

Subject: A Course of Mathematics
Paper: A
Note: Attempt Six questions in all by selecting Three questions from each section.

SECTION-I

(a) Define continuous function in term of $(\delta - \varepsilon)$ form and discuss the continuity of $f(x) = x - [x]$, $x \in \mathbb{R}$, for integral values of \mathbb{R} . 3+6/3

Define least upper bound and prove that the set $S = \{x : x^2 < 2\}$ has least upper bound $= \sqrt{2}$. 2+6/1

Q.2(a) If u is a derivable function of v and v is a derivable function of x , then prove that $\frac{du}{dx} = \frac{du}{dv} \cdot \frac{dv}{dx}$. 9

Q.3(a) If $y(x) = e^{ax} x^2$, find a formula for $y^{(n)}(x)$. 8/8

Q.3(a) If f is differentiable on $[a, b]$ and f' decreases strictly on $[a, b]$, prove that $f'(b) < \frac{f(b) - f(a)}{b - a} < f'(a)$. How is this result modified if f' increases strictly on $[a, b]$? Hence show that if $f(x) = \sin x$, $a = \frac{\pi}{3}$, $b = \frac{61\pi}{180}$ then $\sin 61^\circ - \sin 60^\circ < 0.0088$. 9

Q.4(a) Describe the geometrical significance of the derivative of the radius vector with respect to the polar angle. 8

(b) Show that Pedal equation of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2} - \frac{r^2}{a^2 b^2}$. 9

Q.5(a) Show that the maximum value of $(\frac{1}{x})^x$ is $(e)^{1/e}$. 8

(b) If $y(x) = (x + \sqrt{1+x^2})^m$, prove that $(1+x^2)y''(x) + xy'(x) - m^2 y(x) = 0$ and $(1-x^2)y^{(n+2)}(x) + (2n+1)xy^{(n+1)}(x) + (n^2 - m^2)y^{(n)}(x) = 0$. 2/10

Q.6(a) Find the centre of curvature of the astroid $x^{2/3} + y^{2/3} = a^{2/3}$. 9

(b) The normal to a given curve is a tangent to its evolute. 8

SECTION-II

Q.7(a) State and prove the fundamental theorem of the integral calculus. 2+7/9

(b) Prove that $\int_0^{\pi} \frac{\ln(1+x^2)}{1+x^2} dx = \pi \ln 2$. 8/8

Q.8(a) Define improper integral and determine the convergence or divergence of the following improper integral and evaluate. The convergent integral $\int_0^{\infty} e^{-x} x^5 dx$. 8/2

(b) Evaluate $\int \frac{x^2}{(1+x^2)^3} dx$. 4/1

Q.9(a) Evaluate $\int \frac{x + \sin x}{1 + \cos x} dx$. 4/4

(b) (i) If $f(x)$ and $g(x)$ are two antiderivatives of $\phi(x)$ then $f(x)$ and $g(x)$ must differ by a constant. 8

(ii) Evaluate $\int \frac{\sqrt{9x^2-1}}{x} dx$. 8

Q.10(a) Show that the intrinsic equation of the semicubical parabola $ay^2 = x^3$, taking the cusp as the fixed point is $27S = 8a(\sec^2 \psi - 1)$. 8

(b) Find the area of the region included between the cardioid $r = 2a(1 + \cos \theta)$ and the circle $r = 6a \cos \theta$. 8

Q.11(a) Assuming that the area of an ellipse with semi axes a and b is πab , compute the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$. 8

(b) Find the Fourier series representing the function $f(x) = |x|$, $-\pi \leq x \leq \pi$. 8

Q.12(a) Determine whether the series $\sum_{n=1}^{\infty} \frac{\arctan n}{1+n^2}$ converges or diverges. 8

(b) Apply any appropriate test to determine the convergence or divergence of the series $\sum_{n=1}^{\infty} \frac{(2n+1)!}{n^2(n+1)!}$. 8

O Level Maths Past Papers

David Baud



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O Level Maths Past Papers Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has are more apparent than ever. Its capability to stir emotions, provoke thought, and instigate transformation is truly remarkable. This extraordinary book, aptly titled "**O Level Maths Past Papers**," compiled by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we will delve into the book is central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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