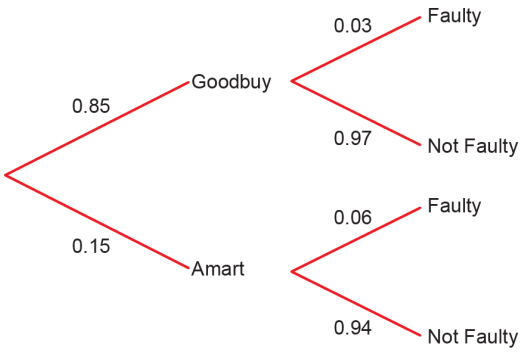
AS Practice Paper F (Statistics & Mechanics) mark scheme

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	 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	2nd Draw and use simple tree diagrams with two branches and two levels.
		(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 $\frac{6435}{32768}$

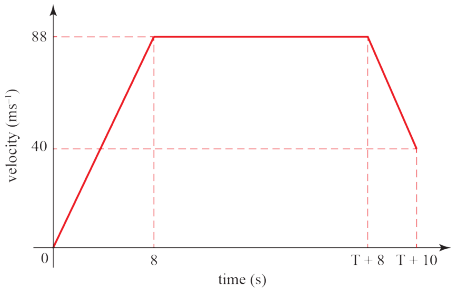
Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	$P(X \leqslant 1) = 0.0076$ and $P(X \leqslant 2) = 0.0355$	**M1**	1.1b	5th Find critical values and critical regions for a binomial distribution.
	$P(X \geqslant 10) = 1 - 0.9520 = 0.0480$ and $P(X \geqslant 11) = 1 - 0.9829 = 0.0171$	**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.

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… (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.