



**MATHEMATICS**

**UNITS 3C AND 3D**

**FORMULA SHEET**

**2014**

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This document is valid for teaching and examining until 31 December 2014.

Number and algebra

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Index laws: For  $a, b > 0$  and  $m, n$  real,

$$a^m b^m = (a b)^m \qquad a^m a^n = a^{m+n} \qquad (a^m)^n = a^{mn}$$

$$a^{-m} = \frac{1}{a^m} \qquad \frac{a^m}{a^n} = a^{m-n} \qquad a^0 = 1$$

For  $a > 0$  and  $m$  an integer and  $n$  a positive integer,  $a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$

Differentiation: If  $f(x) = y$  then  $f'(x) = \frac{dy}{dx}$

If  $f(x) = x^n$  then  $f'(x) = nx^{n-1}$

If  $f(x) = e^x$  then  $f'(x) = e^x$

Product rule: If  $y = f(x) g(x)$

then  $y' = f'(x) g(x) + f(x) g'(x)$

or

If  $y = uv$

then  $\frac{dy}{dx} = \frac{du}{dx} v + u \frac{dv}{dx}$

Quotient rule:

If  $y = \frac{f(x)}{g(x)}$

then  $y' = \frac{f'(x) g(x) - f(x) g'(x)}{(g(x))^2}$

or

If  $y = \frac{u}{v}$

then  $\frac{dy}{dx} = \frac{\frac{du}{dx} v - u \frac{dv}{dx}}{v^2}$

Chain rule: If  $y = f(g(x))$

then  $y' = f'(g(x)) g'(x)$

or

If  $y = f(u)$  and  $u = g(x)$

then  $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

Integration:

Powers:

$$\int x^n dx = \frac{x^{n+1}}{n+1} + c, n \neq -1$$

Exponentials:

$$\int e^x dx = e^x + c$$

Fundamental Theorem of Calculus:

$$\frac{d}{dx} \left( \int_a^x f(t) dt \right) = f(x) \qquad \text{and} \qquad \int_a^b f'(x) dx = f(b) - f(a)$$

Incremental formula:  $\delta y \simeq \frac{dy}{dx} \delta x$

Exponential growth and decay:

$$\text{If } \frac{dy}{dt} = ky, \text{ then } y = Ae^{kt}$$

**Space and measurement**

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Circle:  $C = 2\pi r = \pi D$ , where  $C$  is the circumference,  
 $r$  is the radius and  $D$  is the diameter  
 $A = \pi r^2$ , where  $A$  is the area

Triangle:  $A = \frac{1}{2}bh$ , where  $b$  is the base and  $h$  is the perpendicular height

Parallelogram:  $A = bh$

Trapezium:  $A = \frac{1}{2}(a + b)h$ , where  $a$  and  $b$  are the lengths of the parallel sides

Prism:  $V = Ah$ , where  $V$  is the volume and  $A$  is the area of the base

Pyramid:  $V = \frac{1}{3}Ah$

Cylinder:  $S = 2\pi rh + 2\pi r^2$ , where  $S$  is the total surface area  
 $V = \pi r^2 h$

Cone:  $S = \pi rs + \pi r^2$ , where  $s$  is the slant height  
 $V = \frac{1}{3}\pi r^2 h$

Sphere:  $S = 4\pi r^2$   
 $V = \frac{4}{3}\pi r^3$

Volume of solids of revolution:

$$V = \int \pi y^2 dx \text{ rotated about the } x\text{-axis}$$

$$V = \int \pi x^2 dy \text{ rotated about the } y\text{-axis}$$

Chance and data

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Probability: For any event  $A$  and its complement  $\bar{A}$ , and event  $B$

$$P(A) + P(\bar{A}) = 1$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \cap B) = P(A) P(B|A) = P(B) P(A|B)$$

In a binomial distribution:

Mean:  $\mu = np$  and standard deviation:  $\sigma = \sqrt{np(1-p)}$

A confidence interval for the mean of a population is:

$$\bar{x} - z \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + z \frac{\sigma}{\sqrt{n}}$$

where  $\mu$  is the population mean,  
 $\sigma$  is the population standard deviation,  
 $\bar{x}$  is the sample mean,  
 $n$  is the sample size and  
 $z$  is the cut-off value on the standard normal distribution corresponding to the confidence level.

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