This worksheet focuses on differentiating exponential functions, including those with the base e, and applying the results to rate of change problems.

Easy Questions

1. Differentiate the function $f(x) = e^x$ with respect to x.
2. Differentiate $f(x) = 3e^x$ with respect to x.
3. Differentiate $f(x) = e^{2x}$ with respect to x.
4. Differentiate $f(x) = 5e^x + 2$ with respect to x.
5. Calculate the derivative of $f(x) = e^{0.5x}$ with respect to x.

Intermediate Questions

6. Differentiate $f(x) = e^{3x+1}$.
7. Differentiate $f(x) = 2e^x - 7e^{2x}$ with respect to x.
8. If $f(x) = e^x$, compute $f'(x)$ and evaluate it at $x = 0$.
9. Differentiate $f(x) = e^{\sin x}$ with respect to x.
10. Differentiate $f(x) = e^{\sqrt{x}}$ with respect to x.
11. Differentiate $f(t) = e^{4t-5}$ and then determine $f'(2)$.
12. Differentiate $f(x) = 7e^{-2x}$ with respect to x.
13. Differentiate $f(x) = e^{x^2}$ with respect to x.
14. Differentiate $f(x) = e^{\ln x}$ with respect to x.
15. Differentiate $f(x) = e^{3\cos x}$ with respect to x.
16. Determine the derivative of $f(t) = e^{t^3}$ and calculate its value at $t = 1$.
17. Differentiate $f(x) = 5 + e^{2x}$ with respect to x.
18. Differentiate $f(x) = e^{2x} + e^{-x}$ with respect to x.
19. Differentiate $y = e^{4-3x}$ with respect to x.
20. Find the derivative of $y = e^{2(x+1)}$ with respect to x.

Hard Questions

21. A bacteria population is modelled by $P(t) = e^{0.7t}$. Find the instantaneous growth rate at $t = 3$.

22. Given the continuously compounded interest model $A(t) = e^{0.05t}$, determine the instantaneous rate of change at $t = 10$.

23. A radioactive substance decays according to $M(t) = e^{-0.2t}$. Determine the rate of decay at $t = 5$.

24. Consider $f(x) = e^{x^2}$. Find $f'(x)$ and then compute the rate of change at $x = 2$.

25. Differentiate $f(x) = e^{\tan x}$ with respect to x and briefly discuss the domain of the derivative.

26. A temperature model is given by $T(t) = 10e^{-0.3t} + 20$. Find $\dfrac{dT}{dt}$ at $t = 4$.

27. Differentiate $f(x) = e^{3x} \sin x$ with respect to x.

28. Solve for x given that the derivative of $f(x) = e^{2x}$ is equal to 16.

29. Find the second derivative of $f(x) = e^x$ with respect to x.

30. A cost function is modelled by $C(x) = e^{0.1x}$. Determine the marginal cost when $x = 50$.