Weekly Homework 4

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Formulas

March 23, 2019

1. The fundamental theorem of calculus: $\int_a^b f'(x)dx = f(b) - f(a)$
2. Special relativity formula: $t' = t\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$
3. The minimal surface equation: $\mathcal{A}(u) = \int_\Omega (1 + |\nabla u|^2)^(1/2) dx_1 ... dx_n$
4. TolmanOppenheimerVolkoff (TOV) equation: $\frac{dP}{dr} = -\frac{Gm}{r^2}\rho(1 + \frac{P}{\rho c^2})(1 + \frac{4\pi r^3 P}{mc^2})(1 - \frac{2Gm}{rc^2})^{-1}$
5. The size of a black hole: $r_s = \frac{2GM}{c^2} \approx 2.95\frac{M}{M_{Sun}}km$
6. The Euler Product Formula: $\sum_n \frac{1}{n^s} = \prod_p \frac{1}{1-\frac{1}{p^s}}$
7. The Analytic Continuation of the Factorial: $n! = \int_0^\infty x^n e^{-x} dx$
8. The Explicit Formula for the Fibonacci Sequence: $F(n) = \frac{(\varphi)^n - (-\frac{1}{\varphi})^n}{\sqrt{5}}$
9. Fubini's theorem: $\int_X (\int_Y f(x,y)dy)dx = \int_Y (\int_X f(x,y)dx)dy) = \int_{X\times Y} f(x,y)d(x,y)$
10. The quadratic formula: $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$
11. Fourier transform: $\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx$
12. Black-Scholes equation: $\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} = rV - rS\frac{\partial V}{\partial S}$
13. Normal distribution: $\phi(x) = \frac{e^{-\frac{1}{2}x^2}}{\sqrt{2\pi}}$

14. Navier-Stokes equations: $y_t + A(y)y_x = 0$

15. Maxwell's equations: $\nabla \cdot E = \frac{\rho}{\epsilon_0} \qquad \nabla \cdot B = 0$
$$\nabla \times E = -\frac{\partial B}{\partial t} \qquad \nabla \times B = \mu_0(J + \epsilon_0 \frac{\partial E}{\partial t})$$

16. The Dirac equation: $(\beta mc^2 + \sum_{k=1}^{3} \alpha_k p_k c)\psi(x,t) = i\hbar \frac{\partial \psi(x,t)}{\partial t}$

17. Bayes' theorem: $P(A|B) = \frac{P(B|A)P(A)}{P(B)}$

18. Einstein field equation: $R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$

19. $\int \frac{1}{|x|\sqrt{x^2-1}}dx = sec^{-1}x + X$

20. $\int \frac{du}{\sqrt{a^2-u^2}} = arcsin\frac{u}{a} + C$