| Question | Scheme | Marks | AOs |
|---|---|---|---|
| **5(a)** | $\{V=\}\pi\int_0^2\left[(2-y)^{\frac{1}{2}}\right]^2\,\mathrm{d}y$ or $\{V=\}\pi\int_0^2(2-y)\,\mathrm{d}y$ | B1 | 3.3 |
| | Integrates to the form $\alpha y\pm\beta y^2$ | M1 | 1.1b |
| | Correct integration $2y-\frac{1}{2}y^2$ | A1 | 1.1b |
| | Uses their *y* limits correctly in a changed expression $\pi\left[2y-\frac{1}{2}y^2\right]_0^2=\pi\left(2(2)-\frac{1}{2}\left(2^2\right)\right)-0=...\{2\pi$ or 6.28...$\}$ | M1 | 3.4 |
| | mass = 'their volume' $\times 900$ | M1 | 3.1b |
| | Mass = 5700 (kg) 2 s.f. cao | A1 | 2.2b |
| | | **(6)** | |
| **(b)** | eg The surface will not be smooth<br>The pile will not follow the shape of the curve<br>The pile will not be solid<br>Equation of the curves may not be a suitable model<br>Concrete is likely to be uneven/may have bumps<br>The pile is unlikely to be symmetrical | B1 | 3.5b |
| | | **(1)** | |
| **(c)** | Makes a comparison about the difference between their mass and 5500 and draws a conclusion<br>e.g. 200 difference which is a lot of concrete therefore not a good model<br>e.g. the mass of 5700 is very close to 5500 kg and draws a conclusion about the model – e.g. therefore a good model<br>e.g. Finds the percentage error and draw a conclusion about the model<br>e.g. The masses are very close/significantly different and draws an appropriate conclusion<br>Not sufficient to say 5700 > 5500 B0 | B1ft | 3.5a |
| | | **(1)** | |
| | | | **(8 marks)** |

**Notes:**

**(a)**

**B1:** Sets up the model to find a correct expression for the volume, including limits, d*y* may be implied. The limits may be seen later.

**M1:** Integrates to the form $\alpha y\pm\beta y^2$

**A1:** Correct integration

**M1:** Substitutes their *y* limits the correct way round and subtracts, must be a changed expression

**M1:** Multiplies their volume by 900 to find the mass

**A1:** 5700 cao

**Note** incorrect upper limit of $\sqrt{2}$ leads to 5200kg Scores B0 M1 A1 M1 M1 A0

**Note:** Finding the volume around the *x*-axis can score B0 M0 A0 M0 M1 A0 only

**Note** If they use their calculator to find the value of the definite integration and achieve the correct answer the maximum they can score is B1M0A0M1M1A1

**(b)**

**B1:** See scheme, must be referring to the model and not the value of the density etc

**(c)**

**B1ft:** See scheme, follow through on their answer to (a). If using a calculation, it must be correct. Ignore any contradictory comments e.g. 3.6% out so it's fairly close so it's a good model but it's an overestimate which isn't good. You may need to use your own judgement but any sensible comment comparing their value to 5500 is acceptable.