^4 - a^4.$$

$$5. \rho = \frac{a \sin \alpha}{\sin \varphi}.$$

$$6. \rho = \frac{a \sin (\beta - \alpha)}{\sin (\beta - \varphi)}.$$

$$7. \rho = \frac{a \cos 2\varphi}{\sin \varphi}.$$

$$9. \left(3, \frac{\pi}{6}\right); \left(-6, \frac{3}{2}\pi\right); \left(3, \frac{5}{6}\pi\right);$$

二曲线在极点处也相交.

$$10. \rho = \frac{4}{\pi} \varphi + 44.$$

$$11. (1) \begin{cases} x = at^2, \\ y = 2at; \end{cases} \quad (2) \begin{cases} x = \frac{3at}{1+t^3}, \\ y = \frac{3at^2}{1+t^3}; \end{cases}$$

$$(3) \begin{cases} x = a \sin^3 \theta, \\ y = a \cos^3 \theta; \end{cases} \quad (4) \begin{cases} x = t - t^2, \\ y = t + t^2; \end{cases} \text{ 或 } \begin{cases} x = t - t^2, \\ y = 2 - 3t + t^2. \end{cases}$$

$$12. (2a, a); (-2a, a).$$

$$13. \begin{cases} x = \frac{6k^2 - 8k}{1+k^2}, \\ y = \frac{8-6k}{1+k^2}; \end{cases} \text{ 或 } (x-3)^2 + (y-4)^2 = 25.$$

轨迹是该圆在圆  $x^2 + y^2 = 16$  内的部分.

$$14. \begin{cases} x = -\frac{9}{20}t \\ y = \frac{1}{10}t \end{cases}, \text{ 或 } y = -\frac{2}{9}x. \text{ 轨迹为该直线在椭圆内的部分.}$$

### 习 题 12-1

4. (1)  $a_n = 10n$ ,  $a_5 = 50$ ;  
 (2)  $a_n = \frac{n+1}{n}$ ,  $a_5 = \frac{6}{5}$ ;  
 (3)  $a_n = \left(-\frac{1}{3}\right)^n$ ,  $a_5 = -\frac{1}{243}$ ;  
 (4)  $a_n = (-1)^{n+1} \frac{2n-1}{2n}$ ,  $a_5 = \frac{9}{10}$ .
5. (1)  $n=8$ ; (2) 不是数列的项;  
 (3)  $n=10$ ; (4)  $n=15$ .

### 习 题 12-2

2. (2)  $d=2$ ,  $a_n = 2n-1$ ,  $a_{10} = 19$ ,  $s_{10} = 100$ ;  
 (4)  $d = -\frac{1}{2}$ ,  $a_n = \frac{3}{2} - \frac{1}{2}n$ ,  $a_{10} = -3.5$ ,  $s_{10} = -12.5$ .
3. (1)  $n=10$ ,  $s_{10} = 120$ ; (3)  $a_1 = 4.5$ ,  $n=10$ .  
 4.  $a_1 = 10$ ,  $d = 2.5$ ,  $n=19$ .  
 5.  $a_1 = 5$ ,  $d=5$ ,  $n=6$ .  
 8. 144 毫米, 168 毫米, 192 毫米.  
 9. 2730 个.  
 10. (1) 44.1 米; (2) 20 秒.  
 11.  $n=7$  或  $n=13$ . 12. 2, -1, -4.  
 13. (1)  $x=25$ ; (2)  $x=1$ .  
 14.  $x=48$ ,  $y=80$ ,  $z=120$ .  
 16.  $n=7$ .

## 习 题 12-3

2. (2)  $q = -\frac{1}{3}$ ,  $a_n = 15\left(-\frac{1}{3}\right)^{n-1}$ ,  $s_6 = 11\frac{19}{81}$ ;

(3)  $q = \frac{\sqrt{2}}{2}$ ,  $a_n = (\sqrt{2})^{2-n}$ ,  $s_6 = \frac{7}{4}(\sqrt{2} + 1)$ ;

(4)  $q = \sqrt{2} - 1$ ,  $a_n = (\sqrt{2} - 1)^{n-2}$ ,  $s_6 = 7(2 - \sqrt{2})$ ;

(5)  $q = \frac{a-b}{a+b}$ ,  $a_n = (a-b)^{n-1}(a+b)^{3-n}$ ,

$$s_6 = \frac{2a(3a^2 + b^2)(a^2 + 3b^2)}{(a+b)^3}.$$

3. (1)  $a_1 = -3584$ ,  $s_{10} = -2387$ ;

(3)  $n=7$ ,  $s_7 = 5\frac{61}{64}$ ; (4)  $q = -2$ ,  $n=10$ .

4.  $a_1 = 1$ ,  $q = 2$ ,  $n = 10$ .

5.  $3\sqrt{2}$  厘米, 6 厘米,  $6\sqrt{2}$  厘米, 12 厘米,  $12\sqrt{2}$  厘米.

9. 1, 3, 9 或 -1, 3, -9.

10. 30%.

11. 60 万吨.

12. 16%.

14.  $a=4$ ,  $s_{10}=1398100$ .

## 复 习 题 十 二

1. (1)  $a_6 = -14$ ;

(2)  $a_6 = -32$ .

2. (1)  $a_5 = 15$ ;

(2)  $a_5 = 60\frac{3}{4}$ .

3. (1)  $x = -8$ ;

(3)  $x = -7$ .

5. (1) 8, 4, 0, -4;

(2) 80, 40, 20, 10.

6. 5, 15, 45.

7. -2, 2, 6, 18.

8. 6, 8, 10, 12.

9. 3:4:5.

10.  $n=9$  或  $n=16$ .

11. 9 厘米, 12 厘米, 15 厘米.

12.  $n > 7$ .

13. 60 立方厘米.

15. 4, 5, 6.