| Question | Scheme | Marks | AOs |
|---|---|---|---|
| **14 (a)** | $\mathrm{f}(x) = -3x^2 + 12x + 8 = -3(x \pm 2)^2 + \ldots$ | M1 | 1.1b |
| | $= -3(x-2)^2 + \ldots$ | A1 | 1.1b |
| | $= -3(x-2)^2 + 20$ | A1 | 1.1b |
| | | **(3)** | |
| **(b)** | Coordinates of $M = (2, 20)$ | B1ft<br>B1ft | 1.1b<br>2.2a |
| | | **(2)** | |
| **(c)** | $\int -3x^2 + 12x + 8 \,\mathrm{d}x = -x^3 + 6x^2 + 8x$ | M1<br>A1 | 1.1b<br>1.1b |
| | Method to find $R =$ their $2 \times 20 - \int_0^2 \left(-3x^2 + 12x + 8\right) \mathrm{d}x$ | M1 | 3.1a |
| | $R = 40 - \left[-2^3 + 24 + 16\right]$ | dM1 | 1.1b |
| | $= 8$ | A1 | 1.1b |
| | | **(5)** | |
| | | | **(10 marks)** |
| **Alt(c)** | $\int 3x^2 - 12x + 12 \,\mathrm{d}x = x^3 - 6x^2 + 12x$ | M1<br>A1 | 1.1b<br>1.1b |
| | Method to find $R = \int_0^2 3x^2 - 12x + 12 \,\mathrm{d}x$ | M1 | 3.1a |
| | $R = 2^3 - 6 \times 2^2 + 12 \times 2$ | dM1 | 1.1b |
| | $= 8$ | A1 | 1.1b |
| | | | |

**Notes:**

(a)

**M1:** Attempts to take out a common factor and complete the square. Award for $-3(x \pm 2)^2 + \ldots$

Alternatively attempt to compare $-3x^2 + 12x + 8$ to $ax^2 + 2abx + ab^2 + c$ to find values of a and b

**A1:** Proceeds to a form $-3(x-2)^2 + \ldots$ or via comparison finds $a = -3, b = -2$

**A1:** $-3(x-2)^2 + 20$

(b)

**B1ft:** One correct coordinate

**B1ft:** Correct coordinates. Allow as $x = \ldots, y = \ldots$
Follow through on their $(-b, c)$

**(c)**

**M1:** Attempts to integrate. Award for any correct index

**A1:** $\int -3x^2 + 12x + 8 \, dx = -x^3 + 6x^2 + 8x$ (+ $c$ ) ( which may be unsimplified)

**M1:** Method to find area of $R$. Look for their $2 \times "20" - \int_0^{"2"} f(x) \, dx$

**dM1:** Correct application of limits on their integrated function. Their 2 must be used

**A1:** Shows that area of $R$ = 8