Question				Marking details	Marks Available
1	*(a)*			A quantity which has magnitude [accept size] and direction.	[1]
	(b)			[Resultant] Force (1) Acceleration (1) (award 1 mark only if both symbols identified correctly)	[2]
	(c)	(i)		$2T$ (1) x cos 37° (1) [= 8 000 N]	[2]
		(ii)		F_{drag} = 6 000 [N]	[1]
	(d)			F = 6 000 N (1) **ecf** from *(c)*(ii) d = 2.5 x 60 (1) W = 6 000 x 2.5 x 60 = 9 x 10^5 J (1) **UNIT mark**	[3]
				Question 1 total	**[9]**
2	*(a)*			n- number of free/conducting electrons (charge carriers) per unit volume (1) accept free electron density v- drift velocity (1)	[2]
	(b)			LHS: C s^{-1} (1) RHS: m^{-3} x m^2 x m s^{-1} x C (1) Clear manipulation to show/state LHS = RHS (1)	[3]
	(c)	(i)		$v = \frac{I}{nAe}$ (1) (or correct substitution) v = 1.30 x 10^{-4} m s^{-1} (1) (-1 for slips in powers of 10) $t = \frac{5.0}{1.30 \times 10^{-4}}$ = 3.85 x 10^4 [s] (1) **ecf** for incorrect value of v	[3]
		(ii)		Reduced CSA (or diameter) **and** n,e constant..... (1) ...Increased v ..... (1) .....Hence reduced t (1)	[3]
				Question 2 total	**[11]**

© WJEC CBAC Ltd.

Question				Marking details	Marks Available
3	*(a)*	(i)		Displacement (don't accept distance)	[1]
		(ii)		Shaded area = ½ tv (1) $u = 0$ shown or implied (1) $v = at$ and clear substitution (1)	[3]
	(b)	(i)		2.2 [s]	[1]
		(ii)		Valid substitution into $v = u + at$ (e.g. $0 = u - g \times 1.1$ or $2u = 2.2g$ etc) Or any other valid kinematic equation (**ecf** on t from (i)) Correct algebra/manipulation (1) $u = 10.8\,[\mathrm{m\,s^{-1}}]$ (1)	[3]
		(iii)		Correct substitution into $x = ut + \frac{1}{2}at^2$ (i.e. $x = 10.8 \times 0.3 - \frac{1}{2} \times 9.81 \times 0.3^2$) (**ecf** on $10.8\,\mathrm{m\,s^{-1}}$) (1) $x = 2.8$ [m] (1)	[2]
	(c)			Reasonable scales on both axes (1) Diagonal straight line from (0, ±10.8 (**ecf**)) to (1.1 (**ecf**), 0) (1) Diagonal line continued to (2.2, ±10.8) (1)	[3]
	(d)			Two vertical downwards arrows shown during upward motion (1) Single vertical downwards arrow shown at max height (1) Vertical upwards and vertical downwards arrows shown during downward motion (1) All labels correct (weight or force due to gravity, air resistance or force due to air) (1)	[4]
				Question 3 Total	**[17]**

© WJEC CBAC Ltd.

Question				Marking details	Marks Available
4	*(a)*	(i)		Metal wire at constant temperature - straight diagonal line. Filament of lamp - curved line.	[1]
		(ii)		Straight line: R constant throughout [or V/I constant] as... (1) ....T constant throughout (1) Curve: Initially R constant [or V/I constant] as....(1) Then T increases (1) so R increases - accept explanation in terms of particles (1)	[5]
	(b)	(i)		$I = 2$ [A]	[1]
		(ii)	(I)	Voltage across X = 12 [V]	[1]
			(II)	12 V - 6 V = 6 [V] **ecf** from (I)	[1]
			(III)	$R_2 = \frac{6}{4} = 1.5[\Omega]$ **ecf** from (II)	[1]
			(IV)	V across $R_1 = 3$ [V] (1) I through $R_1 = 6$ [A] (1) $R_1 = \frac{3}{6}$ (**ecf** on I and/or V) $= 0.5[\Omega]$ (1)	[3]
				Question 4 Total	**[13]**

Question				Marking details	Marks Available
5	*(a)*			$R = \frac{\rho \ell}{A}$ (1) ρ constant (1) Effect of change in l **and** A on R (1)	[3]
	(b)	(i)		CSA = 2.4×10^{-10} m^2 (1) $l = 6 \times 3.2 \times 10^{-2}$ m (= 0.192 m) (1) Correct substitution into $R = \frac{\rho \ell}{A}$ to show $R = 56\,[\Omega]$ (1)	[3]
		(ii)		$0.1\% \times 56 = 0.056\,\Omega$ (1) $\Delta l = 1.9 \times 10^{-4}$ [m] (**ecf**) (1)	[2]
		(iii)		Zig-zag pattern ensures long length of wire (1) Therefore maximise Δl (or maximise ΔR - or equivalent) **or** measure strain in a small region (1)	[2]
				Question 5 Total	**[10]**
6	*(a)*			No net force (1) No net moment (1)	[2]
	(b)	(i)		Downward pointing arrow placed in (approximate) centre of beam	[1]
		(ii)		Clockwise: (10 x 1.5) + (20 x 3) (1) Anti-clockwise: 40d (1) d = 1.875 [m] (1)	[3]
		(iii)		10 [N] (1) Downwards (1)	[2]
				Question 6 Total	**[8]**

Question				Marking details	Marks Available
7	*(a)*	(i)		Mass of air = ρAu (1) Convincing substitution into ½ mu^2 (1)	[2]
		(ii)	(I) (II)	4 (1) 8 (1)	[2]
		(iii)		½ $A\rho(u^3 - v^3)$ (or equivalent)	[1]
		(iv)		Turbines in front will have removed energy from the wind - or equivalent	[1]
		(v)		Substitution into ½ $A\rho(u^3-v^3)$ (or equivalent) (1) P = 1 644 [W] (1) (- 1 mark for error in A)	[2]
	(b)	(i)		Energy passing through blades insufficient to overcome friction of moving parts.	[1]
		(ii)		Efficiency = 54% ±1% (1) P = 888 W (**ecf** from *(a)*(v)) **UNIT mark** (1)	[2]
	(c)			<u>Density of water</u> much greater than density of air	[1]
				Question 7 Total	**[12]**