**Part 1:**

**1.** (a) (*x*2 + 1)2  
= 2(*x*2 + 1) × (2*x*) (M1)(M1) (C2)  
= 4*x*(*x*2 + 1)

(b) (ln(3*x* – 1))  
= × (3) (M1)(M1) (C2)  
= 

[4]

**2.** (a) (i) 1 (A1) (C1)

(ii) 2 (A1) (C1)

(iii)  (M1)

= –1 (A1) (C2)

(b) There are five repeated periods of the graph, each with two solutions, (R1)  
(*ie* number of solutions is 5 × 2)

 (A1) (C2)

[6]

**3.**

|  |  |  |
| --- | --- | --- |
| Function | Derivative diagram |  |
| *f*1 | (d) | (AG) |
| *f*2 | (e) | (A2) |
| *f*3 | (b) | (A2) |
| *f*4 | (a) | (A2) |

(C6)

[6]

**4.** Finding anti-derivative of 4*t*3  2*t* (M1)

*s* = *t*4  *t*2 + *c* A1A1

Substituting correctly 8 = 24  22 + *c* A1

**Note**: Exception to the **FT** rule. Allow full **FT** on  
 incorrect integration.

*c* = 4 (A1)

*s* = *t*4  *t*2  4 A1 N3

[6]

**5.** (a) **EITHER**

Recognizing that tangents parallel to the *x*-axis mean maximum

and minimum (may be seen on sketch) R1

Sketch of graph of *f* M1



**OR**

Evidence of using *f* (*x*) = 0 M1

Finding *f* (*x*) = 3*x*2  6*x*  24 A1

3*x*2  6*x*  24 = 0

Solutions *x* = 2 or *x* = 4

**THEN**

Coordinates are P(2, 29) and Q(4, 79) A1A1 N1N1

(b)



(i) (4, 29) A1 N1

(ii) (2, 79) A1 N1

[6]

**6.** (a) **METHOD 1**

*f* (*x*) = 6 sin 2*x* + 2 sin *x* cos *x* A1A1A1

= 6 sin 2*x* + sin 2*x* A1

= 5 sin 2*x* AG N0

**METHOD 2**

 (A1)

*f* (*x*) = 3 cos 2*x* +  A1

*f* (*x*) =  A1

*f* (*x*) =  A1

*f* (*x*) =  5 sin 2*x* AG N0

(b) *k* =  A2 N2

[6]

**Part II:**

**7.** (a) When *t* = 0, (M1)  
*h* = 2 + 20 × 0 – 5 × 02 = 2 *h* = 2 (A1) 2

(b) When *t* = 1, (M1)  
*h* = 2 + 20 × 1 – 5 × 12 (A1)  
= 17 (AG) 2

(c) (i) *h* = 17  17 = 2 + 20*t* – 5*t*2 (M1)

(ii) 5*t*2 – 20*t* + 15 = 0 (M1)

 5(*t*2 – 4*t* + 3) = 0  
 (*t* – 3)(*t* – 1) = 0 (M1)

**Note:** Award (M1) for factorizing or using the formula

 *t* = 3 or 1 (A1) 4

**Note:** Award (A1) for t = 3

(d) (i) *h* = 2 + 20*t* – 5*t*2  
  = 0 + 20 – 10*t*  
= 20 – 10*t* (A1)(A1)

(ii) *t* = 0 (M0)  
  = 20 – 10 × 0 = 20 (A1)

(iii)  = 0 (M1)  
 20 – 10*t* = 0  *t* = 2 (A1)

(iv) *t* = 2 (M1)  
 *h* = 2 + 20 × 2 – 5 × 22 = 22  *h* = 22 (A1) 7

[15]

**8.** (i) At *x* = *a*, *h* (*x*) = *a  
h* (*x*) = *x* => *h* (*a*) =  = gradient of tangent (A1)  
=> *y – a* = (*x – a*) = *x* – *a* (M1)  
=> *y =* *x* + *a* (A1)

(ii) tangent intersects *x*-axis => *y* = 0  
=> *x* = –*a* (M1)  
=> *x* = 5*a* = –4*a* (M1)(AG) 5

[5]

**9.** (a) or  (A1) (N1) 1

(b)  (M1)(A1)

 (may be implied) (A1)

 (accept *a* = 15, *b* = –6) (A1) (N2) 4

[5]

**10.** (a) *x* = 1 (A1) 1

(b) Using quotient rule (M1)  
Substituting correctly *g*(*x*) =  A1

=  (A1)  
 =  (Accept *a* = 3, *n* = 3) A1 4

(c) Recognizing at point of inflexion *g*(*x*) = 0 M1  
*x* = 4 A1

Finding corresponding *y*-value =  = 0.222 *ie* P A1 3

[8]