HW 6 b, c, a
5 k, ~~i~~, a

5a $f(x) = x^2 \cos(2x)$

$f'(x) = x^2(-\sin(2x)(2)) + \cos(2x)(2x)$

$= -2x^2 \sin(2x) + 2x\cos(2x)$

5 k $y = 2\tan(3x)$

$\frac{dy}{dx} = 2\sec^2(3x)(3)$

$= 6\sec^2(3x)$

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6 a) $y = \frac{e^x}{1+e^x}$

$\frac{dy}{dx} = \frac{(1+e^x)(e^x) - (e^x)(e^x)}{(1+e^x)^2}$

$e^x + \cancel{e^{2x}} - \cancel{e^{2x}}$

$\frac{dy}{dx} = \frac{e^x(1 + \cancel{e^x} - \cancel{e^x})}{(1+e^x)^2}$

$= \frac{e^x}{(1+e^x)^2}$

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6b $f(x) = \dfrac{\sin(x) - \cos(x)}{\sin(x) + \cos(x)}$

$$f'(x) = \frac{(\sin x + \cos x)(\cos x + \sin x) - (\sin(x) - \cos(x))(\cos x - \sin x)}{(\sin(x) + \cos(x))^2}$$

$$= \frac{(\sin x + \cos x)^2 + (\cos x - \sin x)^2}{(\sin x + \cos x)^2}$$

$$= \frac{\sin^2 x + 2\sin x\cos x + \cos^2 x + \cos^2 x - 2\sin x\cos x + \sin^2 x}{(\sin x + \cos x)^2}$$

$$= \frac{2}{(\sin x + \cos x)^2}$$

$$= \frac{2}{\sin^2 x + 2\sin x\cos x + \cos^2 x}$$

$$= \frac{2}{1 + 2\sin x\cos x}$$

$$= \frac{2}{1 + \sin 2x}$$

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6 c) $g(x) = \ln\left(\dfrac{x}{2x+1}\right)$

$$g'(x) = \left(\frac{2x+1}{x}\right) \cdot \left(\frac{(2x+1)(1) - (x)(2)}{(2x+1)^2}\right)$$

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

$$= \frac{1}{x(2x+1)}$$

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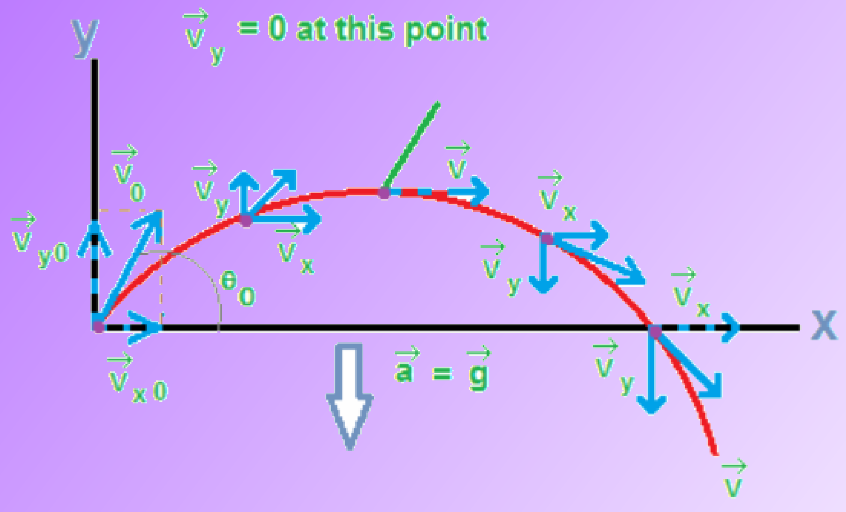
KINEMATICS



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KINEMATICS

Let s(t) = the position at time t

Let v(t) = the velocity at time t

Velocity = change in position in a given time period

$$= \frac{s(b)-s(a)}{b-a}$$

= slope of the s(t) function

= s'(t)

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KINEMATICS

So we have s(t) = the position at time t

and v(t) = the velocity at time t

= s'(t)

Acceleration = change in velocity over time

$$= \frac{v(b)-v(a)}{b-a}$$

= slope of the v(t) function

= v'(t)

= s''(t)

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KINEMATICS

1st derivative

S(t) position

2nd derivative

V(t) velocity

A(t) acceleration

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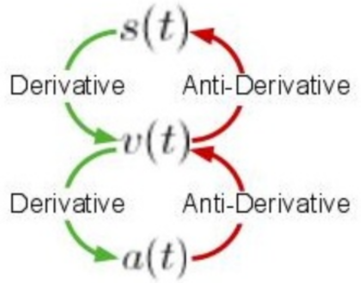
KINEMATICS



$$\frac{d}{dt}s(t) = v(t)$$

$$\frac{d}{dt}v(t) = a(t) \qquad \frac{d^2}{dt^2}s(t) = a(t)$$

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KINEMATICS

Exercise 7N

Use a GDC to help evaluate function values.

EXAM-STYLE QUESTION

1 A ball is thrown vertically upwards. Its height in metres above the ground t seconds after it is thrown is modeled by the function $h(t) = -4.9t^2 + 19.6t + 1.4$

- **a** Find the height of the ball when $t = 0$ seconds and when $t = 2$ seconds.
- **b** Find the average rate of change of the height of the ball from $t = 0$ seconds to $t = 2$ seconds.
- **c** Find the instantaneous rate of change of the height of the ball when $t = 1$ second, $t = 2$ seconds and $t = 3$ seconds. Explain what these values tell you about the motion of the ball.

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KINEMATICS

2 The amount of water in a tank after t minutes is modeled by the function $V(t) = 4000\left(1 - \frac{t}{60}\right)^2$, where V is measured in litres.

Answer the following to the nearest whole number.

a Find the amount of water in the tank when $t = 0$ minutes and when $t = 20$ minutes.

b Find the average rate of change of the amount of water in the tank from when $t = 0$ minutes to $t = 20$ minutes. Explain the meaning of your answer.

c Find the instantaneous rate of change of the amount of water in the tank when $t = 20$ minutes. Explain the meaning of your answer.

d Show that the amount of water in the tank is never increasing from $t = 0$ minutes to $t = 40$ minutes.

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