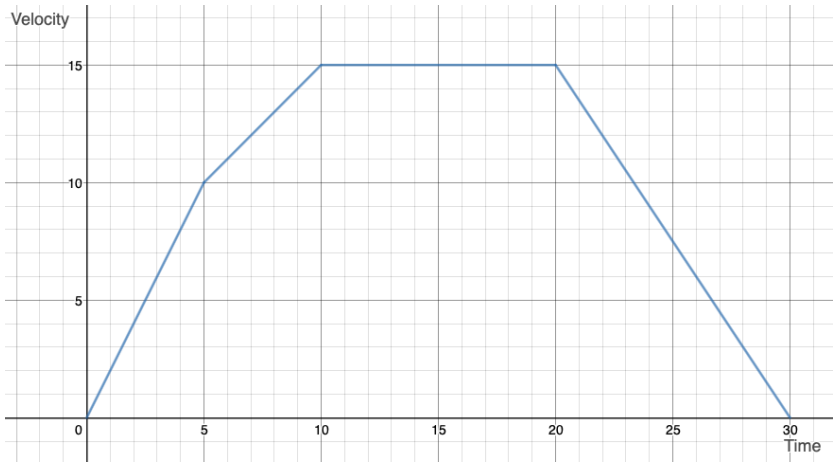
AQA A-Level Mathematics Warmup - Paper 2 2022

Find the binomial expansion of $\sqrt[3]{8+2x}$	Find the centre and radius of the circle $x^2-4x+y^2+6y+4=0$	A ball is dropped from a balcony 4.3 m off the ground. How long does it take for the ball to reach the ground?	How do you determine a point of inflection for $f(x)$?	The velocity of a model boat is given by the vector $\mathbf{v}=3\mathbf{i}+4\mathbf{j}$. Find the magnitude and direction fo the velocity.
Define the moment of a force F from a point A	What definition is used in differentiation from first principles?	When is the expansion $(a+bx)^n$ where n is a fraction or a negative integer valid?	A box of mass 1 kg is being pulled across a smooth floor by a rope inclined at $30°$ 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.	
Simplify $\log_{10}(x^2)+3\log_{10}(x)-2\log_{10}(x)$	A ball is projected upwards at a speed of 5 ms^{-1} at an angle of $25°$. Find the vertical and horizontal components of the velocity.	In projectile motion what happens to the horizontal component of the velocity?	What is a convex curve?	The distance travelled by a car, s, in metres is given by $s=3t^2+\frac{3}{2}t^3$. Find the speed when $t=2$
	For the velocity time graph to the left: a) Describe the motion shown, identifying all key features. b) For what time interval is the acceleration greatest? And what is it? c) What is the total distance travelled?		Differentiate $y=x^2$ from first principles.	State Newton's 3 laws of motion.
			What is limiting friction?	Find the general solution of $\frac{\mathrm{d}y}{\mathrm{d}x}=xy$

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$2 + \frac{x}{6} - \frac{x^2}{72} + \frac{5x^3}{2592} - \cdots$

By completing the square the centre is $(2, -3)$ and the radius is 3.

$\sqrt{\frac{43}{49}}\text{s} \approx 0.88\text{s}$

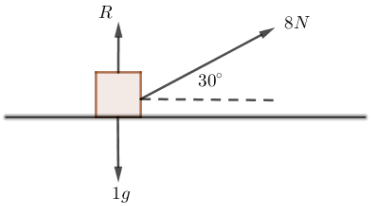
For x to be a point of inflection, $f''(x) = 0$. If in addition $f'(x) = 0$ the point is a "stationary point of inflection", if not then it is a "non-stationary point of inflection".

$|\mathbf{v}| = 5$, at an angle $53.1°$ to the positive $\mathbf{i}$ direction.

The force multiplied by the perpendicular distance from the force's line of action to the point A.

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

Valid for $\left|\frac{bx}{a}\right| < 1$ or equivalently $|x| < \left|\frac{a}{b}\right|$



b) $4\sqrt{3}$ ms^{-1}
b) We have modelled the box as a particle.

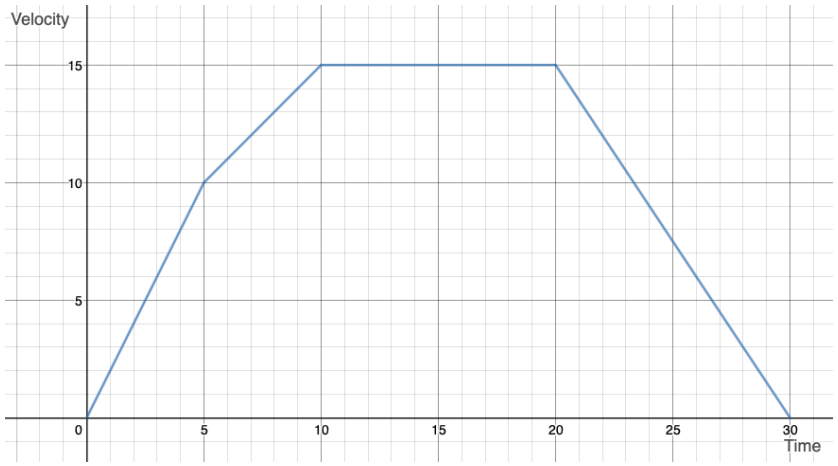
$3\log_{10}(x)$

Vertical: $5\sin(25)$
Horizontal: $5\cos(25)$

It stays constant.

A curve is convex if any line segment joining two points on the curve stays above the curve.

30 ms^{-1}



a) Accelerating between 0 and 5 seconds, still accelerating but at a slower rate between 5 and 10 seconds. Travelling at a constant speed between 10 and 20 seconds and then decelerating between 20 and 30 seconds.
b) Between 0 and 5 seconds.
c) 312.5 units.

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

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.

Limiting friction is when friction is at its maximum. Then $F = \mu R$ where R is the reaction force.

$y = Ae^{\frac{x^2}{2}} + C$