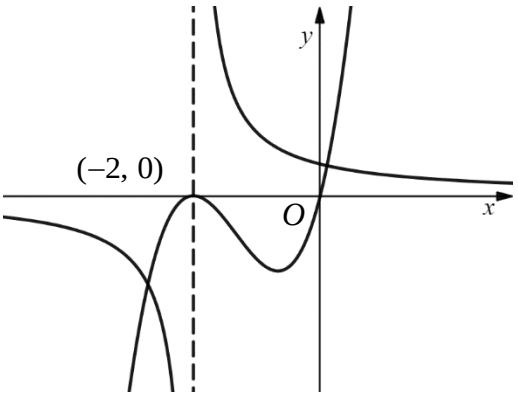
| Question Number | Scheme | Marks |
|---|---|---|
| **4a** | $x=-2$ | B1 |
| | | **(1)** |
| **b** | $x^3+4x^2+4x=x(x+2)^2$ | M1A1 |
| | | **(2)** |
| **c** |   | B1B1B1 |
| | | **(3)** |
| **d** | 2 as the graphs intersect (each other) twice<br>(since $(x+2)(x^3+4x^2+4x)=1$ is the same as $x^3+4x^2+4x=\frac{1}{x+2}$) | B1 |
| | | **(1)** |
| | | **(7 marks)** |

**Note: Check for answers by the questions or on the Figure (rather than the diagram). If there is a contradiction between the answers by the question and the main body of the solution then the main body of the solution takes precedence.**

(a)

B1: $x=-2$ only. Accept labelled on the diagram but do not accept just $-2$. If other equations are given (other than $y=0$) then B0.

Beware that $x=-2$ is one of the solutions to the cubic so the equation of the asymptote must be seen in (a), on the diagram or by the question.

(b)

M1: Attempts to take out a linear factor eg $x(x^2\pm4x\pm4)$ or $(x+2)(x^2\pm2x)$. May be implied by the correct answer.

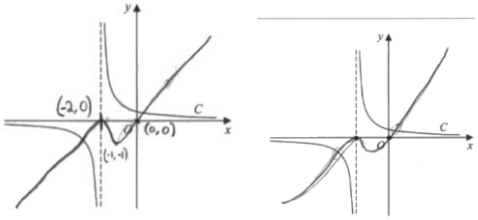
A1: $x(x+2)^2$ or $x(x+2)(x+2)$. Accept $(x+2)(x+2)x$ and condone a missing trailing bracket on the final linear factor e.g. $x(x+2)(x+2$ but $x(x+2^2$ is A0.

Condone $(x+0)(x+2)^2$. Isw once a correct expression is seen and ignore a spurious = 0

(c) **Note: If there are multiple attempts then score the highest one**

B1: Sketches a positive cubic anywhere on a set of axes. Do not penalise poor curvature provided the intention is clear and ignore if the curvature looks asymptotic. The cubic does not need to have two turning points for this mark.

Examples of acceptable cubic shapes (including where poor curvature would be condoned):




(If you are unsure then send to review)

B1: A cubic which

- has a turning point where the *x*-axis and vertical asymptote intersect
- passes through the origin (from quadrants 3 to 1 or from quadrants 2 to 4 – it cannot start or stop at the origin) It also cannot be a turning point.

Do not penalise poor curvature provided the intention is clear and ignore if the curvature looks asymptotic.

B1: $(-2, 0)$ **indicated on the graph** where their graph crosses or turns on the **negative *x*-axis** Do not be concerned regarding any other points where the graph crosses or turns on the *x*-axis including the origin.
Condone -2 labelled on the *x*-axis or the coordinates the wrong way round as $(0, -2)$ or with missing brackets.
The asymptote labelled $x = -2$ does not score this mark and do not be concerned with the point of intersection relative to the asymptote.

(d) **This mark can only be scored provided B1B1B0 or B1B1B1 is scored in (c)**
B1: **2** (real) roots **and** a valid reason e.g. (graphs/curves/functions/equations/they) **intersect/meet/cross/touch** (each other) **twice**. e.g. "intersect twice" or "2 intersections" can score this mark.
May also refer to an intersection in the first and third quadrants.

Only withhold the mark if it is clear that they are referring to intersections between the cubic graph and the *x*-axis.

Do not accept responses relating to the roots of the equation, use of the discriminant or other algebraic methods which do not use the graphs.

| Question Number | Scheme | Marks |
|---|---|---|
| **5a** | e.g. $\left(\cos\theta =\right)\ \dfrac{5^2+(1+x)^2-x^2}{2\times5(1+x)}\ \left(=\dfrac{25+1+2x+x^2-x^2}{2\times5(1+x)}\right)$<br>or e.g. $x^2=5^2+(1+x)^2-2\times5(1+x)\cos\theta$ | M1 |
| | $\cos\theta=\dfrac{13+x}{5+5x}$ * | A1* |
| | | **(2)** |
| **b** | $\theta=$ awrt $42°$ (42.470747….) | B1 |
| | ---<br>Attempts to find *AB*, *AD* or *AC*:<br>e.g. $\dfrac{AB}{\sin"42"}=\dfrac{5}{\sin30}\Rightarrow AB=...$<br>or<br>e.g. $\angle ABC=180-30-"42.5"="107.6"$<br>$\dfrac{\sin DBC}{1+2\sqrt{3}}=\dfrac{\sin"42.5"}{2\sqrt{3}}\Rightarrow\angle DBC="60.5",\ \angle ABD="107.6"-"60.5"="47.1"$<br>$\dfrac{AD}{\sin("47.1")}=\dfrac{2\sqrt{3}}{\sin30}\Rightarrow AD=...$<br>or<br>e.g. $\dfrac{AC}{\sin"108"}=\dfrac{5}{\sin30}\Rightarrow AC=...$<br>--- | M1 |
| | $AB=6.75...$ or $AD=5.07...$ or $AC=9.53...$ | A1 |
| | Area $=\dfrac{1}{2}\times5\times"6.75"\times\sin(180-30-"42.5")$ or<br>$=\dfrac{1}{2}\times5\times"9.54"\times\sin("42.5")$ | dM1 |
| | $=$ awrt $16.1$ ($m^2$) | A1 |
| | | **(5)** |
| | | **(7 marks)** |

(a)

M1: Uses the cosine rule to form an equation for $\cos\theta$. Condone just an expression for $\cos\theta$. (You may not see $\cos\theta=$)
Condone invisible brackets for this mark.
Be aware of longer versions which may involve splitting triangle *BCD* into two right angled triangles. They would still need to proceed to an equation involving $\cos\theta$ to score this mark.

A1*: Achieves the given answer with no errors seen including invisible brackets. There must be at least one stage of intermediate working between their starting equation and achieving the given answer. Condone $\cos\theta$ not appearing in the answer line, provided it is seen correctly as the subject on an earlier line.