

1. Implicit differentiation:  $2x dx + 2y dy = 0$

$$\frac{dy}{dx} = -\frac{x}{y} = \frac{-24}{-7} = \frac{24}{7} \quad C$$

2. This is the negative double of the derivative of  $f(x) = 5x^2$ , so the answer is  $-2f'(x) = -20x \quad C$

3.  $f'(x) = 12x^2 - 2$  where is it = 0?  $x = \pm \frac{\sqrt{6}}{6}$   
 $f'(0) < 0$ , so  $|x| < \frac{\sqrt{6}}{6} \quad D$

4.  $\lim_{x \rightarrow \frac{1}{2}} \frac{(2x-1)(2x+1)}{1-2x} = \lim_{x \rightarrow \frac{1}{2}} (-2x-1) = -2 \quad C$

5. This is a conic section with an eccentricity of 2.  
Parabolas have  $e = 1$ , Ellipses have  $e < 1$ ,  
Hyperbolas have  $e > 1$ . D

6. If it has a rational root, it will be  $\pm 1, \pm 5$ , or  $\pm 25$ .  
 $x=1$  works, giving  $(x-1)(x^2-9x+25)=0$

The other two roots  ~~$x = \frac{9 \pm \sqrt{81-100}}{2} = \frac{9 \pm \sqrt{19}}{2}$~~   
are complex conjugates (thus equal magnitudes) whose product is 25, so their magnitudes are each 5. A

7. By symmetry in the complex plane,  
 $1, \frac{-1+i\sqrt{3}}{2}, \frac{-1-i\sqrt{3}}{2}$  are cube roots of 1, and  
 $-1, \frac{1+i\sqrt{3}}{2}, \frac{1-i\sqrt{3}}{2}$  " " " " -1. D

8. ~~non~~ discriminant:  $b^2 - 4ac = b^2 - 48$

real roots for non-negative discriminants:  $b^2 \geq 48$   
 $|b| \geq 4\sqrt{3}$  B

9. ~~(x-2)(x^2+6x+10)=0~~  $i-3 = -3+i \Rightarrow -3-i$  also a root

~~(x-2)(x^2+6x+10)=0~~

~~$x^3 + 4x^2 - 2x - 20 = 0$~~

~~$a + b + c = -18$~~  D

10.  $A \cdot B = |A||B| \cos \theta = \sqrt{9+4+25} \sqrt{1+16} \cos \theta = -3-20$

$\cos \theta = \frac{-23}{\sqrt{17}\sqrt{38}} \Rightarrow \theta \approx 154.8$  D  
use calculator

11.  $\left. \frac{1}{5}x^5 + \frac{1}{3}x^3 + x - \frac{1}{x} \right|_1^2 = \frac{31}{5} + \frac{7}{3} + 1 + \frac{1}{2} = \frac{186+70+30+15}{30} = \frac{301}{30}$  A

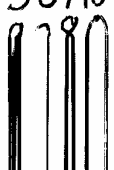
12.  $1 \cdot \begin{vmatrix} -2 & 4 \\ 5 & -4 \end{vmatrix} + 3 \cdot \begin{vmatrix} 3 & 2 \\ -2 & 4 \end{vmatrix} = -12 + 48 = 36$  D

13. Cramer's rule:  $z = \frac{\begin{vmatrix} 0 & 1 & 4 \\ 1 & 0 & 7 \\ 2 & -4 & 3 \end{vmatrix}}{\begin{vmatrix} 0 & 1 & 1 \\ 1 & 0 & -2 \\ 2 & -4 & 0 \end{vmatrix}} = \frac{-1 \cdot \begin{vmatrix} 1 & 4 \\ -4 & 3 \end{vmatrix} + 2 \cdot \begin{vmatrix} 1 & 4 \\ 0 & 7 \end{vmatrix}}{-1 \cdot \begin{vmatrix} 1 & 1 \\ -4 & 0 \end{vmatrix} + 2 \cdot \begin{vmatrix} 1 & 1 \\ 0 & -2 \end{vmatrix}} = \frac{-19+14}{-4-4} = \frac{5}{8}$  B

14.  $12 \pmod{22} : 12, 34, \textcircled{56}$   
 $2 \pmod{6}$

$56 \equiv \textcircled{122} \pmod{66} : 122, \textcircled{188}$  D  
 $3 \pmod{5}$

15. Multiply in base 12, carry 12's not 10's.  $\begin{array}{r} 928 \\ 214 \\ \hline 30A8 \end{array}$   $\rightarrow 175768_{12}$  D



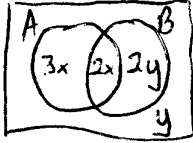
16.  $95, 95, 95, 99, 99, 100, 100 \Rightarrow 37 \quad 100 - 37 = 63 \quad E$

17.  $\frac{1}{2}(x-3)^4 \Big|_0^3 = 0 \quad D$

18.  $v(t) = \int a(t) = 2t^3 - 8t + 0$   
 ↑ initial velocity  
 $2t^3 - 8t = 0$   
 $2t(t^2 - 4) = 0$   
 $t = 2, \cancel{4} \quad A$

19.  $\overline{f(x)} = \frac{\int_2^4 f(x) dx}{4-2} = \frac{1}{2} \int_2^4 (5-4x^2) dx = \frac{1}{2} \left( 5x - \frac{4}{3}x^3 \right) \Big|_2^4 = \frac{1}{2} \left( 10 - \frac{224}{3} \right) = \frac{-97}{3} \quad D$

20.  $x = 2 \sin \theta \quad \int \frac{2 \cos \theta}{\sqrt{4-4 \sin^2 \theta}} d\theta = \int \frac{\cos \theta}{\sqrt{1-\sin^2 \theta}} d\theta = \int d\theta = \theta + C$   
 $dx = 2 \cos \theta d\theta \quad = \arcsin\left(\frac{x}{2}\right) + C$

21.   
 $5x + 2y = \frac{3}{4}$   
 $5x + 3y = \frac{1}{4} \Rightarrow 5x = \frac{1}{4} \Rightarrow x = \frac{1}{20} \quad A$   
 $2x = \frac{1}{10}$

22.  $\frac{\binom{16}{1} \binom{11}{1} \binom{25}{1}}{\binom{184}{3}} = \frac{9 \cdot 11 \cdot 25 \cdot 2}{28 \cdot 14} = \frac{275}{1162} \quad \frac{83}{14} \quad A$

23. Total possible outcomes:  $125 = 5^3$   
 Total good outcomes: 10  $\frac{10}{125} = \frac{2}{25} \quad B$

~~134 = 6~~  $642 = 6$   
~~226 = 3~~  $633 = 3$   
~~244 = 3~~  $444 = 1$

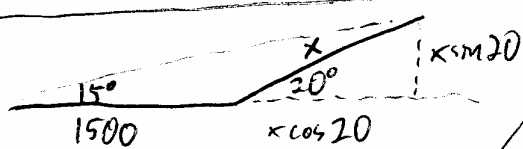
24.  $P(y < 2) = \frac{1}{4}$   $P(2 < y < 3) = \frac{9}{16} - \frac{1}{4} = \frac{5}{16}$  A  
 $P(y < 3) = \frac{9}{16}$

25.  $x = \frac{2}{5+x} \Rightarrow x^2 + 5x - 2 = 0$   
 $x = \frac{-5 \pm \sqrt{25+8}}{2} = \frac{-5 + \sqrt{33}}{2}$  B  
 must be positive

26.  $144 \rightarrow 372$   $12 \sum_{n=12}^{31} n = 12 \left( 43 \cdot \frac{20}{2} \right) = 12 \cdot 430 = 5160$  C  
 $12 \cdot 12 \rightarrow 31 \cdot 12$

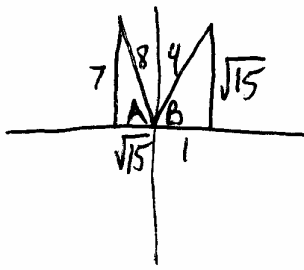
27.  $V = x^3$   $V = 125 \Rightarrow x = 5$   
 $V' = 3x^2 x'$   
 $10 = 3 \cdot 5^2 \cdot x' \Rightarrow x' = \frac{10}{75} = \frac{2}{15}$  C

28.  $\frac{324}{1 - \frac{1}{5}} = \frac{5 \cdot 324}{4} = 5 \cdot 81 = 405$  C

29.   
 $\frac{x \sin 20}{1500 + x \cos 20} = \tan 15$   
 $x = \frac{1500 \tan 15}{-\tan 15 \cos 20 + \sin 20}$   
 $\approx 4454$  A  
 must use calculator

30. ~~tan~~  $\tan^2 \theta = \sec^2 \theta - 1$   
 $\sec^2 \theta - \sec \theta = 0$   
 $\sec \theta (\sec \theta - 1) = 0$   
 $\sec \theta = 0 \Rightarrow$  impossible  
 $\sec \theta = 1 \Rightarrow \theta = 2\pi$  A

31.



$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$= \frac{\sqrt{5}}{8} \cdot \frac{1}{4} - \frac{7}{8} \cdot \frac{\sqrt{5}}{4}$$

$$= \frac{-8\sqrt{5}}{32} = \frac{-4\sqrt{5}}{16} = \frac{-\sqrt{5}}{4} \quad C$$

$$32. \frac{\sqrt{3}}{-\frac{1}{2}} + \frac{1}{-1} = -2\sqrt{3} - 1 \quad E$$

$$33. 135 = 3^3 \cdot 5$$

$$1134 = 2 \cdot 567 = 2 \cdot 3^2 \cdot 63 = 2 \cdot 3^4 \cdot 7$$

$$\text{LCM} = 2 \cdot 3^4 \cdot 5 \cdot 7 = 5 \cdot 1134 = 5670 \quad D$$

$$34. 45 = 3^2 \cdot 5$$

$$24 = 2^3 \cdot 2 \cdot 2 \cdot 3 \quad 2^1 \cdot 3^2 \cdot 5^1 \cdot 7 = 14 \cdot 45$$

$$4 \cdot 3 \cdot 2$$

$$2^3 \cdot 3^2 \cdot 5 = 8 \cdot 45 = 360 \quad D$$

$$35. \frac{152}{7} = 21.x = \# \text{ of } 7\text{'s}$$

$$\frac{21}{7} = 3 = \# \text{ of } 49\text{'s}$$

$$\frac{21}{24}$$

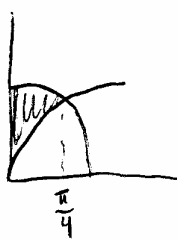
D

$$36. y''(8) = y(8) + 2y'(8)$$

$$= 8^{\frac{1}{3}} + 2 \cdot \frac{1}{3} (8)^{-\frac{2}{3}}$$

$$= 2 + \frac{1}{6} = \frac{13}{6} = 2.1666 \approx 2.17 \quad C$$

37.



$$V = \pi \int_0^{\pi/4} (\cos^2 x - \sin^2 x) dx$$

$$= \pi \int_0^{\pi/4} \cos(2x) dx$$

$$= \frac{\pi}{2} \sin(2x) \Big|_0^{\pi/4} = \frac{\pi}{2} \quad A$$

38. ~~Use~~ Integration by parts:  $u = x$   $v = \frac{1}{4} e^{4x}$

$$\int u dv = uv - \int v du \quad du = dx \quad dv = e^{4x} dx$$

$$= \frac{1}{4} x e^{4x} - \int \frac{1}{4} e^{4x} dx$$

$$= \frac{4x e^{4x}}{16} - \frac{e^{4x}}{16} = \frac{(4x-1)e^{4x}}{16} + C \quad D$$

$$39. (-3+4i) \left( \frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2} i \right) = \frac{-3\sqrt{2}}{2} + \frac{4\sqrt{2}}{2} + \frac{4i\sqrt{2}}{2} + \frac{3i\sqrt{2}}{2} = \frac{\sqrt{2}}{2} + \frac{7\sqrt{2}}{2} i \quad B$$

When two complex numbers are multiplied, the new magnitude is the product of the magnitudes. The new angle is the sum of the angles.

$$40. \int_{\pi/4}^{\pi/3} \frac{\cos 2\theta + 1}{2} = \frac{1}{2} \left( \frac{1}{2} \sin 2\theta + \theta \right) \Big|_{\pi/4}^{\pi/3} = \frac{\frac{\sqrt{3}}{2} - 1 + \frac{\pi}{6}}{4} = \frac{3\sqrt{3} - 6 + \pi}{24} \quad E$$