

## PURE MATHEMATICS

### Exponentials & Logarithms

#### FORMULAE

$$\log(xy) = \log x + \log y$$

$$\log\left(\frac{x}{y}\right) = \log x - \log y$$

$$\log(x^n) = n \log x$$

$$\log_a a = 1 \quad \log_a 1 = 0$$

$$\log_a x = \frac{\ln x}{\ln a}$$

$$e^{\ln x} = x \quad \ln(e^x) = x$$

$$a^x = b \Rightarrow x = \frac{\ln b}{\ln a}$$

#### KEY POINTS

- Domain of  $\log$ :  $x > 0$  always
- $\ln$  and  $e$  are inverses — they cancel each other
- Linearise  $y = Ae^{kx}$ : take  $\ln$  to get  $\ln y = \ln A + kx$

#### COMMON MISTAKES

- ×  $\log(a + b) \neq \log a + \log b$
- × Taking  $\log$  of a negative number or zero — undefined
- ×  $e^x = c \Rightarrow x = \ln c$ , not  $x = \log_{10} c$

#### EXAMINER HINTS

- Equation has  $e^x$ : use  $\ln$ . Has  $\ln x$ : use  $e$
- To linearise  $y = Ab^x$ : take  $\ln$  to get  $\ln y = \ln A + x \ln b$

## MECHANICS (M1)

### Kinematics (SUVAT)

#### FORMULAE

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$s = \frac{1}{2}(u + v)t$$

$$s = vt - \frac{1}{2}at^2$$

Vertical:  $a = g = 9.8 \text{ m s}^{-2}$  downward

Projectile: horizontal  $a = 0$ , vertical  $a = -g$

#### KEY POINTS

- SUVAT valid for CONSTANT acceleration only
- At maximum height in vertical motion:  $v = 0$
- Projectile: resolve into independent horizontal and vertical components

#### COMMON MISTAKES

- × Using SUVAT when acceleration is not constant
- × Losing sign consistency — always define a positive direction first
- × Using  $g = 9.8$  when the question specifies  $g = 10$

#### EXAMINER HINTS

- List  $s, u, v, a, t$  — identify the three known values, then choose the equation
- For projectile range: use vertical  $s = 0$  to find  $t$ , then use horizontal