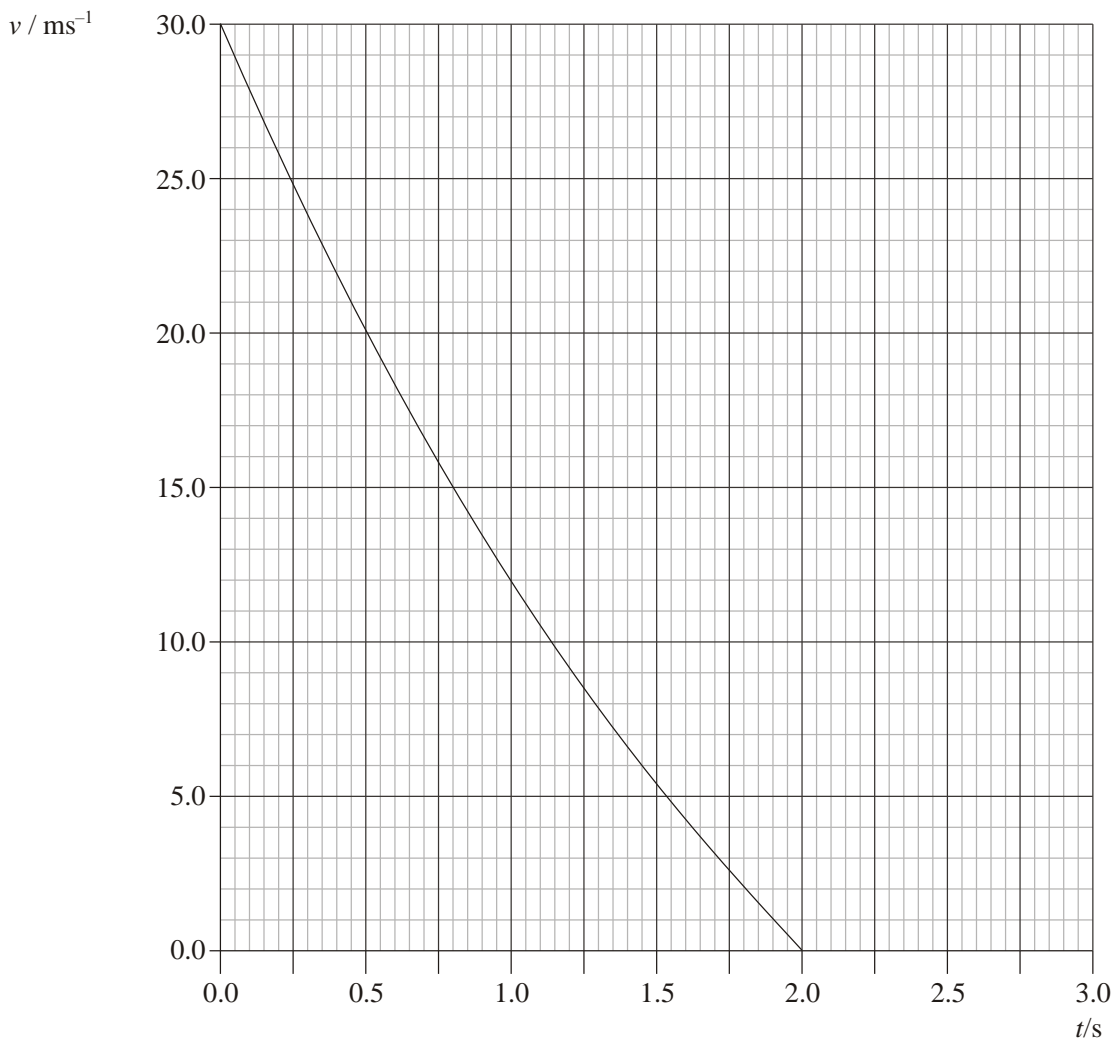


Year End Review: Kinematics

- 1) A plane is flying at 870km/h north while fighting against wind blowing at 120km/h at 30.0° North of East.
 - a. What is the wind's horizontal velocity component in m/s?
 - b. What is the resultant velocity of the plane in m/s?
- 2) A 1.5 kg bowling ball was rolling at 4.7m/s before approaching a 15.0m high cliff. Air resistance is negligible.
 - a. What was the bowling ball's vertical velocity component before leaving the cliff?
 - b. How much time did the ball spend in the air before hitting the ground?
 - c. How far from the base of the cliff will the ball hit?
- 3) Challenge! A ball of mass 0.25 kg is projected vertically upwards from the ground with an initial velocity of 30 m/s. The acceleration of free fall is 10 m/s^2 , but air resistance **cannot** be neglected.

The graph below shows the variation with time t of the velocity v of this ball for the upward part of the motion.

- a. State what the area under the graph represents.
- b. Estimate the maximum height reached by the ball.
- c. Determine, for the ball at $t = 1.0 \text{ s}$,
 - i. the acceleration;
 - ii. the magnitude of the force of air resistance.
- d. Use the graph to explain, without any further calculations, that the force of air resistance is decreasing in magnitude as the ball moves upward.



Name: _____

Answer Key

1)

- a. 29 m/s East
- b. 260 m/s at 6.4° East of North

2)

- a. 0 m/s
- b. 1.7s
- c. 8.2 m

3)

- a. the maximum height reached by the ball / the displacement in the first 2s / the distance travelled;
- b. 30 m; *Accept answers in the range 25m to 30m*
- c.
 - i. drawing tangent at $t = 1.0\text{s}$; using a sufficiently large triangle – at least 6 cm hypotenuse; to get $a = 15\text{ms}^{-2}$
 - ii. $R + mg = ma$; $R = 3.75 - 2.50 = 1.2\text{N}$;
- d. slope of the graph is decreasing; the force of air resistance must decrease as well;