1. Correct separation of variables ( $x$ terms on one side, $y$ terms on the other)
2. Correctly integrate one side
3. Correctly integrate the other side
4. Find C
5. Put together and rearrange into required form
(Note that there may be more marks available if question is more complicated)

How to get marks for AQA Core 4 Differential Equation Questions

| Question <br> \& initial condition <br> Separation of variables | $\frac{d x}{d t}=\frac{1}{15 x \sqrt{2 x-1}}$ | $\frac{d y}{d x}=\frac{x \sqrt{x^{2}+3}}{e^{2 y}}$ | $\frac{d x}{d t}=\frac{t \cos \left(\frac{\pi}{4} t\right)}{32 x}$ | $\frac{d y}{d x}=\frac{16 x e^{2 y}}{(1-3 x)(1+x)^{2}}$ | $\frac{d x}{d t}=\frac{\sqrt{4+5 x}}{5(1+t)^{2}}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $t=0, x=1$ | $y=0, x=1$ | $t=0, x=4$ | $y=0, x=0$ | $t=0, x=0$ |  |
| Correctly integrate one <br> side |  |  |  |  |  |
| Correctly integrate the <br> other side |  |  |  |  |  |
| Find C |  |  |  |  |  |
| Put together and <br> rearrange into required <br> form |  |  |  |  |  |
| Exam Paper Ref. | AQA Jun 12 (8b) | AQA Jan 13 (5b) | AQA June 13 (8b) | AQA June 14 (8b) | AQA June 15 (8a) |

How to get marks for AQA Core 4 Differential Equation Questions - Answers

| Question <br> \& initial condition | $\begin{aligned} \frac{d x}{d t} & =\frac{1}{15 x \sqrt{2 x-1}} \\ t & =0, x=1 \end{aligned}$ | $\begin{gathered} \frac{d y}{d x}=\frac{x \sqrt{x^{2}+3}}{e^{2 y}} \\ y=0, x=1 \end{gathered}$ | $\begin{gathered} \frac{d x}{d t}=\frac{t \cos \left(\frac{\pi}{4} t\right)}{32 x} \\ t=0, x=4 \end{gathered}$ | $\begin{gathered} \frac{d y}{d x}=\frac{16 x e^{2 y}}{(1-3 x)\left(1+x^{2}\right)} \\ y=0, x=0 \end{gathered}$ | $\begin{gathered} \frac{d x}{d t}=\frac{\sqrt{4+5 x}}{5(1+t)^{2}} \\ t=0, x=0 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Separation of variables | $\begin{aligned} & x \sqrt{2 x-1} d x \\ & =\frac{1}{15} d t \end{aligned}$ | $\begin{aligned} & e^{2 y} d y \\ & =x \sqrt{x^{2}+3} d x \end{aligned}$ | $\begin{aligned} & 32 x d x \\ & =t \cos \left(\frac{\pi}{4} t\right) d t \end{aligned}$ | $\begin{aligned} & \frac{1}{e^{2 y}} d y \\ & =\frac{16 x}{(1-3 x)(1+x)^{2}} d x \end{aligned}$ | $\begin{aligned} & \frac{1}{\sqrt{4+5 x}} d x \\ & =\frac{d t}{5(1+t)^{2}} \end{aligned}$ |
| Correctly integrate one side | $\begin{aligned} & \frac{x}{3}(2 x-1)^{\frac{3}{2}} \\ + & \frac{1}{15}(2 x-1)^{\frac{5}{2}} \end{aligned}$ | $\frac{e^{2 y}}{2}$ | $16 x^{2}$ | $-\frac{e^{2 y}}{2}$ | $\frac{2}{5} \sqrt{4+5 x}$ |
| Correctly integrate the other side | $\frac{t}{15}$ | $\frac{\left(x^{2}+3\right)^{\frac{3}{2}}}{3}$ | $\begin{aligned} & \frac{4 t}{\pi} \sin \left(\frac{\pi t}{4}\right) \\ & +\frac{16}{\pi^{2}} \cos \left(\frac{\pi t}{4}\right) \end{aligned}$ | $\begin{aligned} & -\ln (1-3 x) \\ & +\ln (1+x)+\frac{4}{1+x} \end{aligned}$ | $-\frac{1}{5(1+t)}$ |
| Find C | $C=-\frac{4}{15}$ | $C=-\frac{13}{6}$ | $C=256-\frac{16}{\pi^{2}}$ | $C=-\frac{9}{2}$ | $C=1$ |
| Put together and rearrange into required form | $\begin{gathered} t=\frac{3}{2}(2 x-1)^{\frac{5}{2}} \\ +\frac{5}{2}(2 x-1)^{\frac{3}{2}}-4 \end{gathered}$ | $\begin{array}{r} y=\frac{1}{2} \ln \left(\frac{2}{3}\left(x^{2}+3\right)^{\frac{3}{2}}\right. \\ \left.-\frac{13}{3}\right) \end{array}$ | $t=45, x=3.65$ | $\begin{gathered} f(y)=g(x) \\ -\frac{e^{2 y}}{2}=-\ln (1-3 x)+\ln (1+x) \\ +\frac{4}{1+x}-\frac{9}{2} \end{gathered}$ | $\begin{gathered} x=\frac{5}{4}\left(1-\frac{1}{5(1+t)}\right)^{2} \\ -\frac{4}{5} \end{gathered}$ |
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