**Self-assessment answers: 18 Further differentiation methods**

**1.** (a) 5(2*x* + 1)4 × 2 = 10(2*x* + 1)4

(b) 3 cos2 (2*x*) × (– sin(2*x*)) × 2 = − 6 cos2 (2*x*)sin(2*x*)

(c) 

(d) *[9 marks]*

**2. **



= 0 when *x* = −1 (as e −2*x* ≠ 0) *[5 marks]*

**3. ** + 6*x* = 0

⇒  + 3*x* = 0

At (2, 1) :  + 6 = 0

⇒  = −6*[5 marks]*

**4.** (a) *f* ′(*x*) = sin(*ax*) + *ax* cos(*ax*)

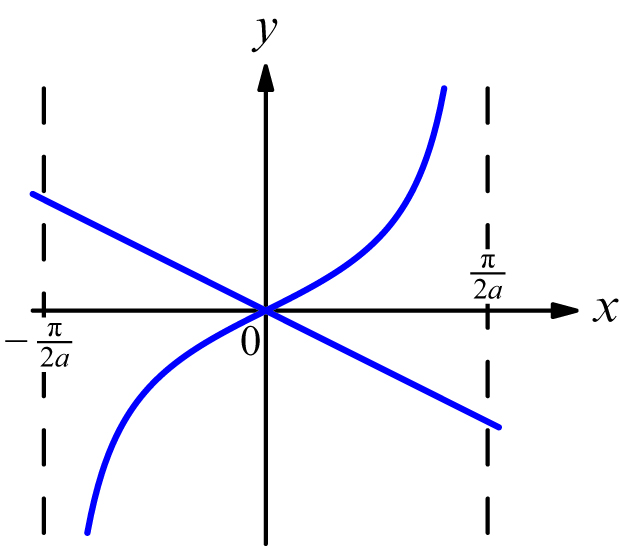
*f* ″(*x*) = *a* cos(*ax*) + *a* cos(*ax*) – *a*2*x* sin(*ax*)

= 2*a* cos(*ax*) – *a*2*x* sin(*ax*)

(b) (i) *f* ′(*x*) = 0 ⇒ sin(*ax*) = −*ax* cos(*ax*)

⇒ tan(*ax*) = −*ax*

(ii)



The only intersection is *x* = 0.

(iii) *f* (0) = 0

*f* ″(0) = 2*a* > 0

So (0, 0) is a minimum point.

(c) *f* ″(*x*) + 4*f* (*x*) = 2*a* cos(*ax*)

⇔ 2*a* cos(*ax*) – *a*2*x* sin(*ax*) + 4*x* sin *x* = 2*a* cos(*ax*)

⇔ 2*a* cos(*ax*) + (4 – *a*2)*x* sin *x* = 2*a* cos(*ax*)

This is satisfied when 4 – *a*2 = 0.

*a* > 0 ∴ *a* = 2*[14 marks]*