1. If $x + \frac{3}{2}$ is a factor of $f(x) = 2x^4 + 3x^3 - 8x^2 - 2x + k$, then the value of k is equal to

$\Rightarrow f(-\frac{3}{2}) = 0$. Calculate $f(-\frac{3}{2})$ by synthetic division.

(a) 15

(b) $-\frac{3}{2}$

(c) $\frac{3}{4}$

(d) -12

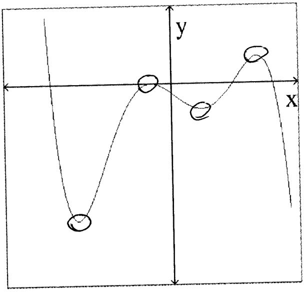
(e) 0

$$\begin{array}{r|rrrrr} -\frac{3}{2} & 2 & 3 & -8 & -2 & k \\ & & -3 & 0 & 12 & -15 \\ \hline & 2 & 0 & -8 & 10 & k-15 \end{array}$$

$f(-\frac{3}{2}) = k - 15 = 0 \Rightarrow k = 15$

See Question 49, Page 322

2. The number of **Turning Points** in the adjacent graph is



(a) 4

(b) 2

(c) 5

(d) 3

(e) 1

See Question D, Page 351

3. The discriminant of the equation $\sqrt{2}x^2 + 5x = 3\sqrt{2}$ is

$$\sqrt{2}\,x^2 + 5x - 3\sqrt{2} = 0$$

$$\Delta = b^2 - 4ac = 25 - 4\cdot\sqrt{2}\cdot(-3\sqrt{2})$$

$$= 25 + 24$$

$$= 49$$

(a) 7

(b) -7

(c) $7\sqrt{2}$

(d) $-7\sqrt{2}$

(e) 49

See Question 81, Page 120

4. The sum of the real part and the imaginary part of the complex number $\dfrac{(-9)^{1/2} + (9)^{1/2}}{i^3 + i^2}$, where $i = \sqrt{-1}$ is equal to

$$(-9)^{\frac{1}{2}} = \sqrt{-9} = 3i$$

$$(9)^{\frac{1}{2}} = \sqrt{9} = 3$$

$$i^3 = -i, \quad i^2 = -1$$

$$\frac{3 + 3i}{-1 - i} = \frac{3(1+i)}{-(1+i)} = -3$$

(a) 9

(b) 0

(c) 3

(d) -9

(e) -3

Division of complex numbers

5. A polynomial function of least degree with only real coefficients has zeros -1 of multiplicity 3 and $2i$ of multiplicity 1. If $f(0) = 4$ then the leading coefficient of $f(x)$ is equal to

(a) 1
(b) -4
(c) 4
(d) 3
(e) -1

$$f(x) = a(x+1)^3(x-2i)(x+2i)$$
$$f(0) = a(-2i)(2i)$$
$$= 4a = 4$$
$$\Rightarrow a = 1$$

Similar to problems in sec. 2.3

6. If $x = L$ and $y = M$ are the equations of the vertical asymptote and the horizontal asymptote to the graph of $f(x) = \frac{-1}{(x-4)^2} + 2$, respectively, then

(a) $L = 4$ and $M = -1$
(b) $L = -1$ and $M = \frac{49}{25}$
(c) $L = 0$ and $M = \frac{31}{16}$
(d) $L = \frac{1}{4}$ and $M = 2$
(e) $L = 4$ and $M = 2$

$x = 4$ is the vertical and $y = 2$ is the horizontal asymptotes.

See Question 28, Page 372

7. If $f(x) = 1 - x^2$, then the value of the difference quotient $\dfrac{f(x+h) - f(x)}{h}$ is equal to

(a) $-2x + h$

(b) $-2x - h^2$

(c) $-2x - h^2 - h$

(d) $-2x + h^2$

(e) $-2x - h$

$$= \frac{1 - (x+h)^2 - 1 + x^2}{h}$$

$$= \frac{1 - x^2 - 2xh - h^2 - 1 + x^2}{h}$$

$$= \frac{-2xh - h^2}{h}$$

$$= -2x - h$$

Similar to example 4, Page 278

8. Given the quadratic function $f(x) = -2x^2 - 12x - 16$, the vertex V and the range R of $f(x)$ are

(a) $V = (-3, 2),\ R = (-\infty, 2]$

(b) $V = (3, -70),\ R = (-\infty, -70]$

(c) $V = (2, -70),\ R = (-\infty, 2]$

(d) $V = (-3, 2),\ R = [-16, \infty)$

(e) $V = (3, -2),\ R = [3, \infty)$

$$h = -\frac{b}{2a} = -\frac{12}{4} = -3$$

$$k = f(-3) = -18 + 36 - 16$$

$$k = 2$$

$$V = (-3, 2)$$

$$R = (-\infty, 2]$$

See Question 23, Page 313

9. The sum of the values of x such that the distance between $(x,-9)$ and $(3,-5)$ is equal to 6 is

$$6 = \sqrt{(x-3)^2 + (-9+5)^2}$$

(a) $4\sqrt{5}$

(b) $2\sqrt{5}$

(c) $-4\sqrt{5}$

(d) -6

(e) 6

$$36 = x^2 - 6x + 9 + 16$$

$$x^2 - 6x - 11 = 0$$

If the solutions are x_1, x_2, then $x_1 + x_2 = -\frac{b}{a} = 6$

See Question 19, Page 292

10. The coefficient of x^3 in the product $x^2\left(3x - \frac{2}{3}\right)\left(5x + \frac{1}{3}\right)$ is

(a) $\frac{2}{3}$

(b) $-\frac{10}{3}$

(c) 3

(d) $-\frac{7}{3}$

(e) $\frac{7}{3}$

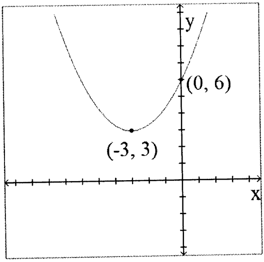
$$x^2\left(15x^2 + x - \frac{10}{3}x - \frac{2}{9}\right)$$

$$= 15x^4 + \left(1 - \frac{10}{3}\right)x^3 - \frac{2}{9}x^2$$

$$1 - \frac{10}{3} = -\frac{7}{3}$$

See Question 51, Page 31

11. If the figure shows the graph of a quadratic function $y = f(x)$, then which one of the following statements is **TRUE**?



(a) The line $x = 3$ is the equation of axis of symmetry

(b) There are two equal real solutions to the equation $f(x) = 3$

(c) The equation $f(x) = 0$ has two real solutions

(d) $y = f(x)$ has an x-intercept

(e) The minimum value of $f(x)$ is -3

See Question 27-30, Page 313

12. A puzzle piece in the shape of a triangle has perimeter 40 cm. If two sides of the triangle are each twice as long as the shortest side, then the length of the shortest side is equal to

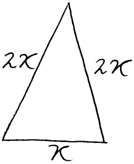
(a) 8 cm

(b) 5 cm

(c) 12 cm

(d) 10 cm

(e) 13 cm



$5x = 40$

$x = 8$

See Question 11, Page 97

13. If $f(x) = \dfrac{x+1}{x-2}$, then the range of f is

(a) $(-\infty, 1) \cup (1, \infty)$

(b) $(-\infty, -1) \cup (-1, \infty)$

(c) $\left(-\infty, -\frac{1}{2}\right) \cup \left(-\frac{1}{2}, \infty\right)$

(d) All real numbers

(e) $(-\infty, 2) \cup (2, \infty)$

$y = 1$ is the horizontal asymptote and $f(x)$ doesn't cross the $y=1$ line. Therefore, the range is $(-\infty, 1) \cup (1, \infty)$

or find the domain of the inverse function of f(x)

14. Which one of the following statements is **FALSE**?

(a) The graph of an odd function is symmetric with respect to the origin

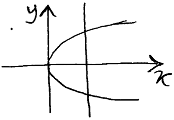
(b) The graph of an even function is symmetric with respect to the y-axis

(c) If (a, b) is on the graph of an even function, then so is $(-a, b)$

(d) The graph of a nonzero function can be symmetric with respect to the x-axis

(e) If (a, b) is on the graph of an odd function, then so is $(-a, -b)$

If a graph is symmetric w.r.t. the x-axis, then it can not be a function by the vertical line test.



See Question 92, Page 295

D

15. The expression $\dfrac{ac+ad+bc+bd}{a^2-b^2}\cdot\dfrac{a^3-b^3}{2a^2+2ab+2b^2}$ simplifies to

$$= \frac{a(c+d)+b(c+d)}{(\cancel{a-b})(a+b)}\cdot\frac{(\cancel{a-b})(\cancel{a^2+ab+b^2})}{2(\cancel{a^2+ab+b^2})}$$

(a) $\dfrac{a-b}{2}$

(b) $\dfrac{c+d}{a+b}$

$$= \frac{(\cancel{a+b})(c+d)}{2(\cancel{a+b})}$$

(c) $\dfrac{a+b}{2}$

(d) $\dfrac{c+d}{2}$

(e) $a-b$

$$= \frac{c+d}{2}$$

See Question 34, Page 50

16. If $m>0$ and $n>0$, then the expression

$$\left(\frac{16m^3}{n}\right)^{1/4}\left(\frac{9n^{-1}}{x^2}\right)^{1/2} = \frac{2\cdot m^{\frac{3}{4}}}{n^{\frac{1}{4}}}\;\frac{3\cdot n^{-\frac{1}{2}}}{|x|}$$

simplifies to

$$= \frac{6}{|x|}\,m^{3/4}\cdot n^{-3/4}$$

(a) $\dfrac{2\sqrt{n}}{3mx}$

(b) $\dfrac{6}{|x|}m^{3/4}m^{1/4}$

$$= \frac{6}{|x|}\left(\frac{m}{n}\right)^{3/4}$$

(c) $\dfrac{6}{|x|}\left(\dfrac{m}{n}\right)^{3/4}$

(d) $\dfrac{6}{|x|}\dfrac{n^{1/4}}{m^{3/4}}$

See Question 67, Page 60

(e) $-\dfrac{6}{x}\left(\dfrac{m}{n}\right)^{3/4}$

17. The equation $\sqrt{2\sqrt{7x+2}} = \sqrt{3x+2}$ has

See Question 53, Page 144

(a) 2 rational solutions

(b) 1 irrational solution only

(c) no solutions

(d) 2 irrational solutions

(e) 1 rational solution only

$$2\sqrt{7x+2} = 3x+2$$

$$4(7x+2) = 9x^2+12x+4$$

$$9x^2-16x-4=0$$

$$b^2-4ac = 16^2+4\cdot 9\cdot 4 > 0$$

$$= 16^2+12^2 = 20^2$$

If the discriminant is a perfect square, then there are two rational zeros. The solutions are:

$$(9x+2)(x-2)=0 \Rightarrow x = -\frac{2}{9},\ 2$$

18. Knowing that the Range of $f(x) = \sqrt{x}$ is $[0, \infty)$, then the Range of $f(x) = -\sqrt{x+2} - 3$ is

(a) $[-3, \infty)$

(b) $(-\infty, 3]$

(c) $[-2, \infty)$

(d) $(-\infty, -3]$

(e) $(-\infty, 2]$

Function	Range
$\sqrt{x}$	$[0, \infty)$
$\sqrt{x+2}$	$[0, \infty)$
$-\sqrt{x+2}$	$(-\infty, 0]$
$-\sqrt{x+2}-3$	$(-\infty, -3]$

See problems on section 2.7

19. The value of k so that the line passing through $(4,-1)$ and $(k,2)$ is perpendicular to the line $2y-5x=1$ is equal to

(a) $\frac{23}{2}$

(b) $-\frac{7}{2}$

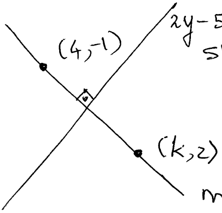
(c) $\frac{5}{2}$

(d) $-\frac{2}{5}$

(e) $-\frac{3}{4}$

$2y-5x=1$

slope $m_1=\frac{5}{2}$



$m_2=\frac{3}{k-4} \Rightarrow$

$$\frac{3}{k-4}=\frac{-2}{5} \Rightarrow 15=-2k+8$$

$$\Rightarrow 2k=-7 \Rightarrow k=-\frac{7}{2}$$

See Question 55, Page 244

20. The y-intercept of the polynomial $f(x)=10x^6-x^5+2x-2$ is

$f(0)=-2$

(a) -2

(b) 2

(c) 0

(d) 10

(e) -1

See problems on section 3.4

21. The solution of $\left|\frac{2}{3}x+\frac{1}{2}\right|<\frac{1}{6}$ is

$$-\frac{1}{6} < \frac{2}{3}x + \frac{1}{2} < \frac{1}{6}$$

$$-1 < 4x+3 < 1$$

$$-4 < 4x < -2$$

$$-1 < x < -\frac{1}{2}$$

(a) $0<x<1$

(b) $\frac{1}{2}<x<1$

(c) $-\frac{1}{4}<x<\frac{1}{3}$

(d) $x<-\frac{1}{2}$ or $x>1$

(e) $-1<x<-\frac{1}{2}$

See Question 39, Page 163

22. The graph of $y=f(x)$ is obtained from the graph of $g(x)=\sqrt{-x}$ by translating $g(x)$ five units down, three units left, then reflecting the graph across the x-axis. Then $f(x)=$

five units down $\sqrt{-x}-5$

three units left $\sqrt{-(x+3)}-5$

reflecting across the x-axis

$$-\left[\sqrt{-x-3}-5\right]$$

$$= -\sqrt{-x-3}+5$$

(a) $-\sqrt{x-3}-5$

(b) $-\sqrt{-x-3}+5$

(c) $\sqrt{x+3}+5$

(d) $\sqrt{x+3}-5$

(e) $-\sqrt{-x+3}-5$

See problems on section 2.7

23. The solution set in interval notation for the inequality $\frac{3}{x-2} < 1$ is

(a) $(2, 5)$

(b) $(-\infty, 2) \cup (2, \infty)$

(c) $(2, \infty)$

(d) $(5, \infty)$

(e) $(-\infty, 2) \cup (5, \infty)$

$$\frac{3}{x-2} - 1 < 0$$

$$\frac{3 - x + 2}{x-2} < 0 \Rightarrow \frac{5-x}{x-2} < 0$$

	$(-\infty, 2)$	2	$(2, 5)$	5	$(5, \infty)$
$5-x$	$+ \ +$		$+ \ + \ +$		$- \ - \ -$
$x-2$	$- \ - \ -$		$+ \ + \ +$		$+ \ + \ + \ +$
$\frac{5-x}{x-2}$	$-$		$+$		$-$

See Question 74, Page 156

$$(-\infty, 2) \cup (5, \infty)$$

24. If $f(x) = \sqrt{6 + x}$, then the value of $(f \circ f)(3) + f^{-1}(\sqrt{6})$ is equal to

(a) 3

(b) $\sqrt{\sqrt{6}}$

(c) $\sqrt{3} - \sqrt{6}$

(d) $\sqrt{3}$

(e) $6\sqrt{3}$

$$(f \circ f)(3) = f(f(3)) = f(3) = 3$$

If $f^{-1}(\sqrt{6}) = x \Rightarrow f(x) = \sqrt{6}$

$$\Rightarrow x = 0$$

$$\Rightarrow (f \circ f)(3) + f^{-1}(\sqrt{6})$$

$$= 3 + 0 = 3$$

See problems on sections 2.8 and 4.1

25. If 2 is a zero of $f(x) = x^4 - 8x^3 + 24x^2 - 32x + 16$ of multiplicity m, then m is equal to

(a) 0

(b) 4

(c) 2

(d) 1

(e) 3

By synthetic division

$$\begin{array}{c|ccccc} 2 & 1 & -8 & 24 & -32 & 16 \\ & & 2 & -12 & 24 & -16 \\ \hline 2 & 1 & -6 & 12 & -8 & 0 \\ & & 2 & -8 & 8 & \\ \hline & 1 & -4 & 4 & 0 & \end{array}$$

$$f(x) = (x-2)^2(x^2 - 4x + 4)$$
$$= (x-2)^2(x-2)^2 = (x-2)^4$$
$$\Rightarrow m = 4$$

See Question 49, Page 322

26. The number of rational zeros of the polynomial $f(x) = 2x^4 - x^3 + 7x^2 - 4x - 4$ is

(a) 0

(b) 3

(c) 1

(d) 4

(e) 2

possible rational zeros are

$$\frac{p}{q} = \frac{\pm 1, \pm 2, \pm 4}{\pm 1, \pm 2} = \pm 1, \pm 2, \pm 4, \pm \frac{1}{2}$$

$$f(1) = 2 - 1 + 7 - 4 - 4 = 0$$

Now use synthetic division

$$\begin{array}{c|ccccc} 1 & 2 & -1 & 7 & -4 & -4 \\ & & 2 & 1 & 8 & 4 \\ \hline & 2 & 1 & 8 & 4 & 0 \end{array}$$

See Question 87, Page 339

$$f(x) = (x-1)(2x^3 + x^2 + 8x + 4)$$
$$= (x-1)(x^2(2x+1) + 4(2x+1))$$
$$= (x-1)(2x+1)(x^2+4)$$

only 1 and $-\frac{1}{2}$ are the rational zeros

27. Which one of the following statements is **TRUE**?

(a) $\dfrac{1}{2+3} = \dfrac{1}{2} + \dfrac{1}{3}$

(b) $\sqrt{4^2 + 3^2} = \sqrt{4^2} + \sqrt{3^2}$

(c) $|(-3)^3| = |3^3|$

(d) $\sqrt{(-5)^2} = -5$

(e) $-2^4 = (-2)^4$

28. Which one of the following statements is **NOT TRUE** about the rational function $f(x) = \dfrac{2}{x+1}$?

Properties of the Reciprocal Functions; Domains, Range increasing, decreasing and so on.

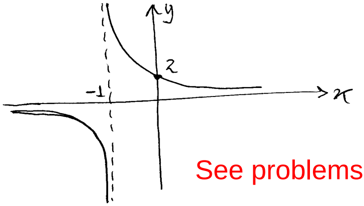
(a) f is discontinuous at $x = -1$.

(b) The graph of f has no vertical asymptotes.

(c) f is decreasing for all x in its domain.

(d) f is neither odd nor even function.

(e) The graph of f has only one horizontal asymptote.



See problems on section 3.5

29. The center C and the radius R of the circle represented by $x^2 - 4x + y^2 + 6y + 12 = 0$ are

$x^2 - 4x + 4 + y^2 + 6x + 9 = 4 + 9 - 12$

$(x-2)^2 + (y+3)^2 = 1$

$(2, -3) =$ center

$1 =$ radius

(a) $C = (2, 3)$, $R = 1$

(b) $C = (-2, -3)$, $R = \sqrt{12}$

(c) $C = (2, -3)$, $R = 1$

(d) $C = (-2, -3)$, $R = 5$

(e) $C = (2, -3)$, $R = 5$

See Questions 3 and 4, Page 196

30. Given $f(x) = x^3 + 3x^2 - 13x - 15$, $f(-2) = 15$ and $f(0) = -15$, which one of the following statements is **TRUE** about $f(x)$?

$f(-2) = 15 > 0$

$f(0) = -15 < 0$

f has a zero between -2 and 0

(a) f is constant in in the interval $[-2, 0]$.

(b) 15 is the maximum vlaue of f.

(c) f has an x-intercept in the interval $[-2, 0]$.

(d) The graph of f is below the x-axis on $(-2, 0)$.

(e) The range of f is $[-15, 15]$.

See Question 30, Page 352

31. If x_1 and x_2 are the solutions of the absolute value equation $|5x - 1| = |2x + 3|$, then $|x_1 x_2| =$

(a) $\frac{14}{3}$

(b) $\frac{3}{14}$

<u>(c)</u> $\frac{8}{21}$

(d) $\frac{2}{15}$

(e) $\frac{21}{8}$

$5x - 1 = 2x + 3$ or $5x - 1 = -2x - 3$

$3x = 4$ | $7x = -2$

$x = \frac{4}{3}$ | $x = -\frac{2}{7}$

$$\left| \frac{4}{3} \cdot \frac{-2}{7} \right| = \frac{8}{21}$$

See Question 176, Page 176

32. The graph of the polynomial function

$$f(x) = -2(x-1)^3(x+1)$$

is above the x-axis on the interval

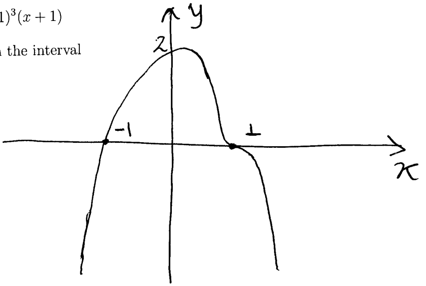
(a) $(2, \infty)$

(b) $(1, \infty)$

<u>(c)</u> $(-1, 1)$

(d) $(-2, 2)$

(e) $(-\infty, -1)$



See Question 68, Page 354

33. $\frac{-4}{\sqrt[3]{3}} + \frac{1}{\sqrt[3]{24}} - \frac{2}{\sqrt[3]{81}} =$ $\frac{-4}{\sqrt[3]{3}} + \frac{1}{2\sqrt[3]{3}} - \frac{2}{3\sqrt[3]{3}}$

$= \frac{-24+3-4}{6\sqrt[3]{3}} = -\frac{25}{6\sqrt[3]{3}}$

$= -\frac{25\sqrt[3]{9}}{18}$

(a) $-\frac{25\sqrt[3]{9}}{18}$

(b) $-\frac{25\sqrt[3]{3}}{6}$

(c) $-\frac{\sqrt[3]{9}}{6}$

(d) $-\frac{5\sqrt[3]{9}}{18}$

(e) $-\frac{\sqrt[3]{9}}{4}$

See Question 83, Page 71

34. A straight line passing through the point $\left(\frac{9}{4}, 2\right)$ and having undefined slope is

(a) $x = \frac{9}{4}$

(b) $x = 2$

(c) $y = \frac{9}{4}$

(d) $x = -\frac{9}{4}$

(e) $y = 2$

$x = \frac{9}{4}$ passes any point with coordinate $\left(\frac{9}{4}, y\right)$ and the slope is undefined

35. The domain of $f(x) = \sqrt{2x^3 - 3x^2 - 5x}$ is

$2x^3 - 3x^2 - 5x \geq 0$

$x(2x^2 - 3x - 5) \geq 0$

$x(2x - 5)(x + 1) \geq 0$

(a) $\left[0, \frac{5}{2}\right]$

(b) $(-\infty, -1] \cup \left[\frac{5}{2}, \infty\right)$

(c) $(-\infty, -1] \cup \left[0, \frac{5}{2}\right]$

<u>(d)</u> $[-1, 0] \cup \left[\frac{5}{2}, \infty\right)$

(e) $\left[-1, \frac{5}{2}\right]$

	-1	0	$5/2$	
x	$- \; -$	$- \; -$	$+ \; +$	$+ \; + \; +$
$x+1$	$- \; - \; -$	$+ \; +$	$+ \; +$	$+ \; + \; +$
$2x-5$	$- \; -$	$- \; -$	$- \; -$	$+ \; + \; + \; +$
$x(2x-5)(x+1)$	$-$	$+$	$-$	$+$

$[-1, 0] \cup [5/2, \infty)$

See Question 94, Page 175

36. If a line has a slope 4, then the slope of its reflection across the line $y = x$ is

<u>(a)</u> $\frac{1}{4}$

(b) -4

(c) 4

(d) $-\frac{1}{4}$

(e) $\sqrt{4}$

If $y = 4x + b$, then the reflection of this line across the $y = x$ line is the inverse of $y = 4x + b$ which is

$$y = \frac{x - b}{4} = \frac{1}{4}x - \frac{b}{4}$$

Thus, the slope of the reflection is $\frac{1}{4}$

See Question 85, Page 414