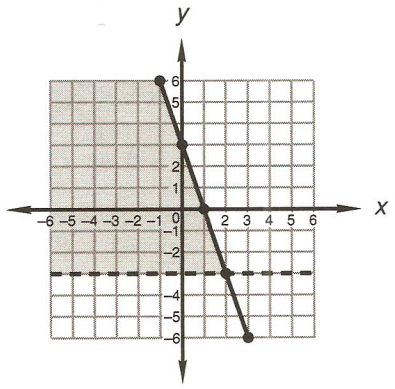
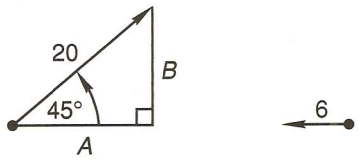
27. (a) $-y < 3$
$y > -3$
(b) $3x + y \le 3$
$y \le -3x + 3$
The first step is to graph each of these lines.



The region we wish to find is on and below the solid line and above the dashed line. This region is shaded in the previous figure.

28.



$A = 20 \cos 45° \approx 14.14$
$B = 20 \sin 45° \approx 14.14$

$$\begin{array}{r} -6.00R + 0.00U \\ 14.14R + 14.14U \\ \hline \mathbf{8.14R + 14.14U} \end{array}$$

$$\tan\theta = \frac{14.14}{8.14}$$
$$\theta \approx 60.07°$$

$$F = \sqrt{(8.14)^2 + (14.14)^2} \approx 16.32$$

$16.32\angle 60.07°$

29. $2x^2 - x - 10 = 0$
$2x^2 + 4x - 5x - 10 = 0$
$2x(x + 2) - 5(x + 2) = 0$
$(2x - 5)(x + 2) = 0$

$2x - 5 = 0 \qquad x + 2 = 0$
$x = \frac{5}{2} \qquad x = -2$

$\mathbf{\frac{5}{2}, -2}$

30. $2x^3 - 7x^2 - 15x = 0$
$x(2x^2 - 7x - 15) = 0$
$x(2x^2 - 10x + 3x - 15) = 0$
$x(2x(x - 5) + 3(x - 5)) = 0$
$x(2x + 3)(x - 5) = 0$

$x = 0 \qquad 2x + 3 = 0 \qquad x - 5 = 0$
$x = -\frac{3}{2} \qquad x = 5$

$\mathbf{0, -\frac{3}{2}, 5}$

Problem Set 112

1. (a) $N_N + N_D + N_Q = 20$
(b) $5N_N + 10N_D + 25N_Q = 325$
(c) $N_Q = 2N_D$
Substitute (c) into (a) and (b) and get:
(a′) $N_N + 3N_D = 20$
(b′) $5N_N + 60N_D = 325$

$$\begin{array}{rr} -5(a') & -5N_N - 15N_D = -100 \\ (b') & 5N_N + 60N_D = 325 \\ \hline & 45N_D = 225 \\ & N_D = \mathbf{5} \end{array}$$

(c) $N_Q = 2(5) = \mathbf{10}$

(a) $N_N + (5) + (10) = 20$
$N_N = \mathbf{5}$

2. T = tens' digit
U = units' digit
$10T + U$ = original number
$10U + T$ = reversed number

(a) $T + U = 7$
$T = 7 - U$
(b) $10U + T = 10T + U - 9$
Substitute (a) into (b) and get:
(b′) $10U + (7 - U) = 10(7 - U) + U - 9$
$9U + 7 = -9U + 61$
$18U = 54$
$U = 3$
(a) $T = 7 - (3) = 4$
Original number = **43**

3. $S_P = P_P + M_U$
$1800 = P_P + 0.2(1800)$
$P_P = 1800 - 360$
$P_P = \mathbf{\$1440}$

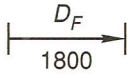
4. Downstream: $(B + W)T_D = D_D$ (a)
Upstream: $(B - W)T_U = D_U$ (b)
$T_D = 2T_U$
(a′) $(B + 3)2T_U = 230$
(b′) $(B - 3)T_U = 85$

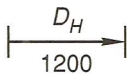
(a′) $2BT_U + 6T_U = 230$
2(b′) $2BT_U - 6T_U = 170$
$4BT_U = 400$
(c) $BT_U = 100$

(a′) $2(100) + 6T_U = 230$
$6T_U = 30$
$T_U =$ **5 hr**; $T_D =$ **10 hr**

(c) $B(5) = 100$
$B =$ **20 mph**

5. $R_FT_F = 1800$; $R_HT_H = 1200$;
$R_H = R_F + 200$; $T_F = 3T_H$





$(R_H - 200)3T_H = 1800$
$3(1200) - 600T_H = 1800$
$-600T_H = -1800$
$T_H =$ **3 hr**
$T_F =$ **9 hr**; $R_H =$ **400 mph**; $R_F =$ **200 mph**

6. $(x + 3)(x - 4) < 0$; $D = \{\text{Reals}\}$

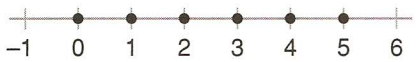
(Neg)(Pos) < 0
$x + 3 < 0$ and $x - 4 > 0$
$x < -3$ and $x > 4$

(Pos)(Neg) < 0
$x + 3 > 0$ and $x - 4 < 0$
$x > -3$ and $x < 4$
There are no real numbers that satisfy the first conjunction, so the solution must be $\mathbf{-3 < x < 4}$.

7. $(x - 6)(x + 1) < 0$; $D = \{\text{Integers}\}$

(Neg)(Pos) < 0
$x - 6 < 0$ and $x + 1 > 0$
$x < 6$ and $x > -1$

(Pos)(Neg) < 0
$x - 6 > 0$ and $x + 1 < 0$
$x > 6$ and $x < -1$
There are no integers that satisfy the second conjunction, so the solution must be $\mathbf{-1 < x < 6}$.

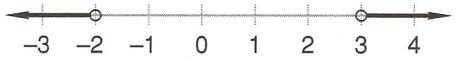


8. $(x + 2)(x - 3) > 0$; $D = \{\text{Reals}\}$

(Pos)(Pos) > 0
$x + 2 > 0$ and $x - 3 > 0$
$x > -2$ and $x > 3$

(Neg)(Neg) > 0
$x + 2 < 0$ and $x - 3 < 0$
$x < -2$ and $x < 3$

Thus, the solution is $\mathbf{x > 3}$ **or** $\mathbf{x < -2}$.



9. $x^{1/2} + y^{1/2}$
$x^{1/2} - y^{-1/4}$
$x + x^{1/2}y^{1/2}$
$- x^{1/2}y^{-1/4} - y^{1/4}$
$\mathbf{x + x^{1/2}y^{1/2} - x^{1/2}y^{-1/4} - y^{1/4}}$

10. $p^6x^6 - k^3 = (p^2x^2)^3 - (k)^3$
$= \mathbf{(p^2x^2 - k)(p^4x^4 + kp^2x^2 + k^2)}$

11. $100N = 401.43\ 43\ 43\ldots$
$N = 4.01\ 43\ 43\ldots$
$99N = 397.42$
$N = \dfrac{\mathbf{39{,}742}}{\mathbf{9900}}$

12. $y = x^2 + 2x + 3$
$y = (x^2 + 2x + 1) + 3 - 1$
$y = (x + 1)^2 + 2$
From this we see:
(a) Opens upward
(b) Axis of symmetry is $x = -1$
(c) y coordinate of vertex is 2