1. B Sine is the only odd function listed. $\sin(-x) = -\sin(x)$.

2. C $\ln t < 0$ for $0 < t < 1 \Rightarrow \ln(x-2) < 0$ for $2 < x < 3$.

3. B Need to have $\lim_{x\to 2} f(x) = f(2) = k$.

$$k = \lim_{x\to 2}\frac{\sqrt{2x+5}-\sqrt{x+7}}{x-2} = \lim_{x\to 2}\frac{\sqrt{2x+5}-\sqrt{x+7}}{x-2}\cdot\frac{\sqrt{2x+5}+\sqrt{x+7}}{\sqrt{2x+5}+\sqrt{x+7}}$$

$$= \lim_{x\to 2}\frac{2x+5-(x+7)}{x-2}\cdot\frac{1}{\sqrt{2x+5}+\sqrt{x+7}} = \lim_{x\to 2}\frac{1}{\sqrt{2x+5}+\sqrt{x+7}} = \frac{1}{6}$$

4. D $\int_0^8 \frac{dx}{\sqrt{1+x}} = 2\sqrt{1+x}\Big|_0^8 = 2(3-1) = 4$

5. E Using implicit differentiation, $6x + 2xy' + 2y + 2y\cdot y' = 0$. Therefore $y' = \frac{-2y-6x}{2x+2y}$.

When $x = 1$, $3 + 2y + y^2 = 2 \Rightarrow 0 = y^2 + 2y + 1 = (y+1)^2 \Rightarrow y = -1$

Therefore $2x + 2y = 0$ and so $\frac{dy}{dx}$ is not defined at $x = 1$.

6. B This is the derivative of $f(x) = 8x^8$ at $x = \frac{1}{2}$

$$f'\left(\frac{1}{2}\right) = 64\left(\frac{1}{2}\right)^7 = \frac{1}{2}$$

7. D With $f(x) = x + \frac{k}{x}$, we need $0 = f'(-2) = 1 - \frac{k}{4}$ and so $k = 4$. Since $f''(-2) < 0$ for $k = 4$, f does have a relative maximum at $x = -2$.

8. B $p(x) = q(x)(x-1) + 12$ for some polynomial $q(x)$ and so $12 = p(1) = (1+2)(1+k) \Rightarrow k = 3$

9. C $A = \pi r^2$, $\frac{dA}{dt} = 2\pi r\cdot\frac{dr}{dt}$ and from the given information in the problem $\frac{dA}{dt} = 2\frac{dr}{dt}$.

So, $2\frac{dr}{dt} = 2\pi r\cdot\frac{dr}{dt} \Rightarrow r = \frac{1}{\pi}$

10. E $x = e^y \Rightarrow y = \ln x$

11. B Let L be the distance from $\left(x, -\frac{x^2}{2}\right)$ and $\left(0, -\frac{1}{2}\right)$.

$$L^2 = (x-0)^2 + \left(\frac{x^2}{2} - \frac{1}{2}\right)^2$$

$$2L \cdot \frac{dL}{dx} = 2x + 2\left(\frac{x^2}{2} - \frac{1}{2}\right)(x)$$

$$\frac{dL}{dx} = \frac{2x + 2\left(\frac{x^2}{2} - \frac{1}{2}\right)(x)}{2L} = \frac{2x + x^3 - x}{2L} = \frac{x^3 + x}{2L} = \frac{x\left(x^2+1\right)}{2L}$$

$\frac{dL}{dx} < 0$ for all $x < 0$ and $\frac{dL}{dx} > 0$ for all $x > 0$, so the minimum distance occurs at $x = 0$.

The nearest point is the origin.

12. A $\frac{4}{2x-1} = 2\left(\frac{4}{x-1}\right) \Rightarrow x - 1 = 4x - 2;\ x = \frac{1}{3}$

13. C $\int_{-\pi/2}^{k} \cos x\, dx = 3\int_{k}^{\pi/2} \cos x\, dx;\ \sin k - \sin\left(-\frac{\pi}{2}\right) = 3\left(\sin\frac{\pi}{2} - \sin k\right)$

$\sin k + 1 = 3 - 3\sin k;\ 4\sin k = 2 \Rightarrow k = \frac{\pi}{6}$

14. E $y = x^5 - 1$ has an inverse $x = y^5 - 1 \Rightarrow y = \sqrt[5]{x+1}$

15. B The graphs do not need to intersect (eg. $f(x) = -e^{-x}$ and $g(x) = e^{-x}$). The graphs could intersect (e.g. $f(x) = 2x$ and $g(x) = x$). However, if they do intersect, they will intersect no more than once because $f(x)$ grows faster than $g(x)$.

16. B $y' > 0 \Rightarrow y$ is increasing; $y'' < 0 \Rightarrow$ the graph is concave down. Only B meets these conditions.

17. B $y' = 20x^3 - 5x^4$, $y'' = 60x^2 - 20x^3 = 20x^2(3 - x)$. The only sign change in y'' is at $x = 3$. The only point of inflection is $(3,162)$.

18. E There is no derivative at the vertex which is located at $x = 3$.

19. C $\frac{dv}{dt} = \frac{1 - \ln t}{t^2} > 0$ for $0 < t < e$ and $\frac{dv}{dt} < 0$ for $t > e$, thus v has its maximum at $t = e$.

20. A $y(0) = 0$ and $y'(0) = \left.\frac{1/2}{\sqrt{1 - \frac{x^2}{4}}}\right|_{x=0} = \left.\frac{1}{\sqrt{4 - x^2}}\right|_{x=0} = \frac{1}{2}$. The tangent line is

$y = \frac{1}{2}x \Rightarrow x - 2y = 0$.