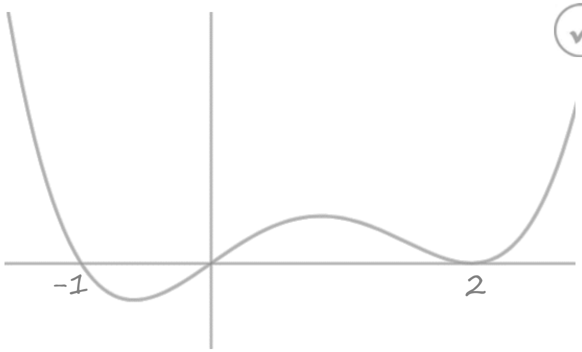
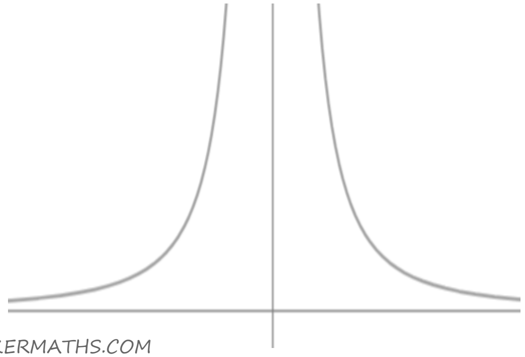
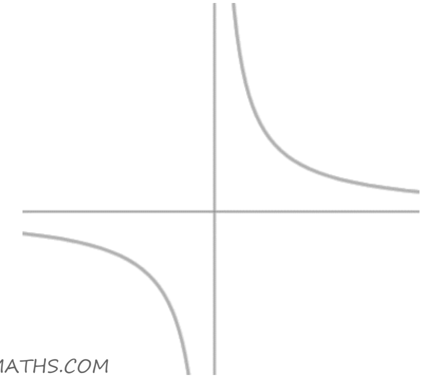
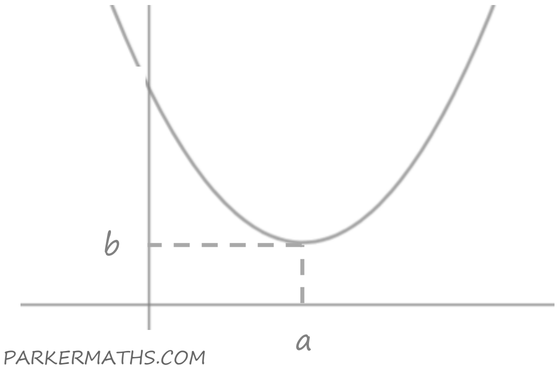
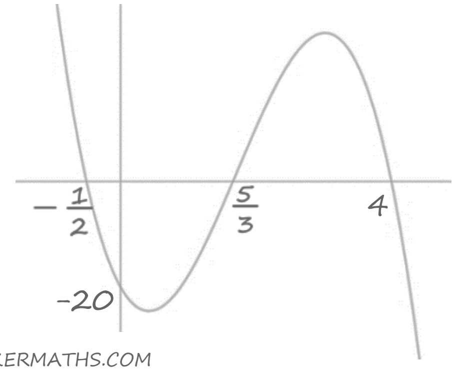




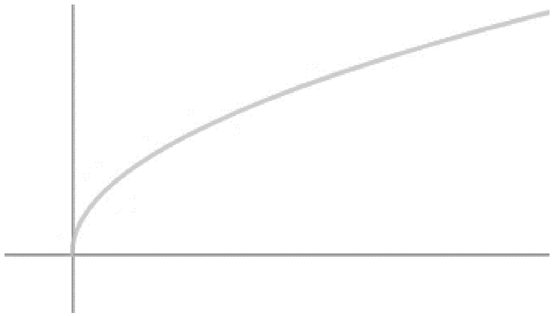




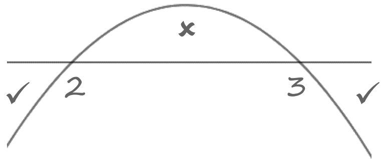


$$y = 2x^2 - 12x + 13$$
$$= 2(x-3)^2 - 5$$

Minimum at $(3, -5)$



$$y = 3x^2 - 21x + 30$$



$x < 2$ or $x > 3$

Note: 'or' is necessary

Key Fact

Sketch the graph of $y = \dfrac{1}{x}$

10s AS-B1

Key Fact

Sketch the graph of $y = \dfrac{1}{x^2}$

10s AS-B2

Technique

Sketch the graph of

$y = x(x-2)^2(x+1)$

15s AS-B3

Technique

Coordinates of the minimum point of

$y = 2x^2 - 12x + 13$

Do not use differentiation

25s AS-B4

Technique

Sketch the graph of

$y = (3x-5)(4-x)(2x+1)$

15s AS-B5

Key Fact

Sketch the graph of

$y = (x-a)^2 + b$

for $a, b > 0$

15s AS-B6

Technique

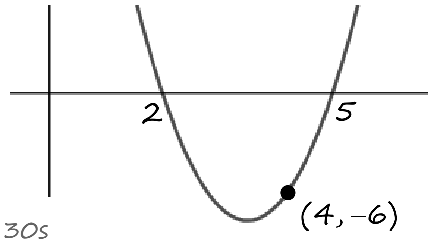
Solve the inequality

$(x-2)(3-x) < 0$

20s AS-B7

Technique

Equation of this quadratic in the form $y = ax^2 + bx + c$



30s AS-B8

Key Fact

Sketch the graph of $y = \sqrt{x}$

10s AS-B9

Gradient of $L_1 = -\frac{2}{3}$

Gradient of $L_2 = \frac{8-2}{2+2} = \frac{3}{2}$

$m_{L1} \times m_{L2} = -1$

$\therefore$ The lines are perpendicular

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$m_{AC} = \frac{11-10}{0-(-7)} = \frac{1}{7}$

$m_{BC} = \frac{11-4}{0-1} = -7$

$m_{AC} \times m_{BC} = -1 \Rightarrow$ AC and BC are $\perp$

$\angle ACB = 90°$, so AB is the diameter.

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C_1 : Centre $(10, 12)$, $r = 3$

C_2 : Centre $(5, 7)$, $r = 4$

$d = \sqrt{(10-5)^2 + (12-7)^2} = \sqrt{50} \approx 7.07$

Since $d > 3 + 4$, the circles do not intersect.

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Midpoint $= (-1, 4)$

Gradient: $m = \frac{5-3}{2-{}^{-}4} = \frac{1}{3}$

$\therefore \quad m_{\perp} = -3$

Equation: $y - 4 = -3(x+1)$

$y + 3x = 1$

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$$(x-a)^2 + (y-b)^2 = r^2$$

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$$y - y_1 = m(x - x_1)$$

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grad of radius $= \frac{4}{3}$

grad of tangent $= -\frac{3}{4}$

$y - 1 = -\frac{3}{4}(x-8)$

$3x + 4y = 28$

Note: Can also be done with implicit differentiation

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(a) $m_1 = m_2$ (parallel)

(b) $m_1 \times m_2 = -1$ (perpendicular)

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(a) Gradient $= \frac{y_2 - y_1}{x_2 - x_1}$

(b) $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

(c) Midpoint $= \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

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Technique

Determine if these circles intersect:

$C_1: \ (x-10)^2 + (y-12)^2 = 9$

$C_2: \ x^2 + y^2 - 10x - 14y + 58 = 0$

120s AS-C1

Technique

Points $A(-7,10)$, $B(1,4)$ and $C(0,11)$ lie on a circle.

Show that AB is the diameter of the circle.

15s AS-C2

Technique

L_1 has equation $2x + 3y = 7$

L_2 passes through $(-2,2)$ and $(2,8)$

Show that the lines are perpendicular.

60s AS-C3

Key Fact

Equation of a straight line with gradient m passing through (x_1, y_1).

10s AS-C4

Key Fact

Equation of a circle with centre (a, b), radius r.

10s AS-C5

Technique

Given two points $(2,5)$ and $(-4,3)$

Equation of perpendicular bisector in the form $ax + by = c$

45s AS-C6

Key Fact

Given two points (x_1, y_1) and (x_2, y_2)

(a) Gradient = ...

(b) Distance between points = ...

(c) Midpoint = ...

25s AS-C7

Key Fact

Two lines with gradients m_1 and m_2 are

(a) Parallel if...

(b) Perpendicular if...

10s AS-C8

Technique

$x^2 + y^2 - 10x + 6y + 9 = 0$

Equation of tangent at $(8,1)$ in the form $ax + by = c$

120s AS-C9

5[km/h]▸[m/s]
1.388888889

5 | OPTN | F6 | CONVERT | F6 | VELOCITY

Km/h | ▶ | VELOCITY | m/s

50000[cm³]▸[L]
50

50000 | OPTN | F6 | CONVERT | VOLUME | cm³

▶ | VOLUME | L

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(a) $x = \frac{7}{12}$, $y = -\frac{5}{6}$

anX+bnY=Cn

	a	b	c
1	2	5	-3
2	-2	1	-2

(b) $x = \frac{10}{27}$, $y = \frac{20}{9}$

anX+bnY=Cn

	a	b	c
1	1.5	-2.5	-5
2	3	2.2	6

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aX³+bX²+cX+d=0

a	b	c	d
1	-4	-11	30

X1 5
X2 2
X3 -3

(a) $(x-5)(x-2)(x+3)$

aX³+bX²+cX+d=0

a	b	c	d
6	23	-6	-8

X1 0.6666
X2 -0.5
X3 -4

(b) $(3x-2)(2x+1)(x+4)$

(a) $\sqrt[4]{7} \times 8\frac{7}{15}$
13.77168156

SHIFT | ^ | 4 | 7 | × | SHIFT | $\frac{\square}{\square}$ | 8 | 7 | 15

(b) $(\sin -35)^2$
0.3289899283

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(a) ${}^8C_3 = 56$

OPTN | F6 | PROB | 8 | nCr | 3

(b) $\log_2(5)$
2.321928095

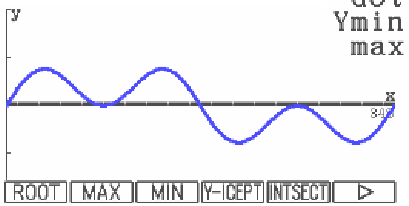
OPTN | CALC | F6 | logab

(c) $7! = 5040$

OPTN | F6 | PROB | 7 | x!

Graph Func :Y=
Y1=sin 2xcos x

View Window
Xmin :0
max :360
scale:1
dot :0.95238095
Ymin :-2
max :2



G-Solv | Max

$x = 35.3°$,
$144.7°, 270°$

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(a) $\frac{d}{dx}(5x^2-\sqrt{x})\Big|_{x=9}$
$\frac{539}{6}$

MATH | d/dx

(b) $\int_0^4 5x^2-\sqrt{x}\,dx$
$\frac{304}{3}$

MATH | $\int dx$

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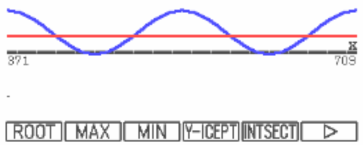
Graph Func
Y1=(cos x)²
Y2=$\frac{2}{5}$

View Window
Xmin :360
max :720
scale:1
dot :0.95238095
Ymin :-2
max :2



G-Solv | Intersect

$x = 411°, 489°,$
$591°, 669°$

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(a) $\frac{3}{4/5} = \frac{15}{4}$

$\frac{\square}{\square}$ | Down arrow | $\frac{\square}{\square}$

(b) $\frac{3/4}{5} = \frac{3}{20}$

$\frac{\square}{\square}$ | $\frac{\square}{\square}$

Note: The second fraction must be created in the correct part of the first fraction.

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Technique

Use your calculator to factorise the following:

(a) $x^3 - 4x^2 - 11x + 30$

(b) $6x^3 + 23x^2 - 6x - 8$

75s AS-CALC1

Technique

Solve the following using your calculator:

(a) $2x + 5y = -3$, $y - 2x = -2$

(b) $5 + 1.5x = 2.5y$, $6 - 2.2y = 3x$

75s AS-CALC2

Technique

Convert between the following units:

$5\,\text{kmh}^{-1} = \dots \text{ms}^{-1}$

$50\,000\,\text{cm}^3 = \dots \text{L}$

60s AS-CALC3

Technique

(a) Use your calculator sketch:

$y = \sin 2x \cos x$, $0° \le x \le 360°$

(b) Find the x-coordinates of the local maxima to 1 d.p.

60s AS-CALC4

Technique

Use your calculator to evaluate the following:

(a) ${}^8C_3 = \dots$

(b) $\log_2 5 = \dots$

(c) $7! = \dots$

60s AS-CALC5

Technique

Use your calculator to evaluate the following:

(a) $\sqrt[4]{7} \times 8^{\frac{7}{15}} = \dots$

(b) $\sin^2\left(-35°\right) = \dots$

40s AS-CALC6

Technique

Use your calculator to evaluate the following:

(a) $\dfrac{3}{4/5} = \dots$

(b) $\dfrac{3/4}{5} = \dots$

30s AS-CALC7

Technique

Use your calculator to solve

$\cos^2 x = \dfrac{2}{5}$, $360° < x < 720°$

Give solutions to 3 s.f.

60s AS-CALC8

Technique

Evaluate the following using your calculator:

(a) $\left.\dfrac{d}{dx}\left(5x^2 - \sqrt{x}\right)\right|_{x=9} = \dots$

(b) $\int_0^4 \left(5x^2 - \sqrt{x}\right) dx = \dots$

45s AS-CALC9

$$\sin x = \sin(180^\circ - x)$$

$$\cos x = \cos(360^\circ - x)$$

$$(\text{alternative: } \cos x = \cos(-x))$$

$$\sin x = \frac{4}{5} \;,\; \tan x = -\frac{4}{3}$$

	0°	30°	45°	60°	90°
sin	0	$1/2$	$1/\sqrt{2}$	$\sqrt{3}/2$	1
cos	1	$\sqrt{3}/2$	$1/\sqrt{2}$	$1/2$	0

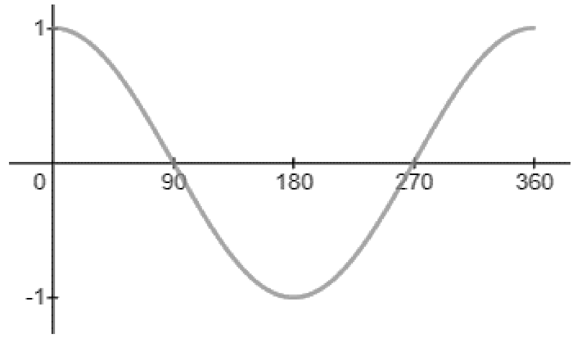
Note: $\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$

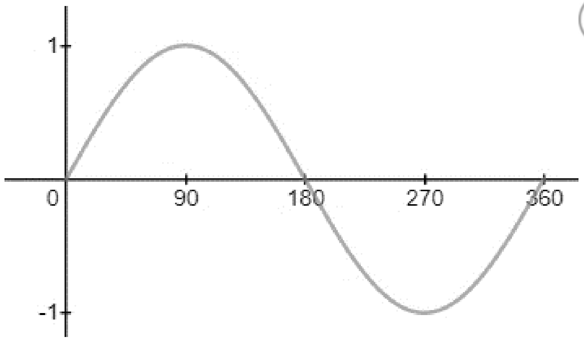
$$\cos x = \frac{\sqrt{5}}{3} \;,\; \tan x = \frac{2}{\sqrt{5}}$$

$$\sin x = \sin(x \pm 360^\circ)$$

$$\cos x = \cos(x \pm 360^\circ)$$

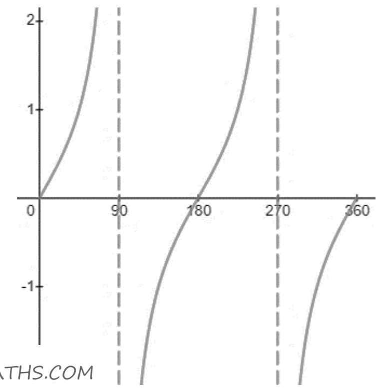
$$\tan x = \tan(x \pm 180^\circ)$$





$$\sin^2 x + \cos^2 x \equiv 1$$

$$\tan x \equiv \frac{\sin x}{\cos x}$$



Key Fact

	$0°$	$30°$	$45°$	$60°$	$90°$
sin					
cos					

25s AS-E1

Key Fact

$\cos x = -\frac{3}{5}$, $90° < x < 180°$

$\sin x = \ldots$, $\tan x = \ldots$

25s AS-E2

Key Fact

Symmetry properties for sin and cos (in degrees)

15s AS-E3

Key Fact

Graph of $y = \cos x$, $0° \le x \le 360°$

Label the x-axis every 90°.

15s AS-E4

Key Fact

Periodic properties for sin, cos and tan (in degrees)

15s AS-E5

Key Fact

$\sin x = \frac{2}{3}$, $0° < x < 90°$

$\cos x = \ldots$, $\tan x = \ldots$

20s AS-E6

Key Fact

Graph of $y = \tan x$, $0° \le x \le 360°$

Label the x-axis every 90°.

15s AS-E7

Key Fact

(a) Identity linking $\sin x$ and $\cos x$

(b) Identity linking $\sin x$, $\cos x$ and $\tan x$

10s AS-E8

Key Fact

Graph of $y = \sin x$, $0° \le x \le 360°$

Label the x-axis every 90°.

15s AS-E9

(a) $\log_a b = c \iff a^c = b$

(b) $\log_2 2 = 1$

(c) $\log_2 16 = 4$

$\ln 1 = 0$

$\ln e = 1$

$\ln 0 = \text{undefined}$

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

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

$\log_a x^n = n\log_a x$

$y = ab^x$

$\log y = \log(ab^x)$

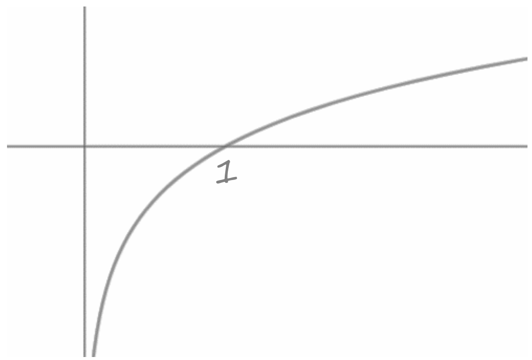
$\log y = \log a + \log b^x$

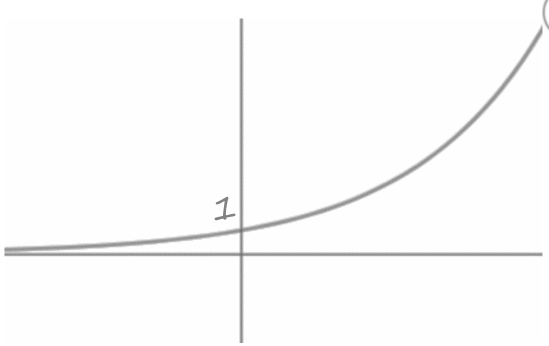
$\log y = \log a + x \log b$

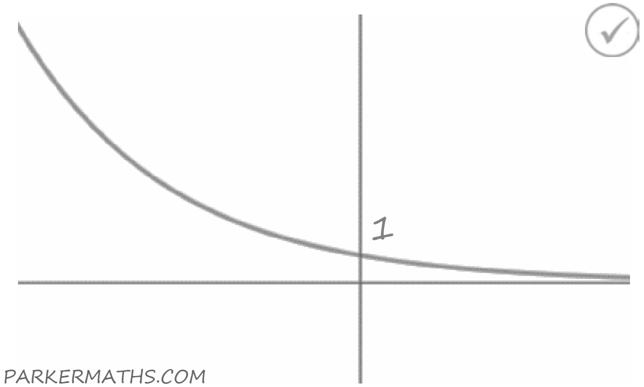
(a) $e^{2\ln x} = e^{\ln x^2} = x^2$

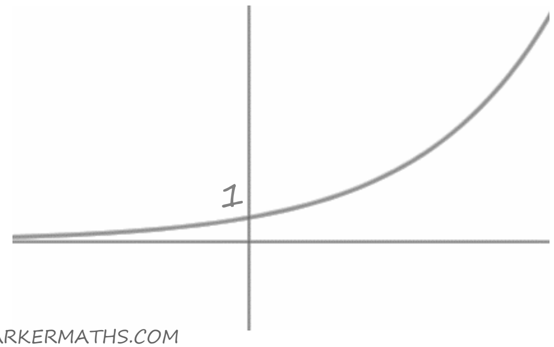
(b) $\frac{1}{2}\ln(4x^2) = \ln(4x^2)^{\frac{1}{2}}$

$= \ln(2x)$









Key Fact

$\log_a x + \log_a y = \ldots$

$\log_a x - \log_a y = \ldots$

$\log_a x^n = \ldots$

15s AS-F1

Key Fact

$\ln 1 = \ldots$

$\ln e = \ldots$

$\ln 0 = \ldots$

10s AS-F2

Key Fact

(a) Write $\log_a b = c$ in index form.

(b) $\log_2 2 = \ldots$

(c) $\log_2 16 = \ldots$

15s AS-F3

Key Fact

Sketch the graph of

$y = \ln x$

10s AS-F4

Key Fact

Simplify

(a) $e^{2\ln x}$

(b) $\frac{1}{2}\ln(4x^2)$

20s AS-F5

Key Fact

$y = ab^x$

Show there is a linear relationship between $\log y$ and x.

30s AS-F6

Key Fact

Sketch the graph of

$y = 3^x$

10s AS-F7

Key Fact

Sketch the graph of

$y = \left(\frac{1}{2}\right)^x$

10s AS-F8

Key Fact

Sketch the graph of

$y = e^x$

10s AS-F9

(a) $\dfrac{dy}{dx} < 0$

(b) $\dfrac{dy}{dx} > 0$

(c) $\dfrac{dy}{dx} = 0$

$2^x \ln 2$

(a) $\dfrac{dy}{dx} = 0$ and $\dfrac{d^2y}{dx^2} > 0$

(b) $\dfrac{dy}{dx} = 0$ and $\dfrac{d^2y}{dx^2} < 0$

$\dfrac{dy}{dx} = 2x + 4$

(a) $\left.\dfrac{dy}{dx}\right|_{x=3} = 2(3) + 4 = 10$

(b) $2x + 4 = 3$

$x = -\dfrac{1}{2}$

(a) $4x^3 + \dfrac{3}{2}x^{-\frac{1}{2}} - 3x^{-4}$

(b) $\dfrac{1}{3}x^{-\frac{2}{3}} - \dfrac{1}{4}x^{-\frac{3}{2}} - \dfrac{12}{5}x^{-\frac{8}{5}}$

(a) e^x

(b) $4e^{4x}$

(c) $-\dfrac{1}{2}e^{-\frac{1}{2}x}$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$\begin{aligned} f'(x) &= \lim_{h \to 0} \frac{3(x+h)^2 - 3x^2}{h} \\ &= \lim_{h \to 0} \frac{3x^2 + 6xh + 3h^2 - 3x^2}{h} \\ &= \lim_{h \to 0} \frac{6xh + 3h^2}{h} \\ &= \lim_{h \to 0} \left(6x - 3h\right) \\ &= 6x \end{aligned}$$

$$\frac{dy}{dx} = \frac{1}{\frac{dx}{dy}}$$

Key Fact

(a) Criteria for a minimum point.

(b) Criteria for a maximum point.

15s AS-G1

Key Fact

$$\frac{d}{dx}2^x = \ldots$$

10s AS-G2

Key Fact

(a) Criteria for a decreasing function.

(b) Criteria for an increasing function.

(c) Criteria for a stationary point.

15s AS-G3

Key Fact

(a) $\frac{d}{dx}e^x = \ldots$

(b) $\frac{d}{dx}e^{4x} = \ldots$

(c) $\frac{d}{dx}e^{-\frac{1}{2}x} = \ldots$

15s AS-G4

Technique

(a) $\frac{d}{dx}\left(x^4 + 3\sqrt{x} + \frac{1}{x^3}\right) = \ldots$

(b) $\frac{d}{dx}\left(x^{\frac{1}{3}} + \frac{1}{2\sqrt{x}} + \frac{4}{x^{\frac{3}{5}}}\right) = \ldots$

60s AS-G5

Technique

$y = x^2 + 4x - 3$

(a) Find the value of $\frac{dy}{dx}$ at $x = 3$

(b) Find the x-coordinate when $\frac{dy}{dx} = 3$

1m 30s AS-G6

Key Fact

Relationship between

$\frac{dy}{dx}$ and $\frac{dx}{dy}$

5s AS-G7

Technique

$f(x) = 3x^2$

Find $f'(x)$ from first principles.

60s AS-G8

Key Fact

Formula for differentiation from first principles.

10s AS-G9

Correlation coefficient:

Value of r	Interpretation
$r \approx 1$	Strong positive correlation
$r \approx 0$	No linear correlation
$r \approx -1$	Strong negative correlation.

(a) $\bar{x} = \dfrac{\sum fx}{n}$

(b) variance $= \sigma^2$

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$$\text{Frequency density} = \frac{\text{frequency}}{\text{class width}}$$

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x	2	3	4	5
$P(X = x)$	$2k$	$6k$	$12k$	$20k$

$40k = 1$

$k = \dfrac{1}{40}$

$P(X < 4) = \dfrac{8}{40} = \dfrac{1}{5}$

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(a) $P(X = 4) = 0.188$

(b) $P(X \leq 2) = 0.398$

(c) $P(X > 5) = 0.0611$

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<u>C</u>onstant Probability

Two <u>O</u>utcomes

<u>I</u>ndependent Events.

Fixed <u>N</u>umber of Trials

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(a) ${}^nC_0 = 1$

(b) ${}^nC_1 = n$

(c) ${}^nC_2 = \dfrac{1}{2}n(n-1)$

(d) ${}^nC_r = \dfrac{n!}{r!(n-r)!}$

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For mutually exclusive events:

$P(A \cap B) = 0$

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

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For independent events:

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

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Key Fact

Histograms:

Frequency density = ...

10s AS-L1

Key Fact

(a) Mean in terms of f, x, and n.

(b) Variance in terms of standard deviation.

10s AS-L2

Correlation coefficient:

Key Fact

Value of r	Interpretation
$r \approx 1$	
$r \approx 0$	
$r \approx -1$	

15s AS-L3

Key Fact

4 criteria to model using the binomial distribution...

20s AS-M1

$X \sim B(15, 0.2)$

Technique

(a) $P(X = 4) = \ldots$

(b) $P(X \leq 2) = \ldots$

(c) $P(X > 5) = \ldots$

60s AS-M2

Technique

$$P(X = x) = \begin{cases} kx(x-1) & \text{for } x = 2, 3, 4, 5 \\ 0 & \text{otherwise} \end{cases}$$

Find $P(X < 4)$

60s AS-M3

Key Fact

Condition for statistically independent events...

5s AS-M4

Key Fact

For mutually exclusive events:

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

$P(A \cup B) = \ldots$

10s AS-M5

Key Fact

(a) ${}^nC_0 = \ldots$

(b) ${}^nC_1 = \ldots$

(c) ${}^nC_2 = \ldots$

(d) ${}^nC_r = \ldots$

30s AS-M6

$$v = u + at$$

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

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

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

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

Acceleration is the gradient.

Distance is the total area enclosed between the graph and the horizontal axis.

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$$\text{Av Velocity} = \frac{\text{total displacement}}{\text{time}}$$

$$\text{Av Speed} = \frac{\text{total distance travelled}}{\text{time taken}}$$

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2 significant figures

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$0.57 \times 60 = 34.2$ minutes

2.57 hours $= 2$ h 34 mins

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$$v = \frac{dx}{dt}$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

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$$x = \int v\,dt$$

$$v = \int a\,dt$$

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$s = ?$
$u = 5$
$v = 0$
$a = -9.81$
$t =$

$$0^2 = 5^2 - 2(9.81)(s)$$
$$s = 1.274\ldots\text{ m}$$

$$\therefore\ h = 1.274\ldots + 10$$
$$= 11.3\text{ m}$$

Must be given to 3 sig fig.

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$s = -10$
$u = 5$
$v =$
$a = -9.81$
$t = ?$

$$-10 = 5t - \tfrac{1}{2}(9.81)t^2$$
$$0 = -4.905t^2 + 5t + 10$$
$$t = 2.03\text{ s}$$

Must be given to 3 sig fig.

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Key Fact

(a) Formula for average speed

(b) Formula for average velocity.

15s AS-Q1

Key Fact

How are acceleration and distance represented on a velocity-time graph?

15s AS-Q2

Key Fact

5 SUVAT equations

30s AS-Q3

Key Fact

$$\ldots = \frac{dx}{dt}$$

$$\ldots = \frac{d\ldots}{dt} = \frac{d^2x}{dt^2}$$

x is displacement

10s AS-Q4

Technique

Convert 2.57 hours into hours and minutes (nearest minute)

15s AS-Q5

Key Fact

When $g = 9.8\ ms^{-2}$, what is a suitable level of accuracy for your final answer?

5s AS-Q6

Technique

A particle is thrown vertically upwards from a window 10m above the ground with speed $5\ ms^{-1}$.

Find the time of flight.

Use $g = 9.81\ ms^{-2}$

60s AS-Q7

Technique

A particle is thrown vertically upwards from a window 10m above the ground with speed $5\ ms^{-1}$.

Find the max height above ground.

Use $g = 9.81\ ms^{-2}$

60s AS-Q8

Key Fact

$$x = \int \ldots dt$$

$$v = \int \ldots dt$$

x is displacement

15s AS-Q9