## Functions Answers

1. (a) $\mathrm{E}(8,0)$
(A1)(A1) 2
Notes: Brackets required. If missing award (A1)(A0).
Accept $x=8, y=0$
Award (A1) for $x=8$
(b) $y+\frac{1}{2} t=4$
(M1)(M1)
Notes: (M1) for the equation of the line seen. (M1) for substituting $t$.

$$
\begin{equation*}
y=4-\frac{1}{2} t \tag{AG}
\end{equation*}
$$

2
Notes: Final line must be seen or previous (M1) mark is lost.
(c) Area $=\frac{1}{2} \times\left(4+4-\frac{1}{2} t\right) \times t$

Note: (M1) for substituting in correct formula, (A1) for correct substitution.

$$
\begin{align*}
& =\frac{1}{2} \times\left(8-\frac{1}{2} t\right) \times t=\frac{1}{2}\left(8 t-\frac{1}{2} t^{2}\right)  \tag{A1}\\
& =4 t-\frac{1}{4} t^{2} \tag{AG}
\end{align*}
$$

Note: Final line must be seen or previous (A1) mark is lost
(d) $4 t-\frac{1}{4} t^{2}=9.75$ or any equivalent form.
(A1) 1
(e) (i) $t=3$ or $t=13$
$(\mathrm{A} 1)(\mathrm{ft})(\mathrm{A} 1)(\mathrm{ft})(\mathrm{G} 2)$
Notes: Follow through from candidate's equation to part (d) Award (A0)(A1)(ft) for $(3,0)$ and $(13,0)$
(ii) $t$ must be a value between 0 and 8 then $t=3$
Accept $B$ is between $O$ and $E$.
Do not award $(R 0)(A 1)$.
2.
(a) (i) $a=19$
(ii) $b=2$
(A1) 2
(b) $c=\frac{360}{12}$

Or
For substituting a point from the graph in the equation.
$\mathrm{c}=30$
(AG) 1
(c) $3.5<x<8.5$
(A1)(A1) 2
Notes: (A1) for 3.5 and 8.5 seen, (A1) for strict inequality signs seen. Accept $3.48<x<8.52$ (found from GDC)
3. (a)


Notes: (A1) for labels and some idea of scale.
(A1) for $x$-intercept seen, (A1) for $y$-intercept seen in roughly the correct places (coordinates not required).
(A1) for vertical asymptote seen, (A1) for horizontal asymptote seen in roughly the correct places (equations of the lines not required).
(A1) for correct general shape.
(b) $x=-4$
(A1)(A1)(ft)
2
Note: (A1) for $x=,(A 1)(f t)$ for -4
(c)


Note: (A1) for correct axis intercepts, (A1) for straight line
(A1)(A1)
(d) $\quad(-2.85078,-2.35078) \mathrm{OR}(0.35078,0.85078)$
(G1)(G1)(A1)(ft)
Notes: (A1) for $x$-coordinate, (A1) for y-coordinate,
(A1)(ft) for correct accuracy. Brackets required.
If brackets not used award (G1)(G0)(A1)(ft).
Accept $x=-2.85078, y=-2.35078$
or $x=0.35078, y=0.85078$
(e) $\quad$ gradient $=1$
(A1) 1
(f) gradient of perpendicular $=-1$

Note: Can be implied in the next step

$$
y=m x+c
$$

$$
\begin{equation*}
-3=-1 \times-2+c \tag{VII}
\end{equation*}
$$

$$
c=-5
$$

$$
y=-x-5
$$

OR
(A1)(ft)(G2)
OR
$y+3=-(x+2)$
( M 1 )(A1)(ft)(G2)
Note: Award (G2) for correct answer with no working at all but (A1)(G1) if the gradient is mentioned as -1 then correct answer with no further working.
4. (a) $(x-5)(x+2)$
(A1)(A1)
Note: Award (A1) for $(x+5)(x-2),(A 0)$ otherwise. If equation is equated to zero and solved by factorizing award (A1) for both correct factors, followed by (A0).
(b) (i) $-3,-2,-1,0,1,2,3$
(A1)(A1)
Notes: Award (A2) for all correct answers seen and no others. Award (A1) for 3 correct answers seen.
(ii) $-26,-7,0,1,2,9,28$

Notes: Award (A2) for all correct answers seen and no others. Award (A1) for 3 correct answers seen. If domain and range are interchanged award (A0) for $(b)(i)$ and (Al)(ft)(Al)(ft) for $(b)(i i)$.
(A1)(A1)
(C2)
(C2)
(A1) (C1)
(M1)
(A1)(ft) (C2)

## [6]

6. (a) $a=1800$
(b) $200 \times 3^{6}($ or $16200 \times 9)=145800$
(c) $200 \times 3^{n}=2 \times 10^{6}$ (where $n$ is each 4 hour interval)

Notes: Award (M1) for attempting to set up the equation or writing a list of numbers.
$3^{n}=10^{4}$
$n=8.38$ ( 8.383613097 ) correct answer only
Time $=33.5$ hours
Notes: Accept 34, 35 or 36 if previous A mark awarded
(A1)(ft) for correctly multiplying their answer by 4.
If 34, 35 or 36 seen, or 32-36 seen, award (M1)(A0)(A0).
(C3)
7. (a) for attemptat substituted $\frac{y \text { distance }}{x \text { distance }}$
gradient $=2$
(A1)(G2)
(b) $2 x-3$
(A1)(A1)
2
(A1) for $2 x$, (A1) for -3
(c) for their $2 x-3=$ their gradient and attempt to solve
(M1)
(A1)(ft)
$x=2.5$
$y=-5.25((\mathrm{ft})$ from their $x$ value)
(A1)(ft)(G2) 3
(d) for seeing $\frac{-1}{\text { their }(a)}$ solving $2 x-3=-\frac{1}{2}$ (or their value)
(M1)(M1)

$$
x=1.25
$$

(A1)(ft)(G1)
$y=-6.1875$
(A1)(ft)(G1) 4
(e) (i) $2 \times 2-3=1 \quad((\mathrm{ft})$ from (b))
(A1)(ft)(G1)
(ii) $y=m x+c$ or equivalent method to find $c \Rightarrow-6=2+c$ $y=x-8$
(A1)(ft)(G2) 3
(f) $\quad x=1.5$
(A1)
(g) for substituting their answer to part (f) into the equation of the parabola
(M1) $(1.5,-6.25)$ accept $x=1.5, y=-6.25$
(A1)(ft)(G2)
gradient is zero (accept $\frac{\mathrm{d} y}{\mathrm{~d} x}=0$ )
(A1) 3
[18]
8. Unit penalty (UP) is applicable in part $(i)(a)(c)(d)(e)$ and $(f)$
(a) $90^{\circ} \mathrm{C}$
(A1) 1
(UP)
(b) $y=16$
(A1) 1
(c) $16^{\circ} \mathrm{C}$ (ft) from answer to part (b)
(A1)(ft) 1
(UP)
(d) $\quad 25.4^{\circ} \mathrm{C}$
(A1) 1
(UP)
(e) for seeing $2^{0.75}$ or equivalent
(A1)
for multiplying their (d) by their $2^{0.75}$
(M1)

$$
42.8^{\circ} \mathrm{C}
$$

(A1)(ft)(G2)
$(\mathrm{UP})$

(M1)(A1)
(A1)(G3) 4
(UP)
9. (a)

(G3) 3
(b) line drawn with - ve gradient and +ve y-intercept (2.45, 2.11)
(G1)(G1) 3
(c) $\quad f^{\prime}(1.7)=3(1.7)^{2}-4(1.7)+1$
(M1) 2
Note: Award (M1) for substituting in their $f^{\prime}(x)$
2.87
(A1)(G2)
[8]
10. (a) $p=-2$
$q=4$
(A1) (C2)
(b) (i) domain $=$ all real numbers except $x=2$

Note: (A1) for $\mathbb{R}$, (A1) for except $x=2$, (or equivalent notation)
(ii) range $g(x)>0 \quad($ accept $y>0)$

OR
$(0, \infty)$
(A1)(A1)
(C2)

OR
$0, \infty$
Note: Accept $0<y \leq \infty$
(iii) $x=2$

Note: must be an equation with $x$
(A1)
(A1)
11. (a)

(A4)(C4)
Notes: (A1) for correct y-intercept
(A1) for correct minimum points
(A1) for correct maximum points
(A1) for smooth sine curve.
(b) $\operatorname{period}=180^{\circ}$
(A1)(ft)
(C1)
(c) amplitude $=\frac{1}{2}$
(A1)(ft) (C1)
12. (i) B (A1)
(ii) D
(A1)
(iii) A
(A1)
(iv) E
(A1)
(v) C
(A1)
(vi) F
(A1) (C6)

