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

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

---

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

---

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

$f'(0) < 0$, so $|x| < \frac{\sqrt{6}}{6}$ D

---

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

---

5. This is a conic section with an eccentricity of 2.

Parabolae have $e = 1$, Ellipses have $e < 1$,

Hyperbolae have $e > 1$. D

---

6. If it has a rational root, it will be $\pm 1, \pm 5$, or ± 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,

$1, \frac{-1}{2} + i\frac{\sqrt{3}}{2}, \frac{-1}{2} - i\frac{\sqrt{3}}{2}$ are cube roots of 1, and

$-1, \frac{1}{2} + i\frac{\sqrt{3}}{2}, \frac{1}{2} - i\frac{\sqrt{3}}{2}$ " " " " -1. D

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

real roots for non-negative discriminants: $b^2 \geq 48$

$|b| \geq 4\sqrt{3}$ B

---

9. $i-3 = -3+i \Rightarrow -3-i$ also a root

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

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

$a+b+c=-18$ D

---

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

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

---

11. $\frac{1}{5}x^5+\frac{1}{3}x^3+x-\frac{1}{x}\Big|_1^2 = \frac{31}{5}+\frac{7}{3}+1+\frac{1}{2} = \frac{186+70+30+15}{30} = \frac{301}{30}$ 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 mod 22: 12, 34, (56)

2 mod 6

$56 \equiv 122 \bmod 66$: 122, (188)

3 mod 5

D

---

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, 98, 99, 99, 100, 100 $\Rightarrow$ 37 $\quad 100-37=63$ E

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

18. $v(t) = \int a(t) = 2t^3-8t+0$ (0 = initial velocity)

$2t^3-8t=0$

$2t(t^2-4)=0$

$t=2,\cancel{-2}$ A

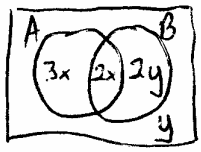
19. $\overline{f(x)} = \dfrac{\int_2^4 f(x)}{4-2} = \frac{1}{2}\int_2^4 5-4x^2 = \frac{1}{2}\left(5x-\frac{4}{3}x^3\right)\Big|_2^4 = \frac{1}{2}\left(10-\frac{224}{3}\right) = \frac{-97}{3}$ D

20. $x=2\sin\theta$

$dx = 2\cos\theta\, d\theta$

$\int \frac{2\cos\theta}{\sqrt{4-4\sin^2\theta}}\,d\theta = \int \frac{\cos\theta}{\sqrt{1-\sin^2\theta}}\,d\theta = \int d\theta = \theta + C$

$= \arcsin\left(\frac{x}{2}\right)+C$

21. 

$5x+2y=\frac{3}{4}$

$5x+3y=1$

$y=\frac{1}{4} \Rightarrow 15x=\frac{1}{4} \Rightarrow x=\frac{1}{20}$

$2x=\frac{1}{10}$ A

22. $\dfrac{\binom{18}{1}\binom{41}{1}\binom{25}{1}}{\binom{84}{3}} = \dfrac{\cancel{9}\cdot\cancel{18}\cdot\cancel{41}\cdot 25\cdot\cancel{82}}{\cancel{84}\cdot 83\cdot\cancel{82}\ \ \cancel{28}\cdot 14} = \frac{225}{1162}$

$83\times 14 = 332 + 830 = 1162$ A

23. Total possible outcomes: $125=5^3$

Total good outcomes: 10 $\quad \frac{10}{125}=\frac{2}{25}$ B

$\cancel{134}=6 \quad 642=6$

$\cancel{226}=3 \quad 633=3$

$\cancel{444}=3 \quad 444=1$

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

---

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

---

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

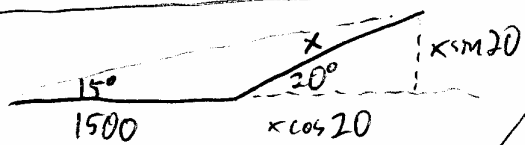
---

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

---

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

29.



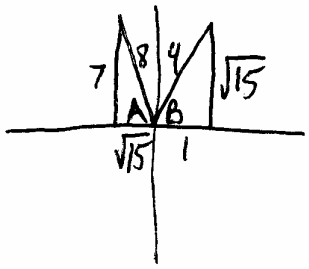
$\frac{x\sin 20}{1500+x\cos 20}=\tan 15$

$x=\frac{1500\tan 15}{-\tan 15\cos 20+\sin 20}$

$\cong 4454$
must use calculator A

---

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

31. 

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

$= \frac{\sqrt{15}}{8}\cdot\frac{1}{4} - \frac{7}{8}\cdot\frac{\sqrt{15}}{4}$

$= \frac{-8\sqrt{15}}{32} = \frac{-4\sqrt{15}}{16} = \frac{-\sqrt{15}}{4}$ C

---

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

---

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

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

$LCM = 2\cdot 3^4\cdot 5\cdot 7 = 5\cdot 1134 = 5670$ D

---

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

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

$4\cdot 3\cdot 2$ $\quad 2^3\cdot 3^2\cdot 5 = 8\cdot 45 = 360$ D

---

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

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

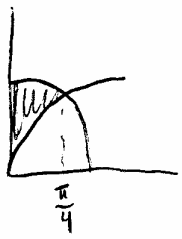
24 D

---

36. $y(10) = y(8) + 2y'(8)$

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

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

37. 

$$V=\pi\int_0^{\frac{\pi}{4}}(\cos^2x-\sin^2x)\,dx$$
$$=\pi\int_0^{\frac{\pi}{4}}\cos(2x)\,dx$$
$$=\frac{\pi}{2}\sin(2x)\Big|_0^{\frac{\pi}{4}}=\frac{\pi}{2}$$ A

---

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

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

$$=\frac{1}{4}xe^{4x}-\int\frac{1}{4}e^{4x}\,dx$$
$$=\frac{4xe^{4x}}{16}-\frac{e^{4x}}{16}=\frac{(4x-1)e^{4x}}{16}+C$$ D

---

39. $(-3+4i)\left(\frac{\sqrt{2}}{2}-\frac{\sqrt{2}}{2}i\right)=\frac{-3\sqrt{2}}{2}+\frac{4\sqrt{2}}{2}+\frac{4i\sqrt{2}}{2}+\frac{3i\sqrt{2}}{2}=\frac{\sqrt{2}}{2}+\frac{7\sqrt{2}}{2}i$ 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. $\int_{-\pi/4}^{\pi/3}\frac{\cos2\theta+1}{2}=\frac{1}{2}\left(\frac{1}{2}\sin2\theta+\theta\right)\Big|_{\frac{\pi}{4}}^{\frac{\pi}{3}}=\frac{\frac{\sqrt{3}}{2}-1+\frac{\pi}{6}}{4}=\frac{3\sqrt{3}-6+\pi}{24}$ E