



MATHEMATICS METHODS ATAR COURSE

FORMULA SHEET

2021

Differentiation and integration

| | | | | |
|---|--|---|-----|---|
| $\frac{d}{dx} x^n = nx^{n-1}$ | $\int x^n dx = \frac{x^{n+1}}{n+1} + c, \quad n \neq -1$ | | | |
| $\frac{d}{dx} e^{ax-b} = ae^{ax-b}$ | $\int e^{ax} dx = \frac{1}{a} e^{ax} + c$ | | | |
| $\frac{d}{dx} \ln x = \frac{1}{x}$ | $\int \frac{1}{x} dx = \ln x + c, \quad x > 0$ | | | |
| $\frac{d}{dx} \ln f(x) = \frac{f'(x)}{f(x)}$ | $\int \frac{f'(x)}{f(x)} dx = \ln f(x) + c, \quad f(x) > 0$ | | | |
| $\frac{d}{dx} \sin(ax-b) = a \cos(ax-b)$ | $\int \sin(ax-b) dx = -\frac{1}{a} \cos(ax-b) + c$ | | | |
| $\frac{d}{dx} \cos(ax-b) = -a \sin(ax-b)$ | $\int \cos(ax-b) dx = \frac{1}{a} \sin(ax-b) + c$ | | | |
| Product rule | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> If $y = uv$ then $\frac{d}{dx} (uv) = v \frac{du}{dx} + u \frac{dv}{dx}$ </td> <td style="width: 10%; border: none; text-align: center;">or</td> <td style="width: 40%; border: none;"> If $y = f(x) g(x)$ then $y' = f'(x) g(x) + f(x) g'(x)$ </td> </tr> </table> | If $y = uv$ then $\frac{d}{dx} (uv) = v \frac{du}{dx} + u \frac{dv}{dx}$ | or | If $y = f(x) g(x)$ then $y' = f'(x) g(x) + f(x) g'(x)$ |
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| Chain rule | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> If $y = f(u)$ and $u = g(x)$ then $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ </td> <td style="width: 10%; border: none; text-align: center;">or</td> <td style="width: 40%; border: none;"> If $y = f(g(x))$ then $y' = f'(g(x)) g'(x)$ </td> </tr> </table> | If $y = f(u)$ and $u = g(x)$ then $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ | or | If $y = f(g(x))$ then $y' = f'(g(x)) g'(x)$ |
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| Fundamental theorem | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> $\frac{d}{dx} \left(\int_a^x f(t) dt \right) = f(x)$ </td> <td style="width: 10%; border: none; text-align: center;">and</td> <td style="width: 40%; border: none;"> $\int_a^b f'(x) dx = f(b) - f(a)$ </td> </tr> </table> | $\frac{d}{dx} \left(\int_a^x f(t) dt \right) = f(x)$ | and | $\int_a^b f'(x) dx = f(b) - f(a)$ |
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| Increments formula | $\delta y \approx \frac{dy}{dx} \times \delta x$ | | | |
| Exponential growth and decay | $\frac{dP}{dt} = kP \Leftrightarrow P = P_0 e^{kt}$ | | | |

Mensuration

| | |
|---------------|---|
| Parallelogram | $A = bh$ |
| Triangle | $A = \frac{1}{2}bh$ or $A = \frac{1}{2}ab \sin C$ |
| Trapezium | $A = \frac{1}{2}(a + b)h$ |
| Circle | $A = \pi r^2$ and $C = 2\pi r = \pi d$ |

| | | |
|----------|---|---|
| Prism | $V = Ah$, where A is the area of the cross section | |
| Pyramid | $V = \frac{1}{3}Ah$, where A is the area of the base | |
| Cylinder | $V = \pi r^2 h$ | $TSA = 2\pi r h + 2\pi r^2$ |
| Cone | $V = \frac{1}{3}\pi r^2 h$ | $TSA = \pi r s + \pi r^2$, where s is the slant height |
| Sphere | $V = \frac{4}{3}\pi r^3$ | $TSA = 4\pi r^2$ |

Trigonometry

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|---------------------------|----------------------------------|
| $\sin^2 x + \cos^2 x = 1$ | $\tan x = \frac{\sin x}{\cos x}$ |
|---------------------------|----------------------------------|

Logarithms

| | |
|--|--|
| $x = \log_a b \Leftrightarrow a^x = b$ | $a^{\log_a b} = b$ and $\log_a(a^b) = b$ |
| $\log_a mn = \log_a m + \log_a n$ | $\log_a \frac{m}{n} = \log_a m - \log_a n$ |
| $\log_a(m^k) = k \log_a m$ | $\log_e x = \ln x$ |

Probability

| | |
|---|-------------------------------------|
| For any event A and its complement A' | $P(A') = 1 - P(A)$ |
| $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ | $P(A B) = \frac{P(A \cap B)}{P(B)}$ |

| Random variables and probability distributions | Mean | Variance |
|---|--|------------------------------------|
| Bernoulli: mean is the sample proportion \hat{p} | $\mu = p$ | $\sigma^2 = p(1 - p)$ |
| Binomial distribution: $P(X = x) = \binom{n}{x} p^x (1 - p)^{n-x}$ | $\mu = np$ | $\sigma^2 = np(1 - p)$ |
| Discrete random variable: $P(X = x) = P(x)$ | $\mu = E(X) = \sum xp(x)$ | $\sigma^2 = \sum (x - \mu)^2 p(x)$ |
| Continuous random variable: $P(a \leq X \leq b) = \int_a^b p(x) dx$ | | |
| Expected value: $\mu = E(X) = \int_{-\infty}^{\infty} xp(x) dx$ | Variance: $\sigma^2 = \int_{-\infty}^{\infty} (x - \mu)^2 p(x) dx$ | |

| | |
|--|--|
| Sample proportions | $\hat{p} = \frac{X}{n}$ |
| Mean: $E(\hat{p}) = p$ | Standard deviation: $\sigma = \sqrt{\frac{p(1-p)}{n}}$ |
| Margin of error: $E = z \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ | Confidence interval: $\hat{p} - z \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \leq p \leq \hat{p} + z \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ |

Note: Any additional formulas identified by the examination panel as necessary will be included in the body of the particular question.

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