1. One statement is False about $f(x) = x|x|$ over $(-\infty, \infty)$

(a) $f(x)$ is concave upward in its domain (correct)

(b) $f'(0)$ exists

(c) $f(x)$ is increasing on its Domain

(d) $f(x)$ is an odd function

(e) $f(x)$ has no global maximum value on its domain

2. Using linear approximation of $f(x) = x^4$, the estimation value of $(1.999)^4$ is:

(a) 15.968 (correct)

(b) 16.032

(c) 16

(d) 15.987

(e) 15.999

3. Let f and g be differentiable functions, such that $f(g(x)) = x$ and $f'(x) = 1 + (f(x))^2$, then $g'(1) =$

(a) $\frac{1}{2}$ (correct)

(b) 1

(c) 0

(d) 2

(e) $\sqrt{2}$

4. The slope of the tangent line to the curve $x^y = y^x$, at the point $(1, 1)$ is:

(a) 1 (correct)

(b) 0

(c) e

(d) $\frac{1}{e}$

(e) $\sqrt{e}$

5. The **closest** point on the line $y = 2x + 3$ to the origin is

(a) $\left(-\frac{6}{5}, \frac{3}{5}\right)$ (correct)

(b) $(0, 3)$

(c) $\left(-\frac{3}{2}, 0\right)$

(d) $\left(-\frac{3}{2}, 3\right)$

(e) $(-1, 1)$

6. Let $f(x) = \ln(1 - \ln x)$, the largest interval where f is decreasing is:

(a) $(0, e)$ (correct)

(b) (e, ∞)

(c) $(0, \infty)$

(d) $(0, 1)$

(e) $(1, e)$

7. $f(x) = e^{\tan^{-1} x}$ is concave up ward over the interval

(a) $\left(-\infty, \frac{1}{2}\right)$ (correct)

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

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

(d) $\left(\frac{1}{2}, \infty\right)$

(e) $\left(\frac{\pi}{4}, \infty\right)$

8. The number satisfying the conclusion of the Mean Value Theorem of $f(x) = \dfrac{x}{x+2}$ over $[1, 4]$ is

(a) $3\sqrt{2} - 2$ (correct)

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

(c) $3\sqrt{2} + 2$

(d) $3\sqrt{2}$

(e) 2

9. The local minimum value of $f(x) = 2\cos x + \cos^2 x$ over $[0, 2\pi]$ is

(a) -1 (correct)

(b) 1

(c) 0

(d) π

(e) $-\pi$

10. The Inflection point of $f(x) = (1-x)\,e^x$ is

(a) $\left(-1, \frac{2}{e}\right)$ (correct)

(b) $\left(-2, \frac{3}{e^2}\right)$

(c) $(0, 1)$

(d) $(1, 0)$

(e) $\left(\frac{1}{2}, \frac{\sqrt{e}}{2}\right)$

11. The horizontal asymptote of $f(x) = \left(\frac{x}{x+2}\right)^x$ is

(a) $y = e^{-2}$ (correct)
(b) $y = e^{-1}$
(c) $y = 1$
(d) $y = e$
(e) $y = 2$

12. The slant asymptote of

$$f(x) = x + \frac{1}{x}$$

is

(a) $y = x$ (correct)
(b) $y = x + 1$
(c) $y = x - 1$
(d) $y = x + \frac{1}{2}$
(e) $y = x - \frac{1}{2}$

13. Starting with $x_1 = -1$, using Newton's Method to find the second approximate root, x_2, for $x^7 + 4 = 0$, gives:

(a) $-\frac{10}{7}$ (correct)

(b) $-\frac{4}{7}$

(c) $-\frac{12}{7}$

(d) $-\frac{8}{7}$

(e) $-\frac{9}{7}$

14. If the graph of a function $f(x)$ passes through $(1, 6)$ and the slope of its tangent line at $(x, f(x))$ is $2x + 1$, then $f(2) =$

(a) 10 (correct)

(b) 4

(c) 2

(d) 6

(e) 8

15. $\lim_{x \to 0^+} \left(\frac{1}{x} - \frac{1}{e^x - 1} \right) =$

(a) $\frac{1}{2}$ (correct)

(b) ∞

(c) 1

(d) e

(e) $-\frac{1}{e}$

16. $\lim_{x \to 0} x^4 \sin\left(\frac{1}{x}\right) =$

(a) 0 (correct)

(b) -1

(c) ∞

(d) 1

(e) $-\infty$

17. $\lim_{x \to 1} \cos(\pi[x])$, (where $[x]$ denotes the greatest integer function)

(a) does not exists (correct)

(b) equals 1

(c) equals -1

(d) equals 0

(e) equals $\frac{1}{2}$

18. If $f'(x) = \sinh x + 2\cosh x$ and $f(0) = 2$, then $f(\ln 2) =$

(a) $\frac{15}{4}$ (correct)

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

(c) 4

(d) $4 \ln 2$

(e) $\ln 2(e - e^{-1})$

19. One statement is False about the function $f(x) = \dfrac{x^2}{x^2+1}$.

(a) The Range of $f(x)$ is $[0, 1]$ (correct)

(b) The $x-$ and $y-$ intercepts are both 0

(c) $y = 1$ is a horizontal asymptote

(d) $f(x)$ is decreasing over $(-\infty, 0)$

(e) $f(x)$ has neither vertical asymptote nor slant asymptote.

20. The value(s) of m that make the function

$$f(x) = \begin{cases} \sin 2x, & x \leq 0 \\ mx, & x > 0 \end{cases}$$

differentiable everywhere is (are)

(a) $m = 2$ (correct)

(b) $m = 0$

(c) all real numbers

(d) all negative numbers

(e) $m = 0,\ m = \dfrac{1}{2}$

21. The Absolute maximum value of $f(t) = 2\cos t + \sin 2t$ over $\left[0, \frac{\pi}{2}\right]$ is

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

(b) 2

(c) 0

(d) $2\sqrt{3}$

(e) 1