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Finding The Derivatives

$A(x) = \frac{1}{20}(x+120)^2 + 15 \{-200 < x \leq -120\}$

$u = x + 120 \quad u' = 1$

$y = \frac{1}{20}u^2 + 15 \quad \frac{dy}{du} = \frac{2}{20}u$

$A'(x) = 1 \cdot \frac{2}{20} \cdot (x+120)$

$= \frac{1}{10} \cdot x + 120$

$= \frac{x+120}{10}$

$B(x) = 8\cos\left(\frac{\pi}{30}x\right) + 7 \{-120 < x \leq -60\}$

$u = \frac{\pi}{30}x \quad u' = \frac{\pi}{30}$

$y = 8\cos u + 7 \quad \frac{dy}{du} = 8\left(-\sin\left(\frac{\pi}{30}x\right)\right)$

$B'(x) = \frac{8\pi}{30} \cdot -\sin\left(\frac{\pi}{30}x\right)$

$= \frac{8\pi\left(-\sin\left(\frac{\pi}{30}x\right)\right)}{30}$

$C(x) = 15 \{-60 < x \leq -35\}$

$C'(x) = 0$

$D(x) = 3\sin\left(\frac{\pi}{10}x\right) + 12 \{-35 < x \leq 5\}$

$u = \frac{\pi}{10}(x) \quad u' = \frac{\pi}{10}$

$v = \sin u \quad v' = \cos u$

$w = 3v + 12 \quad w' = 3$

$D'(x) = \frac{3\pi}{10}\cos\left(\frac{\pi}{10}x\right)$

$E(x) = \frac{-1}{100}(x-15)^2(x-5)^2 + 15 \quad \{5 < x \leq 18\}$

$f = (x-15)^2 \quad f' = 2(x-15)$

$g = (x-5)^2 \quad g' = 2(x-5)$

$f' \cdot g + g' \cdot f$

$\frac{-1}{100} \cdot 2(x-15) \cdot (x-5)^2 + 2(x-5) \cdot (x-15)^2$

$$E'(x) = \frac{-2(x-15) \cdot (x-5)^2 - 2(x-5) \cdot (x-15)^2}{100}$$

$F(x) = -12.48(x-18) - 0.21 \quad \{18 < x \leq 22\}$

$F'(x) = -12.48$

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Prove Continuity

$A(-120) = \frac{1}{20}(-120+120)^2 + 15$
$= \frac{1}{20}(0)^2 + 15$
$= 15$

$B(-120) = 8\cos\left(\frac{-120\pi}{30}\right) + 7$
$= 8\cos(-4\pi) + 7$
$= 8 \cdot 1 + 7$
$= 15$

$B(-60) = 8\cos\left(\frac{-60\pi}{30}\right) + 7$
$= 8(1) + 7$
$= 15$

$C(-60) = 15$

$C(-35) = 15$

$D(-35) = 3\sin\left(\frac{-35\pi}{10}\right) + 12$
$= 3(1) + 12$
$= 15$

$D(5) = 3\sin\left(\frac{5\pi}{10}\right) + 12$
$= 3(1) + 12$
$= 15$

$E(5) = \frac{-1}{100}(5-15)^2(5-5)^2 + 15$
$= \frac{-1}{100} \cdot 100 \cdot 0 + 15$
$= 15$

$E(18) = \frac{-1}{100}(18-15)^2(18-5)^2 + 15$
$= \frac{-1}{100}(9)(13)^2 + 15$
$= \frac{-1521}{100} + 15$
$= -15.21 + 15$
$= -0.21$

$F(18) = -12.48(18-18) - 0.21$
$= -12.48(0) - 0.21$
$= 0.21$

Prove Differentiability

$A'(-120) = \frac{-120+120}{10}$
$= 0$

$B'(-120) = \frac{8\pi(-\sin(\frac{\pi}{30}\cdot -120))}{30}$
$= \frac{8\pi(0)}{30}$
$= 0$

$B'(-60) = \frac{8\pi(-\sin(-\frac{60\pi}{30}))}{30}$
$= \frac{8\pi(0)}{30}$
$= 0$

$C'(-60) = 0$

$C'(-35) = 0$

$D'(-35) = \frac{3\pi}{10}\cos\left(\frac{-35\pi}{10}\right)$
$= \frac{3\pi}{10}\cdot 0$
$= 0$

$D'(5) = \frac{3\pi}{10}\cos\left(\frac{5\pi}{10}\right)$
$= \frac{3\pi}{10}\cdot 0$
$= 0$

$E'(5) = \frac{-2(5-15)\cdot(5-5)^2 - 2(5-5)\cdot(x-15)^2}{100}$
$= 0$

$E'(18) = \frac{-2(18-15)\cdot(18-5)^2 - 2(18-5)\cdot(18-15)^2}{100}$
$= \frac{-2(3)\cdot(13)^2 - 2(13)\cdot(3)^2}{100}$
$= \frac{-1248}{100}$
$= -12.48$

$F'(18) = -12.48$