Mark scheme – Newton's Law (H)

Question			Answer/Indicative content	Marks	Guidance
1			B ✓	1 (AO1.1)	**Examiner's Comments** Only about a third of candidates gave the correct answer 'B'. A common incorrect response was 'A' although the other distractors were also seen on occasions.
			Total	**1**	
2			B ✓	1 (AO1.1)	**Examiner's Comments** This question about F = ma was answered well with about 80% of candidates getting it correct with the answer B. All other responses were seen with A being the most common incorrect answer given.
			Total	**1**	
3			D ✓	1 (AO2.1)	**Examiner's Comments** This was a straightforward question to begin section A. Almost all the candidates correctly substituted the numbers into the given equation. Some candidates wrote their working in the space around the question. The advantages of this method are that there is a smaller chance of making a mistake by using the wrong numbers and it is easier to check the answer later.
			Total	**1**	
4			B ✓	1 (AO1.1)	**Examiner's Comments** This question was generally well answered. Candidates should be encouraged to use the space around the question for their working.
			Total	**1**	
5			C ✓	1 (AO2.1)	**Examiner's Comments** This question was well answered. Candidates should be encouraged to consider each letter of the diagram, adding a small cross to the ones that are eliminated.
			Total	**1**	

6			D	1 (AO1.1)	
			Total	**1**	
7			B	1 (AO2.1)	
			Total	**1**	
8			C	1 (AO2.1)	
			Total	**1**	
9			D	1 (AO2.1)	
			Total	**1**	
10			Re-arrange and substitute into WD = F × D: 217 000 / 6 500 (1) 33.4 (m) (1)	2	
			Total	**2**	
11		i	Velocity is speed in a given / known direction / straight line (1) Direction continuously changing (1)	2	**ALLOW** higher level answers e.g. changing velocity denotes acceleration (1) Always accelerating to the centre (1)
		ii	Higher orbit (1) Less (force of) gravity / acceleration (1)	2	
			Total	**4**	
12			Lorry has more KE than a car at the same velocity (1) More absorption of energy by larger brake discs (1) Higher rate of dissipation of energy to surrounding air (1) Brakes less likely to overheat (1)	4	
			Total	**4**	
13			A	1	
			Total	**1**	
14			C	1	
			Total	**1**	
15			B	1	

			Total	**1**	
16	a	i	Change mass / Force applied (1) Release glider and idea of measuring acceleration with appropriate apparatus to do this stated (e.g. Light gates / datalogger) (1) Check results / plot graph to see if it matches F = ma formula (1)	3	e.g. Fprop a or m prop 1/a
		ii	4 m/s^2 (1)	1	
		iii	Any 2 from: The track is not perfectly frictionless / AW (1) Friction of the pulley (1) (Idea of) light gates incorrectly set up (1)	2	
	b		Attempt 1 at 4 newtons / 12.0 (1) Don't include it in the mean / repeat readings / repeat this reading during the experiment (1)	2	
	c		Another person / group gets similar results / AW (1)	1	
			Total	**9**	
17	a		The momentum at the start and at the end will be equal as long as no external forces act / **AW** (1)	1	
	b		(90 × 2) + (60 × velocity) = 0 (1) Velocity = (−)3 (m/s) (1)	2	
			Total	**3**	
18			Idea that the KE at bottom must be equal to or less than GPE at the top (1) W: KE = 4.5J and so is possible as it is likely that some energy will be lost / **AW** (1) X: KE = 8J and so is possible but it will not be 100% efficient/X is unlikely as it implies no energy is lost / **AW** (1) Y: KE = 12.5J and Z: KE = 18J and so not possible (1)	4	
			Total	**4**	

19	a		momentum ✓ **kinetic** energy or **KE** ✓	2 (AO 2 × 1.1)	**IGNORE** mass conserved If more than two answers mark the first two answers (unless one of them is mass). Eg 'KE, mass, momentum ✓✓ Eg. PE, KE, momentum ✓ **Examiner's Comments** Kinetic energy and momentum were the answers here. Full marks (in 10% of cases) were attained by more able candidates only. Just less than a half gained 1 mark only. 'Energy' or 'potential energy' (rather than kinetic energy) was often seen along with mass, velocity.
	b	i	**FIRST CHECK THE ANSWER ON ANSWER LINES** **If answers = 8.4 (kgm/s) and 6.75 / 6.8 (kgm/s) award 3 marks** 2 × 4.2 2.5 × 2.7 ✓ A: 8.4 (kgm/s) ✓ B: 6.75/6.8 (kgm/s) ✓	3 (AO 1.2) (AO 2.2) (AO 2.2)	8.4 and 6.7 scores ✓✓ (incorrect rounding of one of the values) **Examiner's Comments** The great majority calculated both values of momentum correctly and gained 3 marks.
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3.4 (m/s) award 3 marks** (8.4 + 6.75) × 4.5 ✓ 3.37 / 3.366666667 (m) ✓ 3.4 (rounding to 2 sf) ✓	3 (AO 2.2) (AO 2.2) (AO 1.2)	ECF for momentum values eg. (A + B) ÷ 4.5 Wrong answer but evidence of correct rounding ✓ Eg. 6.75 to 6.8 ✓ **Examiner's Comments** Just under a half of candidates calculated this correctly to two significant figures. About a third did gain any credit at all and gave attempts of calculations that were incorrect or difficult to follow.
			Total	**8**	

20			**only** 2 arrows drawn or directions of the two forces described – one upwards and one downwards ✓	4 (AO 2.1)	Award marks for answer points given in diagrams or prose. **ALLOW** force of gravity or mg or gravitational pull for weight **BUT DO NOT ALLOW** merely 'gravity' **IGNORE** upthrust for this marking point only
			Correctly names weight **and** air resistance / drag ✓	(AO 1.1)	Drag / air resistance (3 marks) Weight or force of gravity
			downward arrow longer than upward arrow / forces are unbalanced / resultant / net / overall force downwards ✓	(AO 2.1)	
			so object accelerates / gets faster / increases velocity or speed ✓	(AO 1.1)	**Examiner's Comments** There were some good answers here. A common error was to state 'gravity' rather than weight or force of gravity. The relative sizes of the arrows were often correct. Upthrust was often unsuccessfully substituted for air resistance. The question discriminated well with about a third gaining full marks.
		Total		**4**	
21			A downwards arrow labelled weight/load ✓ An upwards arrow labelled tension ✓ <u>Two</u> equal length arrows (by eye), one vertically up and one vertically down ✓	3 (AO3x 2.2)	**DO NOT ALLOW** labels pointing to apparatus **ALLOW** gravity/gravitational force **DO NOT ALLOW** mass **ALLOW** force from spring **NOTE** this mark may not be scored if more than two arrows are drawn **Examiner's Comments** A small majority of candidates gained at least two marks for this question. Most of these candidates drew two arrows of equal length and labelled correctly the weight or gravitational force. Few candidates labelled the upwards arrow "tension" or "force from spring". A common misconception was the use of the term "upthrust". When representing vectors by straight lines,

				candidates should be encouraged to use a ruler with a millimetre scale.

Ideally candidates should refer to the gravitational force as "weight" or "force due to gravity" rather than "gravity".

A few candidates did not understand a "free body force diagram" and drew the apparatus and labelled the apparatus. Other errors were the drawing of many arrows on the diagram in varying directions.

Exemplar 3

This candidate has drawn a "free body force diagram" with two arrows of the same length – the candidate confirms that the arrows are the same length. Force of load was allowed for one of the label marks. |
		Total	**3**	
22	i	Gravitational (potential energy store) to kinetic (energy store) ✓	1 (AO2.1)	**ALLOW** kinetic (energy store) to thermal (energy store) / gravitational (potential energy) to thermal (energy) **ALLOW** KE for kinetic energy / GPE for gravitational (potential) energy / heat for thermal **IGNORE** just potential energy / PE
	ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.6 (J) award 4 marks** 86cm = 0.86 m ✓ (Work done =) 3(.0) x 0.86 ✓ (Work done =) 2.58 (J) ✓ (Work done =) 2.6 (J) ✓	4 (AO1.2) (AO2.1) (AO2.1) (AO1.2)	**ALLOW** ecf for missing or incorrect unit conversion e.g. 260 (J) for 3 marks, 258 (J) for 2 marks
		Total	**5**	