		mark	comment	sub
1(i)	The line is not straight	B1	Any valid comment	1
(ii)	$a = 3 - 6t/8$	M1	Attempt to differentiate. Accept 1 term correct but not $3 - \frac{3t}{8}$.	
	$a(4) = 0$	F1		
	The sprinter has reached a steady speed	E1	Accept 'stopped accelerating' but not just $a = 0$. Do not FT $a(4) \neq 0$.	3
(iii)	We require $\int_1^4 \left(3t - \frac{3t^2}{8}\right) \mathrm{d}t$	M1	Integrating. Neglect limits.	
	$= \left[\frac{3t^2}{2} - \frac{t^3}{8}\right]_1^4$	A1	One term correct. Neglect limits.	
	$= (24 - 8) - \left(\frac{3}{2} - \frac{1}{8}\right)$	M1	Correct limits subst in integral. Subtraction seen. If arb constant used, evaluated to give $s = 0$ when $t = 1$ and then sub $t = 4$.	
	$= 14\frac{5}{8}$ m (14.625 m)	A1	cao. Any form. [If trapezium rule used M1 use of rule (must be clear method and at least two regions) A1 correctly applied M1 At least 6 regions used A1 Answer correct to at least 2 s.f.	4
		8		

2(i)	Straight lines connecting (0, 10), (10, 30), (25, 40) and (45, 40)	B1 B1 B1	Axes with labels (words or letter). Scales indicated. Accept no arrows. Use of straight line segments and horiz section All correct with salient points clearly indicated	3
(ii)	$0.5(10+30)\times10+0.5(30+40)\times15+40\times20$ = 200 + 525 + 800 = 1525	M1 M1 A1	Attempt at area(s) or use of appropriate *uvast* Evidence of attempt to find whole area cao	3
(iii)	$0.5\times40\times T=1700-1525$ so $20T$ = 175 and T = 8.75	M1 F1	Equating triangle area to 1700 – **their** (ii) (1700 – **their** (ii))/20. Do not award for – ve answer.	2
				8

3(i)	8 m s^{-1} (in the negative direction)	B1	Allow $\pm$ and no direction indicated	1
(ii)	$(t+2)(t-4)=0$ so $t = -2$ or 4	M1 A1	Equating v to zero and solving or subst If subst used then both must be clearly shown	2
(iii)	$a = 2t-2$ $a = 0$ when $t = 1$ $v(1) = 1-2-8 = -9$ so 9 m s^{-1} in the negative direction $(1,-9)$	M1 A1 F1 A1 B1	Differentiating Correct Accept -9 but not 9 without comment FT	5
(iv)	$\int_1^4 \left(t^2-2t-8\right)\mathrm{d}x$ $= \left[\frac{t^3}{3}-t^2-8t\right]_1^4$ $= \left(\frac{64}{3}-16-32\right)-\left(\frac{1}{3}-1-8\right)$ $= -18$ distance is 18 m	M1 A1 M1 A1 A1	Attempt at integration. Ignore limits. Correct integration. Ignore limits. Attempt to sub correct limits and subtract Limits correctly evaluated. Award if -18 seen but no need to evaluate Award even if -18 not seen. Do not award for -18. cao	5
(v)	$2\times 18 = 36$ m	F1	Award for $2\times$ **their** (iv).	1
(vi)	$\int_4^5 \left(t^2-2t-8\right)\mathrm{d}x = \left[\frac{t^3}{3}-t^2-8t\right]_4^5$ $= \left(\frac{125}{3}-25-40\right)-\left(-\frac{80}{3}\right) = 3\frac{1}{3}$ so $3\frac{1}{3}+18 = 21\frac{1}{3}$ m	M1 A1 A1	$\int_4^5$ attempted or, otherwise, complete method seen. Correct substitution Award for $3\frac{1}{3}$ + **their** (positive) (iv)	3
				17

			mark		Sub
4	(i)	$0.5\times 2\times 12 + 0.5\times 4\times 12$ so 36 m	M1 A1	Attempt at sum of areas or equivalent. No extra areas.	 2
	(ii)	$8-\frac{36}{12}=5$ seconds	**B1**	ca	1
	(iii)	-6 m s^{-2}	M1 B1	Attempt at accn for $0 \le t \le 2$ must be - ve or equivalent	 2
	(iv)	$58.5 = 12\times 6 + 0.5\times a\times 36$ so $a = -0.75$	M1 A1	Use of *uvast* with 12 and 58.5	 2
	(v)	$a = -10 + \frac{9}{2}t - \frac{3}{8}t^2$ $a(1) = -10 + \frac{9}{2} - \frac{3}{8} = -5.875$	M1 A1 **A1**	Differentiation ca	 3
	(vi)	$s = \int\left(12 - 10t + \frac{9}{4}t^2 - \frac{1}{8}t^3\right)\mathrm{d}t$ $= 12t - 5t^2 + \frac{3}{4}t^3 - \frac{1}{32}t^4 + C$ $s = 0$ when $t = 0$ so $C = 0$ $s(8) = 32$	M1 A1 A1 A1* A1	Attempt to integrate At least one term correct All correct. Accept + C omitted Clearly shown cao (award even if A1* is not given)	 5
	(vii)	**either** $s(2) = 9.5$ and $s(4) = 8$ Displacement is negative Car going backwards **or** Evaluate $v(t)$ where $2 < t < 4$ or appeal to shape of the graph Velocity is negative Car going backwards	B1 E1 E1 B1 E1 E1	Both calculated correctly from **their** s. No further marks if **their** $s(2) \le s(4)$ Do *not* need car going backwards *throughout* the interval. e.g. $v(3) = -1.125$ No further marks if **their** $v \ge 0$ Do *not* need car going backwards *throughout* the interval [Award WW2 for 'car going backwards'; WW1 for velocity or displacement negative]	 3 18

		mark		Sub
5(i)	Acceleration is 8 m s^{-2} speed is $0 + 0.5 \times 4 \times 8 = 16$ m s^{-1}	B1 B1		2
(ii)	$a = 2t$	B1		1
(iii)	$t = 7$ $a > 0$ for $t < 7$ and $a < 0$ for $t > 7$	B1 E1	 Full reason required	2
(iv)	Area under graph $0.5 \times 2 \times 8 - 0.5 \times 1 \times 4 = 6$ so 6 m s^{-1} Increase	M1 B1 E1	Both areas under graph attempted. Accept both positive areas. If 2×3 seen accept ONLY IF reference to average accn has been made. Award for $v = -2t^2 + 28t + c$ seen or 24 and 30 seen Award if 6 seen. Accept '24 to 30'. This must be clear. Mark dept. on award of M1	3
	total	8		