Sample Problem Sheet

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1. Differentiate from first principles $f(x) = \sqrt{x}$
2. Differentiate the following functions:
   (a) $y = \cos(x^2)\sin x$.
   (b) $y = \arccos x$.
   (c) $y = \exp(3x + 2)$
   (d) $y = x^3 + 4x^2 - x + 3$
   (e) $f(x) = g(x)^{h(x)}$.
3. Find the gradient of the ellipse given by $4x^2 + 3y^2 = 25$.
4. Find the gradient of the unit circle ($x^2 + y^2 = 1$).
5. Under which of the following functions does $S = \{a_1, a_2\}$ become a probability space?
   (a) $P(a_1) = \frac{1}{3}$, $P(a_2) = \frac{1}{2}$ (b) $P(a_1) = \frac{3}{4}$, $P(a_2) = \frac{1}{4}$
   (c) $P(a_1) = 1$, $P(a_2) = 0$ (d) $P(a_1) = \frac{5}{4}$, $P(a_2) = -\frac{1}{4}$
6. A coin is weighted so that heads is four times as likely as tails. Find the probability that: (a) tails appears, (b) heads appears
7. Which of the following is the derivative of $x\sin(x)$? (Circle the correct answer.)
   A $\sin(x)$
   B $x\cos(x)$
   C $\sin(x) + x\cos(x)$
8. Describe what is meant by object-oriented programming.