

Mark Scheme

Q1.

Question Number	Answer	Mark
	C is the correct answer A is incorrect because the acceleration does not reach zero B is incorrect because the acceleration does not reach zero D is incorrect because the acceleration does not reach zero	(1)

Q2.

Question Number	Answer	Mark
	The only correct answer is D (Gradient increases so line is parabolic and then gradient is constant) A is not correct because constant acceleration gives a parabolic shaped variation in displacement with time B is not correct because constant acceleration gives a parabolic shaped variation in displacement with time C is not correct because when the acceleration becomes zero, the object continues to move at the same velocity, so displacement continues to increase at a constant rate	1

Q3.

Question Number	Answer	Mark
	The only correct answer is C as the acceleration is positive while the fuel is still burning. It then becomes negative, while still travelling upwards, as the only forces acting on it are downwards (weight and drag). <i>A is not the correct answer because the acceleration should be constant as there is a constant upwards thrust from the fuel.</i> <i>B is not the correct answer because the acceleration should be constant as there is a constant upwards thrust from the fuel. The acceleration should become negative before T.</i> <i>D is not the correct answer because the acceleration becomes negative as the fuel runs out and not at the maximum height.</i>	(1)

Q4.

Question Number	Answer	Mark
	The only correct answer is D (the change in velocity of the aeroplane during time t) A is not correct because displacement is the area under a velocity-time graph B is not correct because displacement is the area under a velocity-time graph C is not correct because the shaded area is the change in velocity during time t	1

Q5.

Question Number	Answer	Mark
	B is the correct answer A is incorrect because gradient is velocity, not acceleration C is incorrect because gradient is rate of change of acceleration, not velocity D is incorrect because gradient is rate of change of acceleration, not displacement	1

Q6.

Question Number	Answer	Mark
	A is the correct answer B is incorrect because the gradient is zero except at one point. C is incorrect because the gradient begins negative and becomes positive. D is incorrect because the positive and negative gradients are constant except at one point.	1

Q7.

Question Number	Answer	Mark
	A is the only correct answer B is incorrect because the velocity is always zero C is incorrect because the velocity is always positive D is incorrect because velocity is zero except for a very short time.	1

Q8.

Question Number	Answer	Mark
	The correct answer is D because the area below the t axis represents negative displacement A is incorrect because P is above the line and Q should be subtracted B is incorrect because P is above the line C is incorrect because Q should be subtracted	1

Q9.

Question Number	Answer	Mark
	The correct answer is B because for a constant resultant force acceleration increases if mass decreases A is incorrect because a constant acceleration for a decreasing mass would require a decreasing resultant force C is incorrect because a decreasing acceleration for a decreasing mass would require a decreasing resultant force D is incorrect because a decreasing acceleration for a decreasing mass would require a decreasing resultant force	1

Q10.

Question Number	Answer	Mark
	The correct answer is B A is not the correct answer because the acceleration is not positive C is not the correct answer because the acceleration does not increase D is not the correct answer because the acceleration does not decrease	1

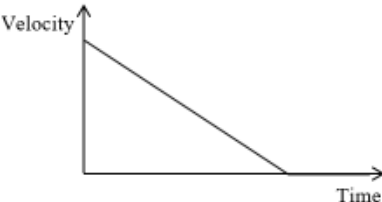
Q11.

Question Number	Answer	Mark
	The correct answer is C (decreasing acceleration) A is incorrect because constant acceleration has a straight line B is incorrect because displacement is increasing D is incorrect because displacement is increasing	1

Q12.

Question Number	Answer	Mark
	A is the correct answer B is not the correct answer as the gravitational force does not increase. C is not the correct answer as an increase in temperature would reduce the viscosity which would not account for a decrease in acceleration. D is not the correct answer as the upthrust depends on the density of the fluid and the volume of the sphere, neither of which changes.	(1)

Q13.

Question Number	Answer	Mark
	The only correct answer is B  A is not correct because this shows constant velocity not constant deceleration C is not correct because this shows varying deceleration D is not correct because this shows varying deceleration	1

Q14.

Question Number	Answer	Mark
	The only correct answer is D (The displacement at 4 hours divided by a time of 4 hours) A is not correct because the area under a displacement-time graph has no significance B is not correct because this would give the instantaneous speed at the end of the marathon C is not correct because this would give the instantaneous speed at 2 hours	1

Q15.

Question Number	Answer	Mark
	B is the correct answer A is not the correct answer as areas above and below time axis not equal C is not the correct answer as graph starts from zero D is not the correct answer as graph starts from zero	(1)

Q16.

Question Number	Answer	Mark
	D is the correct answer A is not the correct answer as the areas under the two graphs are not both zero. B is not the correct answer as the areas under the two graphs are not equal. C is not the correct answer as P is <u>at</u> the initial position.	(1)

Q17.

Question Number	Answer	Mark
	The only correct answer is D $\left(\frac{5vt}{2}\right)$ A is not correct because this gives the distance travelled at a constant velocity $2v$ for time $2t$ B is not correct because this gives twice the distance travelled C is not correct because $\frac{3vt}{2}$ is not the area under the graph	1

Q18.

Question Number	Answer	Mark
	C is the correct answer A is not the correct answer as no indication in Q9 of extremely high velocity required to change displacement apparently instantly B is not the correct answer as lines straight, indicating no change in velocity D is not the correct answer as lines straight, indicating no change in velocity	(1)

Q19.

Question Number	Answer	Mark
	D is the correct answer A is not correct because this gives the change in velocity of the object B is not correct because this gives the average velocity of the object C is not correct because this gives twice the distance travelled by the object	1

Q20.

Question Number	Answer	Mark
	C is the correct answer A is incorrect because this would be stationary B is incorrect because this would be constant velocity D is incorrect because this would be a decreasing velocity	1

Q21.

Question Number	Answer	Mark
	D is the correct answer A is incorrect because the acceleration is not positive B is incorrect because the acceleration is decreasing C is incorrect because the acceleration is constant	(1)

Q22.

Question Number	Answer	Mark
	• Use of $a = \frac{v-u}{t}$ (1) • See 1.6 m s^{-2} Or see $(-4.9 \text{ to } -5.2 \text{ m s}^{-2})$ (1) Max 1 • At 9 s the acceleration becomes negative (1) • From 9 s to 12 s the object is decelerating (1) • From 12 s to 17.5 seconds the object is accelerating while moving in the opposite direction (1) 3 <u>Example of calculation</u> $a = \frac{14 \text{ m s}^{-1} - 0}{9} = 1.56 \text{ m s}^{-2}$	
	Total for question	3

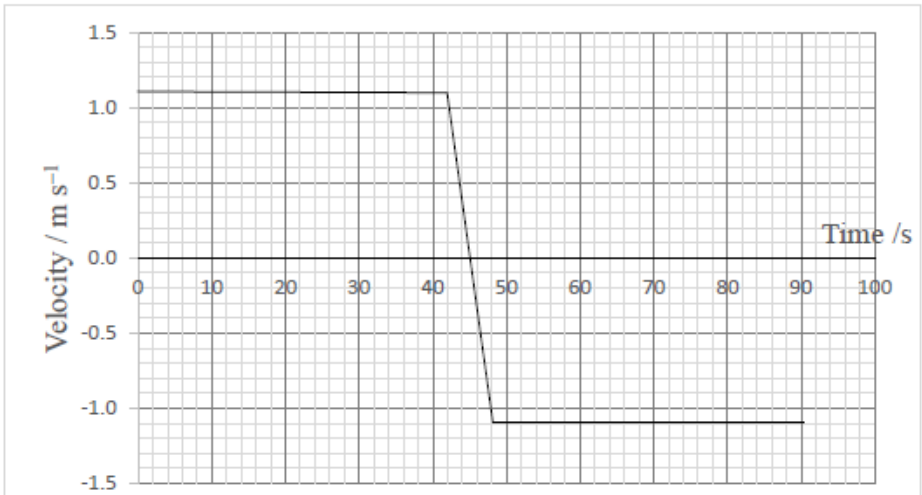
Q23.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	Displacement is a straight line (from start to end) (1) (Whereas) distance is the length of the path (1)	Allow (whereas) distance is not a straight line Allow the person does not travel in a straight line Allow the path is not a straight line If no other mark scored allow 1 mark for 'displacement is a vector but distance is a scalar'	2
(b)	Two pairs of corresponding values of velocity and time read from graph (1) Calculates gradient of the line between 4 s and 16 s (1) Maximum acceleration = 0.27 m s^{-2} (1)	No tolerance if readings taken at 4 s and 16 s Allow a tolerance of $\pm \frac{1}{2}$ a small square if readings taken from other points on the graph <u>Example calculation</u> $a = \frac{5.0 \text{ m s}^{-1} - 1.8 \text{ m s}^{-1}}{16 \text{ s} - 4 \text{ s}} = 0.267 \text{ m s}^{-2}$	3

Q24.

Question Number	Answer	Mark
(a)(i)	(Initial) gradient = 0 Or Tangent horizontal (at $t = 0$)	1
(a)(ii)	EITHER Draws tangent at (1.5, 0.0) (-)14 $\pm$ 1 m s ⁻¹ by graphical method OR <i>suvat</i> method using quantities read from the graph and/or $a = \pm g$. Correct answer from <i>suvat</i> calculation	2
(b)	Straight line from 0 to (1.5, - [magnitude from (a)(ii)]) Second straight line from end of first line to (2.1, 0.0) [Ignore lines beyond 2.1 s]	2
	The graph shows velocity in m s⁻¹ on the vertical axis (ranging from -20.0 to 20.0) and time in seconds on the horizontal axis (ranging from 0.0 to 3.0). A red line is plotted, starting at the origin (0,0), decreasing linearly to a minimum velocity of approximately -14 m s⁻¹ at t = 1.5 s, and then increasing linearly to zero velocity at t = 2.1 s. The area under the curve is shaded with a light blue grid.	
Total for question		5

Q25.

Question Number	Answer	Mark
(a)	- Use of $v = s/t$ Or use of gradient (1) $v = (\pm) 1.1$ to $1.2 \text{ (m s}^{-1}\text{)}$ (1) - Scaling of the velocity axis so that the graph covers at least 50% of the paper above and below the axes. (A minimum of 1 number on each axis required e.g. 1 and -1) (1) - A positive constant velocity from 0 to 42 s and the same negative constant velocity from 48 s to 90 s with connecting line/curve (tolerance of $\pm 1 \text{ s}$) (1) <u>Example of calculation</u> Initial velocity = $\frac{46 \text{ m}}{40 \text{ s}} = 1.15 \text{ m s}^{-1}$ 	4

(b)(i)	The graph should be a curve initially (1) with a decreasing gradient up to 15 m (by eye) (1) (ignore any part of the graph above 15 m)	2
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(b)(ii)	1 mark for a simplification	(1)	2										
	1 mark for a corresponding explanation	(1)											
	<table><tr><th>Simplification</th><th>Explanation</th></tr><tr><td>Velocity constant Or velocity doesn't change Or velocity is an average Or no regions of acceleration/deceleration</td><td> • Variation in velocity during each stroke • The force applied to the swimmer/water varies (within the stroke) • As the swimmer moves above/below water to breathe, the velocity changes • The speed would change as they went from gliding to swimming </td></tr><tr><td>The velocity of the swimmer has the same magnitude in both parts of the race</td><td>The swimmer may have tired and this could be less for the second half of the race</td></tr><tr><td>The initial velocity after the turn would be greater</td><td>The swimmer would probably glide (underwater) after the turn</td></tr><tr><td>Gradient should initially increase from zero</td><td>Swimmer initially pushes off from starting block/turn</td></tr></table>	Simplification		Explanation	Velocity constant Or velocity doesn't change Or velocity is an average Or no regions of acceleration/deceleration	• Variation in velocity during each stroke • The force applied to the swimmer/water varies (within the stroke) • As the swimmer moves above/below water to breathe, the velocity changes • The speed would change as they went from gliding to swimming	The velocity of the swimmer has the same magnitude in both parts of the race	The swimmer may have tired and this could be less for the second half of the race	The initial velocity after the turn would be greater	The swimmer would probably glide (underwater) after the turn	Gradient should initially increase from zero	Swimmer initially pushes off from starting block/turn	
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Gradient should initially increase from zero	Swimmer initially pushes off from starting block/turn												
Treat references to drag as neutral.													
Total for question													
			8										

Q26.

Question Number	Answer	Mark
(a)(i)	The graph is less steep Or The gradient is smaller	(1) (1)
(a)(ii)	Use of $a = \frac{v-u}{t}$ Or Use of $a = \text{gradient}$ $a_2 = 0.96 \text{ to } 1.3 \text{ m s}^{-2}$ <u>Example of calculation</u> $a_2 = \frac{13.2 \text{ m s}^{-1} - 6.8 \text{ m s}^{-1}}{(10.5 - 4)\text{s}} = 0.98 \text{ m s}^{-2}$	(1) (1) (2)
(a)(iii)	Velocity is large(r) (in higher gears) so force (of the engine) will be smaller.	(1) (1) (2)
(b)(i)	Conversion of mph to m s^{-1} Use of acceleration values for first and second gears only. Use of $a = \frac{v-u}{t}$ to determine a time total time = 13.0 to 14.0 s <u>Example of calculation</u> Velocity conversion = $\frac{60 \text{ mph} \times 1600 \text{ m}}{3600} = 26.7 \text{ m s}^{-1}$ $2.9 \text{ m s}^{-2} = \frac{18 \text{ m s}^{-1} - 0}{t_1} \quad t_1 = 6.21 \text{ s}$ $1.2 \text{ m s}^{-2} = \frac{26.7 \text{ m s}^{-1} - 18 \text{ m s}^{-1}}{t_2} \quad t_2 = 7.22 \text{ s}$ Total time = $6.21 \text{ s} + 7.22 \text{ s} = 13.4 \text{ s}$	(1) (1) (1) (1) (4)
(b)(ii)	As velocity increases the air resistance increases (When) frictional forces are equal to the (driving) force of engine/car There is no resultant/net/unbalanced force and no acceleration	(1) (1) (1) (3)
Total for question		12