Question 1:

(a)[5] Determine an equation of the tangent line to the curve

$$x^2 + y^2 = \frac{x}{y} + 1$$

at the point $(0, -1)$.

(b)[5] Use logarithmic differentiation to determine y' where $y = (1+x)^{1/x}$.

Question 2:

(a)[3] Differentiate $y = e^{\sin x} - \ln(\cos x)$

(b)[3] Differentiate $y = \log_7(x \tan x)$

(c)[4] Determine $f''(0)$ where $f(x) = \ln(2 - e^x)$. (Simplify your final answer.)

Question 3:

(a)[4] Determine $\lim_{x\to 3^+} \frac{x}{\ln(x-3)}$.

(If the limit does not exist but is ∞ or $-\infty$, state which with an explanation of your reasoning.)

(b)[6] Use a linear approximation to estimate $\sqrt{16.1}$.

Question 4 (related rates) [10]:

Sand is falling onto a pile at a rate of 1 m^3 per minute. The pile of sand maintains the shape of a cone with height equal to half the diameter of the base. How fast is the height of the sand pile increasing when the height is exactly 3 m? State units with your answer. (Recall: A cone of height h and base radius r has volume $V = \frac{\pi}{3} r^2 h$.)

Question 5: For this question use the function $f(x) = x^2e^x$

(a)[7] Determine the intervals of increase and decrease of $f(x)$. State a clear conclusion.

(b)[3] State the relative extrema of $f(x)$.