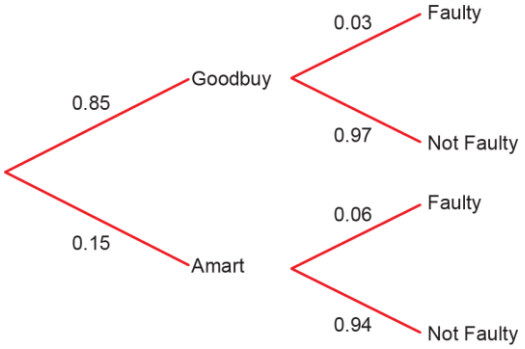
AS Practice Paper F (Statistics & Mechanics) mark scheme

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1a	A complete collection of relevant individual people or items.	**B1**	1.2	2nd Understand the vocabulary of sampling.
		(1)		
1b	Opportunity (convenience).	**B1**	1.2	3rd Understand quota and opportunity sampling.
		(1)		
1c	Systematic.	**B1**	1.2	3rd Understand and carry out systematic sampling.
		(1)		
1d	Two from: • not random • electoral register may have errors • there may not be enough (500) households on the register.	**B1** **B1**	2.4 2.4	5th Select and critique a sampling technique in a given context.
		(2)		
1e	**Either**: random sampling – it avoids bias. **Or**: quota sampling – no sampling frame required, continue until all quotas filled.	**B1**	2.4	5th Select and critique a sampling technique in a given context.
	Either: Random sampling from people buying kitchen cleaners in a large store, as this would reduce potential bias. **Or:** Quota sampling from people based on a chosen set of ages and genders who use kitchen cleaners, continuing until all quotas are filled, as this would avoid the need for a sampling frame and allow for a more clearly representative sample.	**B1**	2.4	
		(2)		
				(7 marks)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a				2nd Draw and use simple tree diagrams with two branches and two levels.
	Tree (both sections) and labels 0.85, 0.15 0.03, 0.97, 0.06, 0.94	**B1** **B1** **B1**	3.1a 1.1b 1.1b	
		(3)		
2b	P(Not faulty) = (0.85 × 0.97) + (0.15 × 0.94) = 0.9655	**M1** **M1dep** **A1**	3.4 1.1b 1.1b	2nd Draw and use simple tree diagrams with two branches and two levels.
		(3)		
				(6 marks)

Notes

2b

M1 for either 0.85 × 0.97 or 0.15 × 0.94 (ft from their tree diagram) and M1 (dep) for adding two such probabilities (allow one error).

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3	Three comparisons in context: For example: **Very** much warmer in Beijing than Perth. Both consistent in the temperatures. Less rainfall in Beijing. Less likely to have high rainfall in Beijing.	**B3**	2.4	4th Compare data sets using a range of familiar calculations and diagrams.
	Rainfall in Beijing is consistently less than in Perth.	**B1**	2.4	
	Evidence of use of a statistic from the boxplots: For example: Medians Measure of a difference in medians Mention of a particular outlier			
	For accurately reading data from boxplots.	**B1**	2.4	
		(5)		
				(5 marks)
Notes				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4a	$X \sim B(15, 0.5)$ B1 for binomial B1 for 15 and 0.5	**B1** **B1**	3.1b 3.1b	5th Understand the binomial distribution (and its notation) and its use as a model.
		(2)		
4bi	from calculator $P(X = 8) = 0.19638\ldots$	**M1** **A1**	3.4 1.1b	5th Calculate binomial probabilities.
		(2)		
4bii	$P(X \geqslant 4) = 1 - P(X \leqslant 3)$ $= 1 - 0.0176$	**M1**	3.4	6th Use statistical tables and calculators to find cumulative binomial probabilities.
	= awrt 0.982 or $\frac{503}{512}$	**A1**	1.1b	
		(2)		
				(6 marks)

Notes

4bi

$P(X = 8) = P(X \geqslant 8) - P(X \leqslant 7) = 0.6964 - 0.5$

or $\frac{15!}{8!7!}0.5^8(1 - 0.5)^7$

or ${}^{15}C_8 \times 0.5^8 \times 0.5^7$

or 6435×0.5^{15}

= awrt 0.196 or $\frac{6435}{32768}$

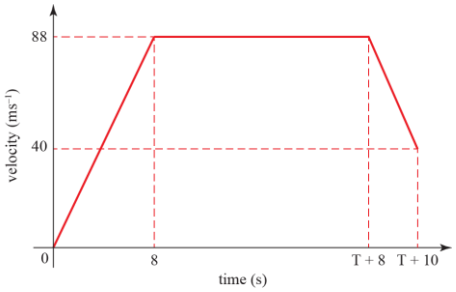
Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	P($X \leqslant 1$) = 0.0076 and P ($X \leqslant 2$) = 0.0355	**M1**	1.1b	5th Find critical values and critical regions for a binomial distribution.
	P($X \geqslant 10$) = 1 – 0.9520 = 0.0480 and P($X \geqslant 11$) = 1 – 0.9829 = 0.0171	**A1**	1.1b	
	Critical region is $X \leqslant 1 \cup 11 \leqslant X$ ($\leqslant 20$)	**A1**	1.1b	
		(3)		
5b	Significance level = 0.0076 + 0.0171 = 0.0247 or 2.47%	**B1**	1.1b	6th Calculate actual significance levels for a binomial distribution test.
		(1)		
5c	Not in critical region therefore insufficient evidence to reject H_0.	**B1**	2.2b	6th Interpret the results of a binomial distribution test in context.
	There is insufficient evidence at the 5% level to suggest that the value of p is not 0.3.	**B1**	3.2a	
		(2)		
				(**6 marks**)

Notes

5c

Conclusion must contain context and non-assertive for first B1.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6a	Makes an attempt to find the distance from *A* to *B*. For example, $\sqrt{(-28)^2+(80)^2}$ is seen.	**M1**	3.1b	4th Find the magnitude and direction of a vector quantity.
	Makes an attempt to find the distance from *B* to *C*. For example, $\sqrt{(130)^2+(15)^2}$ is seen.	**M1**	3.1b	
	Demonstrates an understanding that these two values need to be added. For example, 84.75… + 130.86… is seen.	**M1**	1.1b	
	215.62… (m) Accept anything which rounds to 216 (m)	**A1**	1.1b	
		(4)		
6b	States that $\overrightarrow{AC}=102\mathbf{i}+95\mathbf{j}$ (m) Award one point for each value.	**B2**	3.1b	4th Find the magnitude and direction of a vector quantity.
	States or implies that $\tan\theta=\frac{95}{102}$	**M1**	1.1b	
	Finds $\theta=42.96...°$ Accept awrt 43.0°	**A1**	1.1b	
		(4)		
				(8 marks)
Notes				

Q	Scheme		Marks	AOs	Pearson Progression Step and Progress descriptor
7a	Velocity = acceleration × time seen or implied.		**M1**	3.1b	4th Use and interpret graphs of velocity against time.
	Velocity = $11 \times 8 = 88\ \text{m s}^{-1}$		**A1**	1.1b	
	Figure 2  	General shape of the graph is correct. i.e. positive gradient, followed by horizontal line, followed by negative gradient not returning to zero.	**M1**	3.3	
		Vertical axis labelled correctly.	**A1**	1.1b	
		Horizontal axis labelled correctly.	**A1**	1.1b	
			(5)		
7b	Makes an attempt to find the area of the trapezoidal section. For example, $2\times\frac{1}{2}(88+40)$ is seen.		**M1**	1.1b	4th Calculate and interpret areas under velocity–time graphs.
	Demonstrates an understanding that the three areas must total 1404. For example, $\frac{1}{2}(8\times 88)+88T+2\times\frac{1}{2}(88+40)=1404$ or $352+88T+128=1404$ is seen.		**M1**	2.1	
	Correctly solves to find $T = 10.5$ (s).		**A1**	1.1b	
			(3)		
					(8 marks)

Notes

7a

Accept the horizontal axis labelled with the correct intervals.

7b

Award full marks for correct final answer, even if some work is missing.

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
8a	Either states that $\tan 30 = \frac{10}{a}$ or $\tan 60 = \frac{a}{10}$	**M1**	1.1b	5th Use Newton's second law to model motion in two directions.
	Correctly find $a = 10\sqrt{3}$	**M1**	1.1b	
	Interprets a in the context of the question, stating $a = -10\sqrt{3}$	**A1**	3.2	
		(3)		
8b	States that the magnitude of $\mathbf{R} = \sqrt{\left(-10\sqrt{3}\right)^2 + (10)^2}$	**M1**	1.1b	5th Use Newton's second law to model motion in two directions.
	States $R = 20$ (N).	**A1 ft**	1.1b	
		(2)		
8c	States $F = ma$ or implies use of $F = ma$. For example $20 = 6 \times a$ is seen.	**M1**	3.3	5th Use Newton's second law to model motion in two directions.
	Correctly finds $a = \frac{10}{3}$ m s^{-2}.	**A1 ft**	1.1b	
		(2)		
8d	States that $s = ut + \frac{1}{2}at^2$ or implies it use by writing $640 = (0)t + \frac{1}{2} \times \frac{10}{3} \times t^2$	**M1**	3.1b	5th Use Newton's second law to model motion in two directions.
	Solves to find $t = 8\sqrt{6}$ (s). Accept awrt 19.6 (s).	**A1 ft**	1.1b	
		(2)		
				(9 marks)

Notes

8b

Award ft marks for a correct answer using their value from part **a** for the **i** component of the force.

8c

Award ft marks for a correct answer using their value from part **b** for the resultant force.

8d

Award ft marks for a correct answer using their value from part **c** for the acceleration.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
9	$t = 5$, $v = 0$	**B1**	1.1b	6th Uses differentiation to solve problems in kinematics.
	Expands brackets and attempts differentiation. Reducing any power by one is sufficient evidence of differentiation.	**M1**	3.1b	
	Solves $25 - 20t + 3t^2 = 0$ to find $t = \frac{5}{3}$. The expression can be factorised, or the quadratic formula can be used. $t = 5$ does not have to be seen to award the mark.	**A1**	1.1b	
	Makes an attempt to substitute $t = \frac{5}{3}$ into $v = \frac{1}{20}t(5-t)^2$. For example, $v = \left(\frac{1}{20}\right)\left(\frac{5}{3}\right)\left(\frac{10}{3}\right)^2$ is seen.	**M1**	2.2a	
	Correctly finds $v = \frac{25}{27}$ or $0.92\ldots$ (m s^{-1}). Accept awrt 0.9 (m s^{-1}).	**A1 ft**	1.1b	
		(5)		
				(7 marks)

Notes

9

Award the final method mark and the final accuracy mark for a correct substitution using their value for t.