**Self-assessment answers: 16 Basic differentiation and its applications**

**1.** (a) 

(b) sec2 *x* – 2 sin *x*

(c) 2*x* − e*x*

(d) *[8 marks]*

**2. **

When *x* = 3: *y* = 6 – ln 3,  = 2 − ⇒ *m* = 

Equation of normal: *y* – (6 – ln 3) =  (*x* – 3)

(or *y* = ) *[6 marks]*

**3.**  = 3e*x* – 1 = 0 when e*x* =  ⇔ *x* = ln

*y* = 3 − ln = 1 − ln = 1 + ln 3

Stationary point is (−ln 3, 1 + ln 3) *[6 marks]*

**4.** (a) (i) (*x* + *h*)2 – *x*2 = *x*2 + 2*xh* + *h*2 – *x*2 = 2*xh* + *h*2

(ii) Let *f* (*x*) = *x*2. Then,



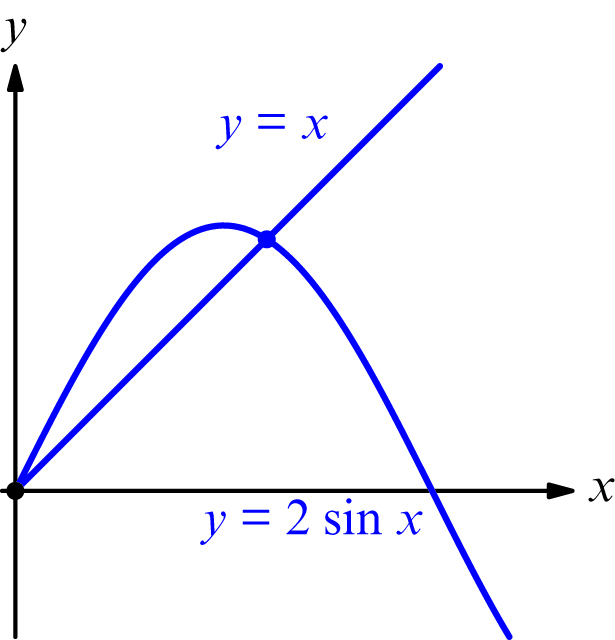


∴ *f* ′(*x*) = 2*x*

(b) (i) Stationary point when *f* ′(*x*) = 0:

2*x* – 4 sin *x* = 0

⇔ *x* = 2 sin *x*



As *y* = 2 sin *x* has gradient 2 at the origin and *y* = *x* has gradient 1, the graphs intersect once, hence there is only one stationary point of *f* (*x*). It has *x* >  because 2 sin *x* > *x* when *x* = .

(ii) *f* ″(*x*) = 2 – 4 cos *x*

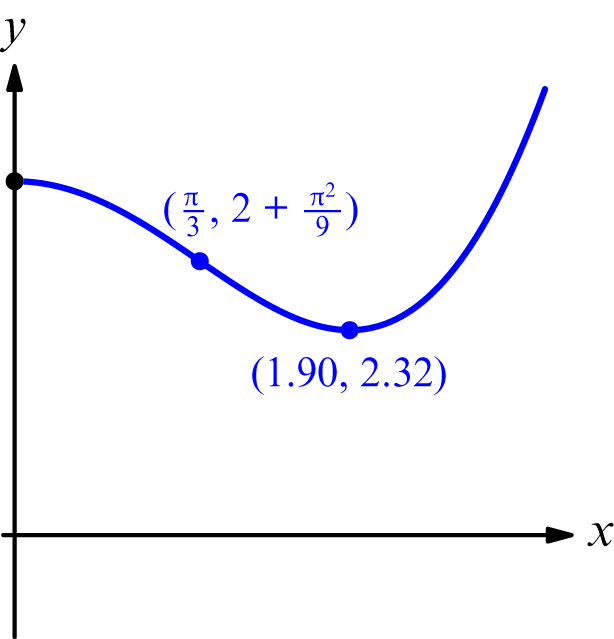
The stationary point has *x* > , so cos *x* < 0 and *f* ″(*x*) > 0.

Hence the stationary point is a minimum.

(iii) *f* ″(*x*) = 0 ⇔ 2 – 4 cos *x* = 0 ⇔ cos *x* = 

0 < *x* < *π* ∴ *x* = , *y* = 2 + 

(iv)



*[19 marks]*