Variable Acceleration - Edexcel Past Exam Questions MARK SCHEME

Question 1: June 06 Q1

1.	$a = 5 - 2t \Rightarrow v = 5t - t^2, + 6$	M1 A1, A1
	$v = 0 \Rightarrow t^2 - 5t - 6 = 0$	indep M1
	$(t - 6)(t + 1) = 0$	dep M1
	$t = \underline{6\text{ s}}$	A1
		(6)

Question 2: June 07 Q8

Question Number	Scheme	Marks
(a)	$0 \le t \le 4$: $a = 8 - 3t$	M1
	$a = 0 \Rightarrow t = 8/3$ s	DM1
	$\rightarrow v = 8.\frac{8}{3} - \frac{3}{2}\left(\frac{8}{3}\right)^2 = \frac{32}{3}$ (m/s)	DM1 A1
	second M1 dependent on the first, and third dependent on the second.	(4)
(b)	$s = 4t^2 - t^3/2$	M1
	$t = 4$: $s = 64 - 64/2 = \underline{32\text{ m}}$	M1 A1 (3)
(c)	$t > 4$: $v = 0 \Rightarrow t = \underline{8\text{ s}}$	B1 (1)
(d)	*Either*	
	$t > 4$ $s = 16t - t^2$ $(+ C)$	M1
	$t = 4, s = 32 \rightarrow C = -16 \Rightarrow s = 16t - t^2 - 16$	M1 A1
	$t = 10 \rightarrow s = 44$ m	M1 A1
	But direction changed, so: $t = 8, s = 48$	M1
	Hence total dist travelled $= 48 + 4 = \underline{52\text{ m}}$	DM1 A1 (8)
	Or (probably accompanied by a sketch?)	
	t=4 v=8, t=8 v=0, so area under line $= \frac{1}{2} \times (8-4) \times 8$	M1A1A1
	t=8 v=0, t=10 v=-4, so area above line $= \frac{1}{2} \times (10-8) \times 4$	M1A1A1
	$\therefore$ total distance = 32(from b) + 16 + 4 = $\underline{52\text{ m.}}$	M1A1 (8)

Or M1, A1 for t > 4 $\frac{dv}{dt} = -2$, =constant

t=4, v=8; t=8, v=0; t=10, v=-4

M1, A1 $s = \frac{u+v}{2}t = \frac{32}{2}t$, =16 working for t = 4 to t = 8

M1, A1 $s = \frac{u+v}{2}t = \frac{-4}{2}t$, =-4 working for t = 8 to t = 10

M1, A1 total = 32+14+4, =52

M1 Differentiate to obtain acceleration
DM1 set acceleration. = 0 and solve for t
DM1 use their t to find the value of v
A1 32/3, 10.7oro better

OR using trial an improvement:
M1 Iterative method that goes beyond integer values
M1 Establish maximum occurs for t in an interval no bigger than 2.5<t<3.5
M1 Establish maximum occurs for t in an interval no bigger than 2.6<t<2.8
A1

Or M1 Find/state the coordinates of both points where the curve cuts the x axis.
DM1 Find the midpoint of these two values.
M1A1 as above.

Or M1 Convincing attempt to complete the square:

DM1 substantially correct $8t - \frac{3t^2}{2} = -\frac{3}{2}(t - \frac{8}{3})^2 + \frac{3}{2} \times \frac{64}{9}$

DM1 Max value = constant term
A1 CSO

M1 Integrate the correct expression
DM1 Substitute t = 4 to find distance (s=0 when t=0 - condone omission / ignoring of constant of integration)
A1 32(m) only

B1 t = 8 (s) only

M1 Integrate 16-2t
M1 Use t=4, s= their value from (b) to find the value of the constant of integration.
or 32 + integral with a lower limit of 4 (in which case you probably see these two marks
occurring with the next two. First A1 will be for 4 correctly substituted.)
A1 $s = 16t - t^2 - 16$ or equivalent
M1 substitute t = 10
A1 44
M1 Substitute t = 8 (their value from (c))
DM1 Calculate total distance (M mark dependent on the previous M mark.)
A1 52 (m)

	OR the candidate who recognizes v = 16 – 2t as a straight line can divide the shape into two triangles: M1 distance for t = 4 to t = candidates's 8 = ½ x change in time x change in speed. A1 8-4 A1 8-0 M1 distance for t = their 8 to t = 10 =½ x change in time x change in speed. A1 10-8 A1 0-(-4) M1 Total distance = their (b) plus the two triangles (=32 + 16 + 4). A1 52(m) NB: This order on epen grid (the A's and M's will not match up.)		

Question 3: Jan 09 Q4

(a)	$v = 10t - 2t^2$, $s = \int v dt$	M1	
	$= 5t^2 - \frac{2t^3}{3} (+C)$	A1	
	$t = 6 \Rightarrow s = 180 - 144 = \underline{36}$ (m)	A1	
			(3)
(b)	$\underline{s} = \int v\,dt = \underline{\frac{-432t^{-1}}{-1}} (+K) = \underline{\frac{432}{t}} (+K)$	B1	
	$t = 6$, $s =$ "36" $\Rightarrow 36 = \frac{432}{6} + K$	M1*	
	$\Rightarrow K = -36$	A1	
	At $t = 10$, $s = \frac{432}{10} - 36 = \underline{7.2}$ (m)	d*M1	
		A1	
			(5) [8]

Question 4: June 09 Q2

Question Number	Scheme	Marks
(a)	$\frac{dv}{dt} = 8 - 2t$	M1
	$8 - 2t = 0$	M1
	Max $v = 8 \times 4 - 4^2 = 16\,(\text{ms}^{-1})$	M1A1
		(4)
(b)	$\int 8t - t^2 dt = 4t^2 - \frac{1}{3}t^3 (+c)$	M1A1
	(t=0, displacement = 0 $\Rightarrow$ c=0)	
	$4T^2 - \frac{1}{3}T^3 = 0$	DM1
	$T^2(4 - \frac{T}{3}) = 0 \Rightarrow T = 0, 12$	DM1
	$T = 12$ (seconds)	A1
		(5)
		[9]

Question 5: Jan 10 Q1

Question Number	Scheme	Marks
	$\frac{dv}{dt} = 6t - 4$	M1 A1
	$6t - 4 = 0 \Rightarrow t = \frac{2}{3}$	M1 A1
	$s = \int 3t^2 - 4t + 3 \, dt = t^3 - 2t^2 + 3t \; (+c)$	M1 A1
	$t = \frac{2}{3} \Rightarrow s = -\frac{16}{27} + 2$ so distance is $\frac{38}{27}$ m	M1 A1
		[8]

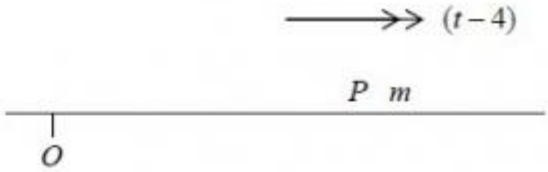
Question 6: June 10 Q1

Question Number	Scheme	Marks
		
	$\frac{dv}{dt} = 3t + 5$	
	$v = \int (3t+5)\,dt$	M1*
	$v = \frac{3}{2}t^2 + 5t \ (+c)$	A1
	$t = 0 \ v = 2 \ \Rightarrow \ c = 2$	B1
	$v = \frac{3}{2}t^2 + 5t + 2$	
	$t = T \quad 6 = \frac{3}{2}T^2 + 5T + 2$	DM1*
	$12 = 3T^2 + 10T + 4$	
	$3T^2 + 10T - 8 = 0$	
	$(3T-2)(T+4) = 0$	M1
	$T = \frac{2}{3} \quad (T = -4)$	
	$\therefore T = \frac{2}{3} \quad$ (or 0.67)	A1
		[6]

Question 7: Jan 11 Q3

(a)	$a = 4t^3 - 12t$	
	Convincing attempt to integrate	M1
	$v = t^4 - 6t^2 (+c)$	A1
	Use initial condition to get $v = t^4 - 6t^2 + 8\left(\text{ms}^{-1}\right)$.	A1
		(3)
(b)	Convincing attempt to integrate	M1
	$s = \frac{t^5}{5} - 2t^3 + 8t(+0)$ Integral of their v	A1ft
		(2)
(c)	Set their $v = 0$	M1
	Solve a quadratic in t^2	DM1
	$(t^2-2)(t^2-4) = 0 \Rightarrow$ at rest when $t = \sqrt{2},\ t = 2$	A1
		(3)
		[8]

Question 8: June 11 Q6

Question Number	Scheme	Marks
(a)	 $\frac{dv}{dt} = t - 4$ $v = \frac{1}{2}t^2 - 4t(+c)$ $t = 0 \quad v = 6 \quad \Rightarrow c = 6$ $\therefore v = \frac{1}{2}t^2 - 4t + 6$	M1 A1 M1 A1 (4)
(b)	$v = 0 \quad 0 = t^2 - 8t + 12$ $(t-6)(t-2) = 0$ $t = 6 \quad t = 2$	M1 DM1 A1 (3)
(c)	$x = \frac{t^3}{6} - 2t^2 + 6t + k$ $x_6 - x_2 = \frac{6^3}{6} - 2\times 6^2 + 6^2 + k$ $-\left(\frac{2^3}{6} - 2\times 2^2 + 6\times 2 + k\right)$ $= -5\frac{1}{3}$ $\therefore$ Distance is $5\frac{1}{3}$ m	M1 A1 ft DM1 A1 (4) **11**