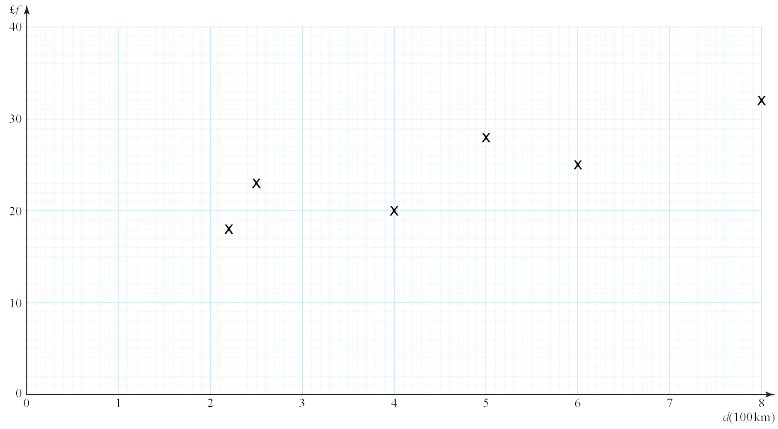
AS Practice Paper H (Statistics & Mechanics) mark scheme

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1a	Quota.	**B1**	1.2	3rd Understand quota and opportunity sampling.
		(1)		
1b	Advantages – two from: • easy to get sample size • inexpensive • fast • can be stratified if required.	**B1** **B1**	2.4 2.4	5th Select and critique a sampling technique in a given context.
	Disadvantages – one from: • not random • could be biased.	**B1**	2.4	
		(3)		
1c	Allocate each of the males a number from 1 to 300	**B1**	3.1b	3rd Understand and carry out simple random sampling.
	Use calculator or number generator to generate 50 different random numbers from 1 to 300 inclusive.	**B1**	1.1b	
	Select males corresponding to those numbers.	**B1**	1.1b	
		(3)		
1d	$300 \div 50 = 6$	**B1**	3.1b	3rd Understand and carry out simple random sampling.
	Use a random number generator to select the first name (or one of the first 6 names on the list) as a starting point and then select every 6th name thereafter to get 50 names.	**B1**	1.1b	
		(2)		
				(9 marks)
Notes				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a	All points correctly plotted.  	**B2**	1.1b	2nd Draw and interpret scatter diagrams for bivariate data.
		(2)		
2b	The **points** lie reasonably close to a **straight line** (o.e.).	**B1**	2.4	2nd Draw and interpret scatter diagrams for bivariate data.
		(1)		
2c	f	**B1**	1.2	2nd Know and understand the language of correlation and regression.
		(1)		
2d	Line of best fit plotted for at least $2.2 \leqslant x \leqslant 8$ with D and F above and B and C below.	**M1**	1.1a	4th Make predictions using the regression line within the range of the data.
	26 to 31 inclusive (must be correctly read from $x = 7$ from the line of best fit).	**A1**	1.1b	
		(2)		

2e	It is reliable because it is interpolation (700 km is within the range of values collected).	**B1**	2.4	4th Understand the concepts of interpolation and extrapolation.
		(1)		
2f	No, it is not sensible since this would be extrapolation (as 180 km is outside the range of distances collected).	**B1**	2.4	4th Understand the concepts of interpolation and extrapolation.
		(1)		
				(8 marks)

Notes

2a

First B1 for at least 4 points correct, second B1 for all points correct.

2b

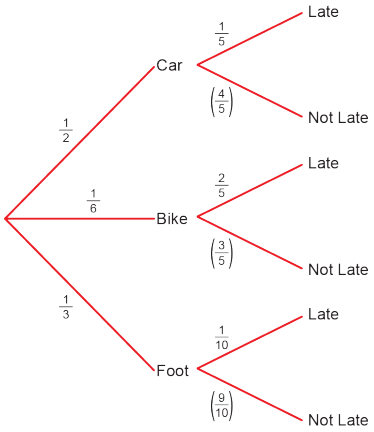
Do not accept 'The points lie reasonably close to a line'. Linear or straight need to be noted.

2e

Also allow 'It is reliable because the points lie reasonably close to a straight line'.

2f

Allow the answer 'It is sensible since even though it is extrapolation it is not by much' provided that the answer contains both ideas (i.e. it IS extrapolation but by a small amount compared to the given range of data).

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	 Correct tree structure. All labels correct. All probabilities correct.	 **B1** **B1** **B1**	 3.1a 1.1b 1.1b	3rd Draw and use tree diagrams with three branches and/or three levels.
		(3)		
3bi	$\frac{1}{3}\times\frac{1}{10}=\frac{1}{30}$ or equivalent.	**M1** **A1**	3.4 1.1b	3rd Draw and use tree diagrams with three branches and/or three levels.
		(2)		
3bii	Car NL + Bike NL + Foot NL $=\left(\frac{1}{2}\times\frac{4}{5}\right)+\left(\frac{1}{6}\times\frac{3}{5}\right)+\left(\frac{1}{3}\times\frac{9}{10}\right)$	**M1**	3.4	3rd Draw and use tree diagrams with three branches and/or three levels.
	$=\frac{4}{5}$ or equivalent.	**A1**	1.1b	
		(2)		
				(7 marks)

Notes

3bii

ft from their tree diagram. Allow one error for M1.

Can also be found from $1-\left(\left(\frac{1}{2}\times\frac{1}{5}\right)+\left(\frac{1}{6}\times\frac{2}{5}\right)+\left(\frac{1}{3}\times\frac{1}{10}\right)\right)$

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4a	Two from: • Each bolt is either faulty or not faulty. • The probability of a bolt being faulty (or not) may be assumed constant. • Whether one bolt is faulty (or not) may be assumed to be independent (or does not affect the probability of) whether another bolt is faulty (or not). • There is a fixed number (50) of bolts. • A random sample.	**B2**	1.2 1.2	5th Understand the binomial distribution (and its notation) and its use as a model.
		(2)		
4b	Let X represent the number of faulty bolts. X~B(50, 0.25) P($X \leqslant 6$) = 0.0194 P($X \leqslant 7$) = 0.0453 P($X \geqslant 19$) = 0.0287 P($X \geqslant 20$) = 0.0139	**M1** **M1dep**	3.4 1.1b	5th Find critical values and critical regions for a binomial distribution.
	Critical Region is $X \leqslant 6 \cup X \geqslant 20$	**A2**	1.1b 1.1b	
		(4)		
				(6 marks)

Notes

4a

Each comment must be in context for its mark.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	Makes an attempt to find the absolute value. For example, $\sqrt{(14)^2+(22)^2}$ is seen.	**M1**	3.1b	4th Find the magnitude and direction of a vector quantity.
	Simplifies to $\sqrt{680}$	**M1**	1.1b	
	Finds speed = 26.07… (ms^{-1}) Accept awrt 26.1 (ms^{-1})	**A1**	1.1b	
		(3)		
5b	States that $\tan\theta = \frac{22}{14}$	**M1**	1.1b	4th Find the magnitude and direction of a vector quantity.
	Finds the value of θ, $\theta = 57.52…$	**A1**	1.1b	
	Demonstrates that the angle with the unit **j** vector is 90 – 57.52…	**M1**	1.1b	
	Finds 32.47… (°) Accept awrt 32.5(°)	**A1**	1.1b	
		(4)		
5c	Ignore the value of friction between the hockey puck and the ice.	**B1**	3.4	3rd Understand assumptions common in mathematical modelling.
		(1)		
5d	$\frac{1.4\,\text{g}}{1\,\text{cm}^3}\times\frac{1\,\text{kg}}{1000\,\text{g}}\times\frac{100\,\text{cm}}{1\,\text{m}}\times\frac{100\,\text{cm}}{1\,\text{m}}\times\frac{100\,\text{cm}}{1\,\text{m}}$ Award 1 method mark for division by 1000 and 1 method mark for multiplication by 100 only once and the final method mark for multiplication by 100 three times.	**M3**	1.1b	4th Know derived quantities and SI units.
	1400 kg m^{-3}	**A1**	1.1b	
		(4)		
				(12 marks)

Notes

5b

Award all 4 marks for a correct final answer. Award 2 marks for a student stating $\tan\theta = \frac{14}{22}$, and then either making a mistake with the inverse or subtracting that answer from 90.

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6	Makes an attempt to integrate $a = \frac{1}{500}\left(20t^2 - t^3\right)$ Raising power by one would constitute an attempt.	**M1**	3.1b	6th Uses differentiation to solve problems in kinematics.
	Correctly finds $v = \frac{1}{500}\left(\frac{20}{3}t^3 - \frac{1}{4}t^4\right)$. Note that $C = 0$.	**A1**	1.1b	
	Makes an attempt to integrate $v = \frac{1}{500}\left(\frac{20}{3}t^3 - \frac{1}{4}t^4\right)$. Raising power by one would constitute an attempt.	**M1**	3.1b	
	Correctly finds $s = \frac{1}{500}\left(\frac{20}{12}t^4 - \frac{1}{20}t^5\right)$. Note that $C = 0$.	**A1**	1.1b	
	Substitutes $t = 10$ into $s = \frac{1}{500}\left(\frac{20}{12}t^4 - \frac{1}{20}t^5\right)$ to obtain $s = \frac{70}{3}$ (m). Accept awrt 23.3 (m).	**A1 ft**	1.1b	
		(5)		
				(5 marks)

Notes

6

Award the final accuracy mark for a correct substitution using their equation for displacement.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7a	Makes an attempt to substitute $t = 25$ into $s = 30t - 0.4t^2$. For example $s = 30(25) - 0.4(25)^2$ is seen.	**M1**	1.1b	5th Use equations of motion to solve problems in unfamiliar contexts.
	Correctly states that $AB = 500$ (m). Accept $s = 500$ (m).	**A1**	1.1b	
		(2)		
7b	Differentiates $s = 30t - 0.4t^2$ to obtain $v = 30 - 0.8t$	**M1**	3.1b	6th Solve problems using calculus and the equations of motion.
	Differentiates $v = 30 - 0.8t$ to obtain $a = -0.8$	**M1**	3.1b	
	States that $a = -0.8$ (m s^{-2}) is a constant as it does not depend on t.	**A1**	3.5a	
		(3)		
7c	States distance of the car from point A is $s_1 = 30t - 0.4t^2$	**M1**	3.3	6th Solve problems using calculus and the equations of motion.
	$u = 2$ and $a = 0.1$ and an attempt to use $s = ut + \frac{1}{2}at^2$ is seen.	**M1**	3.3	
	States distance of the runner from point B is $s_2 = 2t + 0.05t^2$	**M1**	1.1b	
	States that the runner and the car will pass each other when their distances total 500 (m), or writes $s_1 + s_2 = 500$ (m)or writes $30t - 0.4t^2 + 2t + 0.05t^2 = 500$	**M1**	3.3	
	States that $0.35t^2 - 32t + 500 = 0$ or equivalent.	**A1**	1.1b	
	Solves to find $t = 20$ (s). Answer does not need to state that $t = \frac{500}{7}$ or 71.4… (s) is not in the given range.	**A1**	1.1b	
	Makes an attempt to substitute $t = 20$ into $s_1 = 30t - 0.4t^2$ or $s_2 = 2t + 0.05t^2$.	**M1**	1.1b	
	Correctly states they will pass each other 440 (m) from A or 60 (m) from B.	**A1 ft**	3.5a	
		(8)		
				(13 marks)
Notes				