Name: _____

Motion Foundation

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

Q1.

Question Number	Answer	Mark
	B 1.0 m/s **The only correct answer is B** *A 0.1 m/s is incorrect, being 1 metre every 10s, insect crawling pace* *C 10 m/s is incorrect, being an Olympic sprinter's pace, much too fast for 'walking'* *D 100 m/s is incorrect, being a very fast sport's car's pace*	**(1)** AO 1 1

Q2.

Question Number	Answer	Acceptable answers	Mark
	{steady/constant} speed (at first) (1) (then) slows down (1)	accept velocity for speed ignore as time increases distance travelled increases (then) slower/less speed/decelerates/negative acceleration	**(2)**

Q3.

Question Number	Answer	Additional guidance	Mark
	• direction (1) • size (1)	answers only acceptable in given order or magnitude	**(2)** AO 2 1

Q4.

Question Number	Answer	Additional guidance	Mark
	substitution (1) $\frac{80(^2) (- 0^2)}{2 \times 4}$ evaluation (1) 800 (m)	allow 1 mark for seeing $\frac{80}{8}$ ignore any minus signs award full marks for the correct answer without working	**(2)**

Q5.

Question Number	Answer	Additional guidance	Mark
	a description to include 3 points from: • measure a distance (at the bottom) / use mark(er)s (certain distance apart) (1) • starting timer (at first mark(er)) (1) • stopping timer (at 2nd mark(er)) OR measures a time (interval) (1) • (use speed) = distance/time (1)	use a light gate (or equivalent sensors idea) not over whole slope for this mark point use of video / (speed) camera /interrupts the light beam accept any time measured for this mp including data logger OR timer / stopwatch	**(3)** AO 2 2

Q6.

	Answer	Acceptable answers	Mark
	substitution into given equation (1) 1.3 × 300 000 evaluation (1) 390 000 (km)	 Power of 10 error max 1 mark 3.9×10^5 (km) 2 marks for correct numerical answer with no working shown Ignore any unit given by candidate.	**(2)**

Q7.

	Answer	Acceptable answers	Mark
	An explanation linking • {acceleration of sports is 2x / time to reach 30 m/s is ½} that of family car / RA (1) • mass of sports car LESS than ½ that of family car or RA (1) (so resultant force required is less)	Attempt to use f = m × a scores one mark e.g. 4200 OR 3600 scores 1 Correct numerical comparison scores both marks e.g. 4200:3600 numerically or in words scores 2 marks	**(2)**

Q8.

	Answer	Acceptable answers	Mark
(i)	D the same size as the driving force		**(1)**
(ii)	transposition: (1) (change in) speed= accelerationxtime substitution: (1) speed = 12 × 4	transposition and substitution can be in either order substitution mark can be scored when incorrectly transposed word/symbol equation is given	**(3)**

	evaluation: (1) 48 (m/s) (1)	Give full marks for correct answer no working	

Q9.

	Answer	Acceptable answers	Mark
(i)	8 – 0 (m/s)	8	**(1)**
(ii)	substitution 8 / 5 (1) evaluation (1) 1.6 (m/s^2)	ecf from (i) full marks for correct answer (or ecf) with no working shown.	**(2)**
(iii)	0	Nil / nothing / zero / none (no mark for no response)	**(1)**

Q10.

Question Number	Answer	Additional guidance	Mark
(i)	(metre) rule(r) (1)	accept measuring tape/stick tape measure light gate	**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	A description that combines the following points to produce a logical method: hang/attach/add/put/increase {masses / weights} (1) on/to (the end of) the string (over the pulley wheel) (1) OR apply a force to the trolley /string (1) (by a) pull / push / rubber band (1) OR putting trolley on a slope (1) allow the trolley to run down (1)	 accept on/at/from the pulley wheel ` pull the string` OR push the trolley scores 2 marks slanting the bench (let) gravity pull the trolley	(2) exp

Question Number	Answer	Additional guidance	Mark
(iii)	Any one from: speed (at the start/end of the run) (1) time (between changes in speed) (1)	 (different/additional) speed / velocity appropriate ticker tape(s)	(1)

Q11.

Question Number		Indicative Content	Mark
QWC	*	An explanation including some of the following points: • Statement of what is meant by stopping distance Factors affecting driver • factors affecting driver's thinking distance/reaction time Factors dependent on the car • factors affecting braking distance e.g. tyre tread, condition of brakes • cars may be carrying different loads • cars may have different masses External factors • road surface • weather • uphill / downhill Use of data • calculation of thinking, braking and or stopping distances for average driver • calculation of thinking, braking and or stopping distances for driver A • calculation of thinking, braking and or stopping distances for driver B	(6)

Level	0	No rewardable content
1	1 - 2	• a limited explanation of the differences using one fact OR one piece of data from the chart OR factor(s) affecting thinking/braking distance. e.g. A has a longer thinking distance OR B is a longer braking distance OR thinking distance can be affected by a driver using their phone • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple explanation, giving more than one fact using data from the chart about either car OR at least one piece of data about each OR using one piece of data from the chart about one car AND at least one factor affecting thinking/braking distance OR a statement linking data from the chart to the cause for one car but nothing correct about the other car e.g. A has a braking distance of (about) 33 m, its thinking distance is longer than an average car. OR B has a longer stopping distance. B's reaction time is faster than the Highway code. OR B has a very short thinking time. Car B's brakes may be worn out OR Driver A may have drunk alcohol making his reaction time slower. Car B has better brakes (NB 2nd sentence is incorrect) • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed explanation linking data from the chart to the cause for one car AND at least one statement about the other OR two statements linking data from the chart to the cause for one car e.g. B has a braking distance of (about) 60 m. This means B might be on a wet road. A has a longer thinking distance. OR B has a shorter thinking distance than A. A has a longer thinking distance compared to the average (in highway code). He may be a drink driver. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q12.

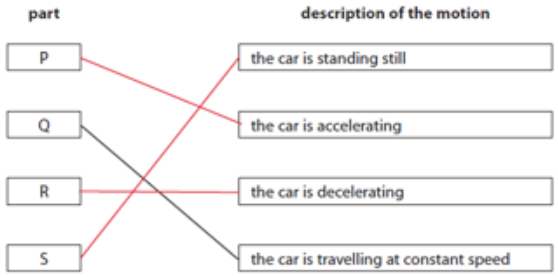
Question Number	Answer	Acceptable answers	Mark
(a)	stopwatch /stopclock (1) {trundle/measuring} wheel/measuring tape or tape measure (1) ignore speedometer/speed camera/radar	(electronic) timer timing app (on 'phone) clock and watch on their own are insufficient any suitable length measuring device e.g. accept metre {rule(r)/stick} but ruler on its own is insufficient **Answers may be in either order**	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b) (i)	white (car) (1)	Allow the use of other columns that identify correct car e.g. 5.6(s)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b) (ii)	substitution (1) 80 ÷ 4.3 evaluation (1) 19 (m/s) Throughout the paper do not penalise answers to many places of decimal e.g. here 18.604651 gets both marks	Allow full marks for correct answer with no working seen. accept 18.6 (m/s) ignore 18 and 18.0 as incorrect rounding accept any power of 10 error for 1 mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b) (iii)	40 (miles per hour) (1)	accept answers in range 39 – 43 (miles per hour) ecf from b(ii) multiply bii by 2.222 range +/- 2.0	**(1)**

Q13.

Question Number	Answer	Mark
(i)	all three correct (2) one or two correct (1)  	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	Q and S Q (1) (and) S (1) OR S (1) (and) Q (1)	in either order maximum of 1 mark if 3 letters given no marks if 4 or more letters given	(2)

Question Number	Answer	Additional guidance	Mark
(iii)	substitution (1) (distance =) 30 x 100 evaluation (1) 3000 (m)	for 1st mp accept 100 x 30 OR (30 x 50) x 2 award full marks for the correct answer without working allow **1 mark** for EITHER 30 x 50 OR 30 x 150 OR 30 x 250	(2)

Q14.

	Answer	Acceptable answers	Mark
(a)(i)	B to the left ←		**(1)**
(a)(ii)	A accelerating		**(1)**
(a)(iii)	substitution 625x 10 (1) Evaluation 6250 (N) (1)	625 x 9.8 6125 (N) give full marks for correct answer, no working	**(2)**
(b)(i)	 (1) air resistance (1)	upward arrow on any part of line vertical line from any point on the diagram air friction, upthrust, drag Ignore any downward arrow labelled weight or gravity	**(2)**
(b)(ii)	Balanced (1) Zero (1)		**(2)**

Total for marks for question = 8

Q15.

	Answer	Acceptable answers	Mark
(a)	D		**(1)**
(b)(i)	12 (m/s) (1)	Range from 11(m/s) to 14 (m/s)	**(1)**
(b)(ii)	Substitution (1) 20-0 5 evaluation (1) 4 (m/s^2)	20 5 Full marks for correct answer with no working Allow answers between 3.6 and 4.7 for 2 marks to reflect readings taken from the graph	**(2)**
b(iii)	• velocity/ speed (measured in) m/s (1) • divided by time in s (1)	velocity/ speed (measured in) ms^{-1} acceleration is rate of change of velocity m/s/s m per s per s	**(2)**

		[accept per for divide] do not accept m/s <u>times</u> time	
b(iv)	at constant vel • distance = 60 (m) (1) slowing down • distance = ½×2×20 (1) • = 20 (m) (1)	correct answer scores 2 marks	**(3)**

Total for question = 10 marks

Q16.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	8 – 0 (m/s)	8	**(1)**
(a)(ii)	substitution 8 / 5 (1) evaluation (1) 1.6 (m/s^2)	ecf from (i) full marks for correct answer (or ecf) with no working shown.	**(2)**
(a)(iii)	0	Nil / nothing / zero / none (no mark for no response)	**(1)**
(b)	substitution F = 1200 × 0.8 (1) evaluation (1) 960 (N)	full marks for correct answer with no working shown.	**(2)**

		Indicative Content	
QWC	***(c)**	an explanation linking some of the following points: compared to a car with just the driver, a fully loaded c • have a greater mass / be heavier • greater kinetic energy / momentum • experience the same braking force (when brak applied) • require a greater braking force (than available the same distance) • have a smaller acceleration / deceleration • take a longer time to come to rest (from given	

		• travel greater distance in this time • needs to do more work with same amount of f • use of relevant equations such as F = ma, wor d • consequence of driver distractions	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation using one idea from the indicative content eg fully loaded car is heavier. • in answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation which links ideas from the indicative content eg it is heavier and so it takes a longer distance to stop • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation which links several ideas from the indicative content e.g. It has more momentum and so it will take a longer time to stop. This means that it will travel a further distance. The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	