**Self-assessment: 12 Basic differentiation and its applications**

**1.** Differentiate the following:

(a) 

(b) tan *x* + 2 cos *x*

(c) *x*2 − e*x*

(d) 3 ln *x* − 1 *[8 marks]*

**2.** **Do not use a calculator to answer this question.**

Find the equation of the normal to the curve *y* = 2*x* – ln *x* at the point where *x* = 3.

*(accessible to students on the path to grade 3 or 4) [6 marks]*

**3.** Find the exact coordinates of the stationary point on the graph of *y* = 3e*x* − *x*.

*(accessible to students on the path to grade 3 or 4) [6 marks]*

**4.** (a) (i) Expand and simplify (*x* + *h*)2 – *x*2.

(ii) Hence prove from first principles that the derivative of *x*2 is 2*x*.

*(accessible to students on the path to grade 5 or 6)*

(b)The function *f* is defined by *f* (*x*) = *x*2 + 4 cos *x* for 0 < *x* < *π*.

(i) By considering the graphs of *y* = *x* and *y* = 2 sin *x*, show that *f* (*x*) has only one stationary point, and explain why this stationary point is between  and *π*.

(ii) Find *f* ″(*x*) and hence prove that the stationary point is a minimum.

(iii) Find the coordinates of the point of inflection on the graph of *y* = *f* (*x*).

(iv) Sketch the graph of *y* = *f* (*x*), clearly labelling the stationary point and the point of inflection.

*(accessible to students on the path to grade 7)*

*[19 marks]*