AQA A-Level Mathematics Warmup - Paper 2 2024

Find, up to the term in x^3 the expansion of $(1+3x)^{-2}$. When is this expansion valid?

Sketch $y = 5 - 2|x|$ and $y = |2x - 3|$ on the same graph and find their point of intersection.

Find the centre and radius of the circle $x^2 - 4x + y^2 + 8y - 35 = 0$

Differentiate $y = x^2 + 5x$ from first principles.

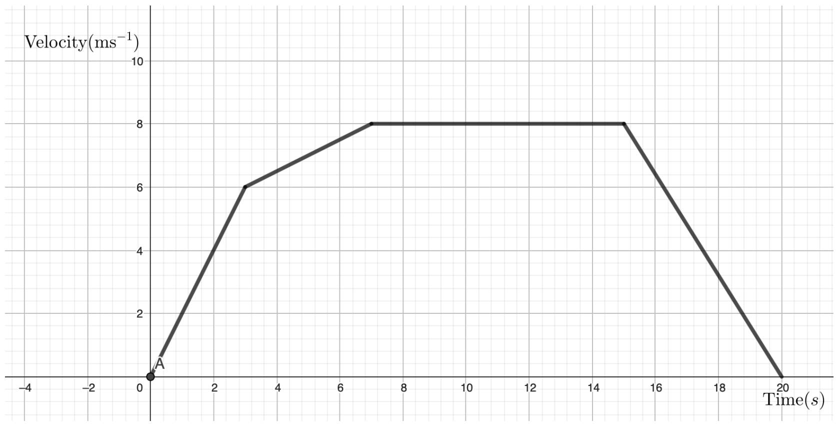
Sketch $y = \cot(x)$ and $y = \arctan(x)$

A box of mass 2 kg is being pulled across a smooth floor by a rope inclined at 45° to the horizontal. The tension in the rope is 8 N
a) Draw a labelled force diagram.
b) Find the acceleration of the box.
c) State a modelling assumption made about the box.

Find the magnitude and direction (relative to the unit vector $\mathbf{i}$ of the vector $\mathbf{u} = 12\mathbf{i} - 5\mathbf{j}$

Express in partial fractions $\frac{4x^2 + 13x + 11}{(x+1)(x+2)^2}$

Simplify $3\ln(x) + 2\ln(x+1) - 2\ln(xy)$



The speed of a runner over 20 s is recorded.
For the velocity-time graph to the left.

a) Describe the motion
b) What is the acceleration between 3s and 7s.
c) Between what time are they not-accelerating.
d) What is the distance travelled.
e) Is the magnitude of acceleration greater when they are decelerating than between 0 and 3 seconds.

Find the general solution of $\frac{dy}{dx} = 2x^2y$

A ball is thrown upwards at a speed of 5 ms^{-1}. Find the time taken to return to the ground and its maximum height.

Two particles are suspended over a pulley by a light inextensible string. One has mass 5kg and the other mass 2kg. They are released from rest. Find the acceleration of of the 5 kg particle.

State Newton's 3 laws of motion.

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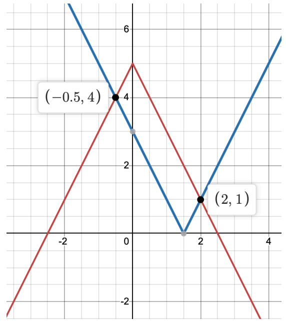
$(1+3x)^{-2} = 1 - 6x + 27x^2 - 108x^3$

Valid for $\left|\frac{|3x|}{1}\right| < 1$

or $|x| < \frac{1}{3}$



Centre: $(2, -4)$

Radius: $\sqrt{55}$

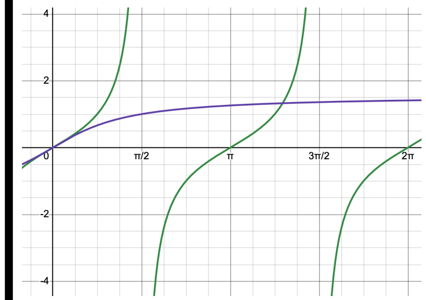
$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$

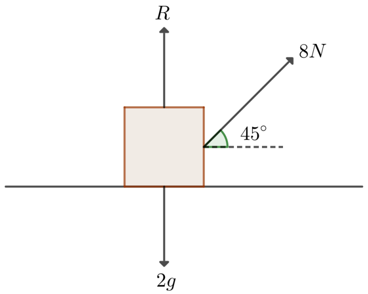
$f'(x) = \lim_{h\to 0} \frac{(x+h)^2 + 5(x+h) - (x^2+5x)}{h}$

$= \lim_{h\to 0} \frac{x^2 + 2xh + h^2 + 5x + 5h - x^2 - 5x}{h}$

$= \lim_{h\to 0} 2x + h + 5$

$= 2x + 5$





b) Apply $F = ma$ in direction of motion:

$8\cos(45) = 2a$, so

$a = \sqrt{2}$ms^{-2}

c) We have modelled the box as a particle.

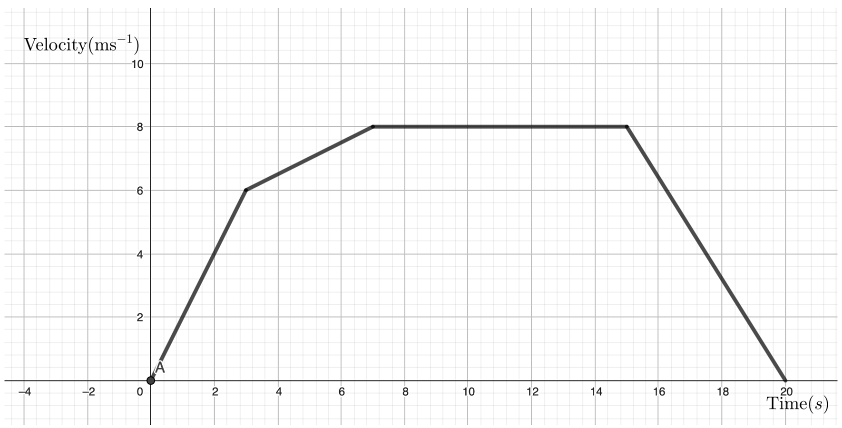
$|\mathbf{u}| = \sqrt{12^2 + 5^2} = 13$

$\arctan\left(\frac{5}{12}\right) = 22.6°$

and the vector is directed $22.6°$ below $\mathbf{i}$

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

$\ln\left(\frac{x^3(x+1)^2}{x^2y^2}\right) = \ln\left(\frac{x(x+1)^2}{y^2}\right)$



a) Accelerating between 0 and 3 seconds, still accelerating but at a slower rate between 3 and 7 seconds. Travelling at a constant speed between 7 and 15 seconds and then decelerating between 15 and 20 seconds.

b) $a = 6/3 = 2$ ms^{-2}

c) Between 7 and 15 seconds they are moving at a constant speed.

d) Area under graph = 89 m

e) Between 0 and 3 seconds: $a = 2$ ms^{-2}

Between 15 and 20 seconds: $a = -8/5 = -1.6$ ms^{-2}, so no.

$y = Ae^{\frac{2x^3}{3}}$

Using SUVAT.

For the time, using $s = ut + \frac{1}{2}at^2$ with $s = 0,\ u = 5,\ a = -9.8$, $t = \frac{50}{49}$ s.

For the maximum height use $v^2 = u^2 + 2as$ with $u = 5,\ v = 0,\ a = -9.8$ to get $s = 122.5$ m.

Drawing a force diagram, and applying $F = ma$ to both particles we obtain $5g - T = 5a$ and $T - 3g = 2a$ Adding these equations gives $39 = 7a$ so $a = 4.2$ ms^{-1}

NL1: A body will stay at rest, or maintain a constant velocity unless acted upon by a force.

NL2: The overall resultant force is equal to the mass times the acceleration of a body.

NL3: When one body exerts a force on a second body, the second body simultaneously exerts a force of equal magnitude and opposite direction on the first body.