

AS Practice Paper G (Statistics & Mechanics) mark scheme

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1a	One of: - to obtain a representative sample - large number of students compared to staff so would be unfair to take same numbers of both.	B1	2.4	5th Select and critique a sampling technique in a given context.
		(1)		
1b	A list of the names of staff and students.	B1	1.2	2nd Understand the vocabulary of sampling.
		(1)		
1c	A member of staff or a student.	B1	1.2	2nd Understand the vocabulary of sampling.
		(1)		
1d	Find proportions for different strata out of 60 (either explained or some sensible calculation seen).	M1	3.1b	3rd Understand and carry out stratified sampling.
	$\frac{250}{280} \cdot 60 \gg 54$ students, $\frac{30}{280} \cdot 60 \gg 6$ staff.	A1	1.1b	
	Select at random using a random number generator.	B1	1.1b	
		(3)		
1e	One of: - absence on the day of the survey - sampling frame may contain errors.	B1	2.2b	5th Select and critique a sampling technique in a given context.
		(1)		
(7 marks)				

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Notes

1d

Must be whole numbers for A1.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a	Order the data. 125, 160, 169, 171, 175, 186, 210, 243, 250, 258, 390, 420	M1	1.1b	2nd Understand quartiles and percentiles.
	$Q_3 = \frac{1}{2}(250 + 258) = 254$	A1	1.1b	
		(2)		
2b	$Q_3 + 1.5(Q_3 - Q_1) = 254 + 1.5(254 - 170)$	M1	1.1b	4th Calculate outliers in data sets and clean data.
	= 380	A1	1.1b	
	Patients <i>F</i> (420) and <i>B</i> (390) are outliers (so may be suspected by the doctor as smoking more than one packet of cigarettes per day).	B1	3.2a	
		(3)		
(5 marks)				
Notes				

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	$\frac{2+3}{\text{total number of students}} = \frac{5}{30} = \frac{1}{6} \text{ or awrt } 0.167$	M1 A1	1.1b 1.1b	1st Calculate probabilities for single events.
		(2)		
3b	$\frac{4+2+5+3}{\text{total}}$	M1	1.1b	3rd Understand and use Venn diagrams for multiple events.
	$= \frac{14}{30} \text{ or } \frac{7}{15} \text{ or awrt } 0.467$	A1	1.1b	
		(2)		
3c	0	B1	1.1b	3rd Understand and use the definition of mutually exclusive in probability calculations.
	No student reads both magazine A and magazine C.	B1	1.1b	
		(2)		
3d	$P(C \text{reads at least one magazine}) = \frac{6+3}{20} = \frac{9}{20}$	B1	1.1b	3rd Understand and use Venn diagrams for multiple events.
		(1)		
3e	$P(B) = \frac{10}{30} = \frac{1}{3}, P(C) = \frac{9}{30} = \frac{3}{10}$	B1	2.1	4th Understand and use the definition of independence in probability calculations.
	$P(B \text{ and } C) = \frac{3}{30} = \frac{1}{10}, \text{ and}$	M1	2.2a	
	$P(B) \cdot P(C) = \frac{1}{3} \cdot \frac{3}{10} = \frac{1}{10} = P(B \text{ and } C)$ So yes, they are independent.	A1	2.4	
		(3)		
(10 marks)				

Notes

3e

Allow alternative using formal conditional probability: $P(B) = \frac{1}{3}$ (B1). Finding $P(B|C) = \frac{3}{(3+6)} = \frac{1}{3}$ and comparing with $P(B)$ (M1). Correct conclusion (A1).

Or $P(C) = \frac{3}{10}$ (B1). Finding $P(C|B) = \frac{3}{(2+3+5)} = \frac{3}{10}$ and comparing with $P(C)$ (M1). Correct conclusion (A1).

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor																
4a	$2k + k + 0 + k = 1$	M1	2.1	4th																
	$\Rightarrow 4k = 1$, so $k = 0.25$ (answer given).	A1*	1.1b	Calculate probabilities from discrete distributions.																
		(2)																		
4b	$P(X_1 + X_2 = 5) = P(X_1 = 3 \text{ and } X_2 = 2) + P(X_1 = 2 \text{ and } X_2 = 3)$ $= 0 + 0 = 0$ (answer given).	B1*	2.4	4th Calculate probabilities from discrete distributions.																
		(1)																		
4c	<table><tr><td>$x_1 + x_2$</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>$P(X_1 + X_2)$</td><td>0.25</td><td>0.25</td><td>0.0625</td><td>0.25</td><td>0.125</td><td>0</td><td>0.0625</td></tr></table>	$x_1 + x_2$	0	1	2	3	4	5	6	$P(X_1 + X_2)$	0.25	0.25	0.0625	0.25	0.125	0	0.0625	M1 A1 A1	2.5 1.1b 1.1b	4th Calculate probabilities from discrete distributions.
	$x_1 + x_2$	0	1	2	3	4	5	6												
	$P(X_1 + X_2)$	0.25	0.25	0.0625	0.25	0.125	0	0.0625												
		(3)																		
4d	$P(1.3 \leq X_1 + X_2 \leq 3.2) = P(X_1 + X_2 = 2) + P(X_1 + X_2 = 3)$	M1	3.4	4th																
	$= 0.0625 + 0.25 = 0.3125$ or $\frac{5}{16}$	A1ft	1.1b	Calculate probabilities from discrete distributions.																
		(2)																		
(8 marks)																				
Notes																				
4b Must show that 5 can only be obtained from 2 and 3 or 3 and 2, and so must use $P(X = 2) = 0$ but condone explanation in words.																				
4c M1 for correct set of values for $X_1 + X_2$. Condone omission of 5 column.																				
A1 for correct probabilities for 0, 2 and 6. A1 for others. Equivalent fractions are $\frac{1}{4}, \frac{1}{4}, \frac{1}{16}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}$																				

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	States correct answer: $5.3 \text{ (m s}^{-1}\text{)}$	B1	2.2a	4th Understand the difference between a scalar and a vector.
		(1)		
5b	States correct answer: $-4.8 \text{ (m s}^{-1}\text{)}$	B1	2.2a	4th Understand the difference between a scalar and a vector.
		(1)		
5c	States correct answer: -30 (m)	B1	2.2a	4th Understand the difference between a scalar and a vector.
		(1)		
(3 marks)				
Notes				

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6a	Figure 1	M1	3.3	4th Use and interpret graphs of velocity against time.
	Vertical axis labelled correctly.	A1	1.1b	
	Horizontal axis labelled correctly.	A1	1.1b	
		(3)		
6b	Makes an attempt to find the area of trapezoidal section where the car is decelerating. For example, $\frac{T}{4}(15 + 10)$ is seen.	M1	1.1b	4th Calculate and interpret areas under velocity–time graphs.
	Makes an attempt to find the area of the trapezoidal section where the car is accelerating. For example, $\frac{3T}{4}(10 + 20)$ is seen.	M1	1.1b	
	States that $15T + \frac{25T}{4} + \frac{90T}{4} = 1312.5$	M1	1.1b	
	Solves to find the value of T : $T = 30$ (s).	A1	1.1b	
		(4)		
(7 marks)				
Notes 6a Accept the horizontal axis labelled with the correct intervals. 6b 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
7a	States, or implies in a subsequent step, that the resistances to motion will total $1600k$ (N). (Any variable is acceptable.)	M1	3.1b	4th Solve problems of connected particles in one dimension.
	Uses $F = ma$ to write $3200 - 1600k = 1600(0.4)$	M1	3.3	
	Solves the equation to find $k = 1.6$	A1	1.1b	
	Finds the resistance forces acting on the trailer: $R_{\text{trailer}} = 400 \times 1.6 = 640$ (N).	A1	1.1b	
		(4)		
7b	Demonstrates an understanding that the resultant force for the trailer is $T - 640$, or for the car is $3200 - 1920 - T$	M1	3.1b	4th Solve problems of connected particles in one dimension.
	Either states $T - 640 = 400(0.4)$ using the trailer or states $3200 - 1920 - T = 1200(0.4)$ using the car.	M1	3.3	
	Correctly finds $T = 800$ (N).	A1 ft	1.1b	
		(3)		
7c	Uses $F = ma$ to write $-640 = 400a$	M1	3.3	4th Solve problems of connected particles in one dimension.
	Correctly solves to find $a = -1.6 \text{ m s}^{-2}$	A1 ft	1.1b	
	Uses $v^2 = u^2 + 2as$ to write $0 = 25^2 + 2(-1.6)s$	M1	3.1b	
	Correctly solves to find $s = 195.31 \dots$ (m). Accept awrt 195 (m).	A1 ft	1.1b	
		(4)		
7d	States ‘the acceleration of the car will be equal to the acceleration of the trailer’ or states ‘the car and the trailer will move as one’.	B1	3.5	4th Solve problems of connected particles in one dimension.
		(1)		
(12 marks)				
Notes				
7b				
Award ft marks for a correct answer using their value from part a for the resistance acting on the trailer.				
7c				
Award ft marks for a correct answer using their value from part a for the resistance acting on the trailer and from part b for tension.				

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
8	Integrates $a = 12t - 4$ to obtain $v = 6t^2 - 4t + A$. Any constant is acceptable.	M1	3.1b	6th Uses integration to solve problems in kinematics.
	Integrates $v = 6t^2 - 4t + A$ to obtain $s = 2t^3 - 2t^2 + At + B$. Any constant are acceptable.	M1	3.1b	
	Makes an attempt to form a pair of simultaneous equations by separately substituting (1, 2) and (3, 30) into the equation. For example: $2 = 2 - 2 + A + B$ and $30 = 54 - 18 + 3A + B$ are seen.	M1	3.1b	
	Simplifies to obtain a correctly pair of simultaneous equations: $A + B = 2$ and $3A + B = -6$ are seen.	M1	1.1b	
	Solves to find $A = -4$	A1	1.1b	
	Solves to find $B = 6$	A1	1.1b	
	Attempts to make a substitution of $t = 2$ into $s = 2t^3 - 2t^2 - 4t + 6$ For example, $s = 2(2)^3 - 2(2)^2 - 4(2) + 6$ is seen.	M1	1.1b	
	Correctly finds $s = 6$ (m).	A1 ft	1.1b	
		(8)		
(8 marks)				
Notes 8 Award the final method mark and the final accuracy mark for a correct substitution using their values for A and B.				