## *Maclaurin Series Exam Questions (Edexcel)*

**Q1.**

$$y = \sqrt{8 + e^x} \quad x \in \mathbb{R}$$

Find the series expansion for $y$ in ascending powers of $x$, up to and including the term in $x^2$, giving each coefficient in its simplest form.

**(8)**

**(Total 8 marks)**

**(Q10 6668/01, June 2014)**

**Q2.**

$$y = \ln\left(\frac{1}{1-2x}\right), \quad |x| < \frac{1}{2}$$

(a) Find $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ and $\frac{d^3y}{dx^3}$

**(4)**

(b) Hence, or otherwise, find the series expansion of $\ln\left(\frac{1}{1-2x}\right)$ about $x = 0$, in ascending powers of $x$, up to and including the term in $x^3$. Give each coefficient in its simplest form.

**(3)**

(c) Use your expansion to find an approximate value for $\ln\left(\frac{3}{2}\right)$, giving your answer to 3 decimal places.

**(3)**

**(Total for question = 10 marks)**

**(Q11 6668/01, June 2017)**

**Q3.**

$$f(x) = \arcsin x \qquad -1 \leq x \leq 1$$

(a) Determine the first two non-zero terms, in ascending powers of $x$, of the Maclaurin series for f($x$), giving each coefficient in its simplest form.

**(4)**

(b) Substitute $x = \frac{1}{2}$ into the answer to part (a) and hence find an approximate value for $\pi$

Give your answer in the form $\frac{p}{q}$ where $p$ and $q$ are integers to be determined.

**(2)**

**(Total for question = 6 marks)**

**(Q03 9FM0/02, Oct 2021)**

**Q4.**

$$y = \cosh^n x \qquad n \geq 5$$

(a) (i) Show that

$$\frac{d^2y}{dx^2} = n^2 \cosh^n x - n(n-1)\cosh^{n-2} x$$

**(4)**

(ii) Determine an expression for $\frac{d^4y}{dx^4}$

**(2)**

(b) Hence determine the first three non-zero terms of the Maclaurin series for $y$, giving each coefficient in simplest form.

**(2)**

**(Total for question = 8 marks)**

**(Q09 9FM0/02, June 2022)**

**Q5.**

$$f(x) = \tanh^{-1}\left(\frac{3-x}{6+x}\right) \qquad |x| < \frac{3}{2}$$

(a) Show that

$$f'(x) = -\frac{1}{2x+3}$$

**(4)**

(b) Hence determine f ''($x$)

**(1)**

(c) Hence show that the Maclaurin series for f($x$), up to and including the term in $x^2$, is

$$\ln p + qx + rx^2$$

where $p$, $q$ and $r$ are constants to be determined.

**(3)**

**(Total for question = 8 marks)**

**(Q02 9FM0/02, June 2024)**

**Q6.**

$$y = \sin x \sinh x$$

(a) Show that $\frac{d^4y}{dx^4} = -4y$

**(4)**

(b) Hence find the first three non-zero terms of the Maclaurin series for $y$, giving each coefficient in its simplest form.

**(4)**

(c) Find an expression for the $n$th non-zero term of the Maclaurin series for $y$.

**(2)**

**(Total for question = 10 marks)**

**(Q05 9FM0/02, Specimen papers )**

**Q7.**

(a) Write down the Maclaurin series of $e^x$, in ascending power of $x$, up to and including the term in $x^3$

**(1)**

(b) Hence, without differentiating, determine the Maclaurin series of

$$e^{(ex\,-\,1)}$$

in ascending powers of $x$, up to and including the term in $x^3$, giving each coefficient in simplest form.

**(5)**

**(Total for question = 6 marks)**

**(Q02 9FM0/02, June 2023)**

**Q8.**

(a) Use the Maclaurin series expansion for cos $x$ to determine the series expansion of $\cos^2\left(\frac{x}{3}\right)$ in ascending powers of $x$, up to and including the term in $x^4$

Give each term in simplest form.

**(2)**

(b) Use the answer to part (a) and calculus to find an approximation, to 5 decimal places, for

$$\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \left(\frac{1}{x}\cos^2\left(\frac{x}{3}\right)\right) \mathrm{d}x$$

**(3)**

(c) Use the integration function on your calculator to evaluate

$$\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \left(\frac{1}{x}\cos^2\left(\frac{x}{3}\right)\right) \mathrm{d}x$$

Give your answer to 5 decimal places.

**(1)**

(d) Assuming that the calculator answer in part (c) is accurate to 5 decimal places, comment on the accuracy of the approximation found in part (b).

**(1)**

**(Total for question = 7 marks)**

**(Q02 9FM0/01, Oct 2021)**