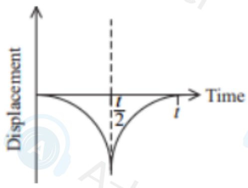
8	**The only correct answer is B** $s = 0 + \frac{1}{2}at^2$ so $s = \frac{1}{2} \times 9.81 \times 1.6^2 = 12.56$ s A is not correct because $s = 0 + \frac{1}{2}at$ was used to determine s C is not correct because $s = 0 + at$ was used to determine s D is not correct because $s = 0 + at^2$ was used to determine s	**1**

7	**B** 	**1**
	Incorrect Answers: A – Correct shape graph but, relative to the given v-t graph the direction is incorrect C – Initial direction incorrect but final direction correct D – Initial direction correct but final direction incorrect	

8	**The only correct answer is D** (-9.8 m s^{-1}) A is not correct because the ball is in freefall so has acceleration due to gravity B is not correct because the ball is in freefall so has acceleration due to gravity C is not correct because the ball is in freefall so has acceleration due to gravity	**1**

6	**A is the correct answer** B is not the correct answer as the change in velocity is not 2 m s^{-1}. C is not the correct answer as it gives a negative time, and the collision takes a positive amount of time. D is not the correct answer for the same reason that B is not.	**(1)**

2	**B is the correct answer** A is not the correct answer as force per unit length has no meaning. C is not the correct answer as this is the gravitational force. D is not the correct answer as this is gravitational potential.	**(1)**

Question Number	Answer		Mark
15(a)(i)	Use of $v^2 = u^2 + 2as$ with $u = 0$ **Or** use of $t = s$/average velocity and $v = u + at$ with $u = 0$	(1)	
	The final velocity in m s^{-1} **Or** distance in km	(1)	
	$a = 2.8 \times 10^5$ m s^{-2} **Or** 280 km s^{-2}	(1)	**3**
	<u>Example of calculation</u> $(11 \times 10^3 \text{ m s}^{-1})^2 = 0^2 + (2 \times a \times 220 \text{ m})$ $a = 275\,000$ m s^{-2}		
15(a)(ii)	Use of $E_k = ½ mv^2$ with $m = 1500$ kg	(1)	
	Correct use of 50% e.g. $(2 \times E_k)$ or $(0.5 \times 3 \times 10^6)$	(1)	
	Use of mass of fuel = kinetic energy/energy per kg of fuel	(1)	
	Mass of fuel required = 6.1×10^4 kg	(1)	**4**
	<u>Example of calculation</u> $E_k = ½ \times 1500 \text{ kg} \times (11 \times 10^3 \text{ m s}^{-1})^2 = 9.075 \times 10^{10}$ J Energy to be supplied by fuel = $2 \times 9.075 \times 10^{10}$ J = 1.815×10^{11} J Mass of fuel required = 1.815×10^{11} J/3×10^6J kg^{-1}= 6.05×10^4 kg		
***15(b)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)**		
	<u>Gas</u> is ejected forwards	(1)	
	By N3, there is a backward/opposite force/push (on the capsule).	(1)	
	There is a (backwards) resultant force (on the capsule)	(1)	
	By N1/N2, there is an acceleration	(1)	
	Force/acceleration is in opposite direction to motion, so a deceleration **Or** force/acceleration is in opposite direction to motion, so negative acceleration	(1)	**5**
	(accept upwards and downwards for forwards and backwards)		
	Total for question 13		**12**

Question Number	Answer		Mark
15(a)	20 m s^{-1} is the average velocity **Or** the velocity is not constant **Or** the car is accelerating	(1)	
	Tangent drawn onto graph at $t = 15$ s **Or** use of correct equations of motion with $u = 0$	(1)	
	Velocity = 40 (m s^{-1})	(1)	**3**
	(Do not award MP2 for approximation of the curve to a straight line at 15 s)		
	<u>Example of calculation</u> Gradient of tangent = $\frac{520\text{ m} - 100\text{ m}}{20.0\text{ s} - 10.5\text{ s}}$ = 44.2 m s^{-1}		
15(b)	The acceleration is decreasing **Or** the rate of change of velocity is decreasing	(1)	
	Drag forces are increasing (with increased velocity) **Or** the car is heading towards terminal velocity **Or** the resultant force is decreasing due (to the increasing drag force) **Or** air resistance is proportional to velocity (squared)	(1)	**2**
	Total for question 15		**5**