Day 344 **A Level Maths: A Tier 10-a-day**

1 At 12:00 ship P has position $(8\mathbf{i} + 13\mathbf{j})$ km and velocity $(-3\mathbf{i} - \mathbf{j})$ km h^{-1}; ship Q has position $(15\mathbf{j})$ km and velocity $(\mathbf{i} - 2\mathbf{j})$ km h^{-1}. Show that the ships collide and find the time and position vector of the collision.

2 The random variable X has P(X = x) = k(x + 1) for x = 0, 1, 2, 3.

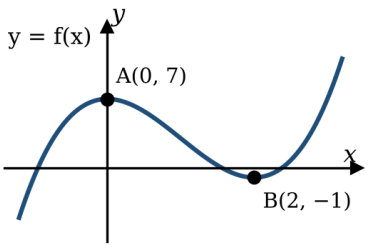
(a) Show that $k = \frac{1}{10}$. (b) Find E(X) and Var(X).

(c) Find P(X ≥ 1).

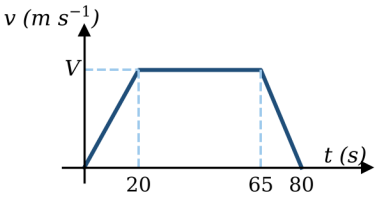
3 The diagram shows the curve y = f(x), with turning points A and B.

Find the coordinates of the turning points of

(a) y = f(x + 3) (b) y = −f(x)



4 The diagram shows the speed-time graph for a train journey of 1625 m. Find (a) V, (b) the deceleration in the final stage. Give answers to 3 s.f. if not exact.



5 (a) Express 24 sin x + 7 cos x in the form R sin(x + α), where R > 0 and 0° < α < 90°. Give α to 1 d.p.

(b) Solve 24 sin x + 7 cos x = 20 for 0° ≤ x < 360°, giving answers to 1 d.p.

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6 Find the coefficient of x^{10} in the expansion of $(2x^2 - \frac{1}{x})^8$.	
7 Water drains from a tank so that the depth h metres falls at a rate proportional to $\sqrt{h}$. Initially h = 36, and after 2 hours h = 25. Form and solve a differential equation to find how long, in total, the tank takes to empty.	
8 A circle touches both coordinate axes and passes through the point (−6, 3). Its centre lies in the second quadrant. Find the equations of the two possible circles.	
9 Solve cos 2x + sin x = 0 for $-180° \leq x \leq 180°$.	
10 X ~ B(30, p). H_0: p = 0.3 is tested against H_1: p ≠ 0.3 at the 10% level. (a) Find the critical region. (b) Find the actual significance level of the test (3 s.f.).	