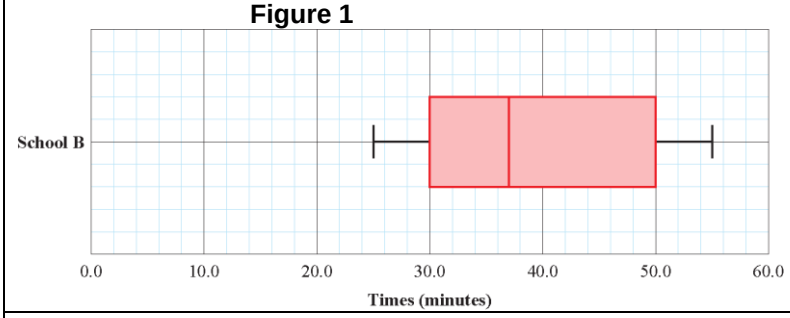
AS Practice Paper I (Statistics & Mechanics) mark scheme

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1a	All readers of the online newspaper.	**B1**	1.2	2nd Understand the vocabulary of sampling.
		(1)		
1b	A list of readers who subscribe to the extra content.	**B1**	1.2	2nd Understand the vocabulary of sampling.
		(1)		
1c	The subscribers.	**B1**	1.2	2nd Understand the vocabulary of sampling.
		(1)		
1d	Advantage: accuracy of the data, unbiased.	**B1**	1.2	3rd Comment on the advantages and disadvantages of samples and censuses.
	Disadvantage: difficult to get a 100% response to a survey.	**B1**	1.2	
		(2)		
1e	Natural variation in a small sample.	**B1**	1.2	3rd Comment on the advantages and disadvantages of samples and censuses.
	Bias.	**B1**	1.2	
		(2)		
				(7 marks)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2ai	37 (minutes).	**B1**	1.1b	2nd Draw and interpret box plots.
		(1)		
2aii	Upper quartile or Q_3 or third quartile or 75^{th} percentile or P_{75}	**B1**	1.2	2nd Understand quartiles and percentiles.
		(1)		
2b	Outliers. Sensible interpretation: For example: Observation that are very different from the other observations (and need to be treated with caution). Possible errors. These two children probably walked/took a lot longer.	**B1** **B1**	1.2 2.4	3rd Recognise possible outliers in data sets.
		(2)		
2**c**	$50 + 1.5 \times 20 = 80$ or $30 - 1.5 \times 20 = 0$ Maximum value $= 55 < 80$ minimum value $= 25 > 0$ No outliers.	**M1** **A1** **B1**	1.1b 1.1b 1.1b	4th Calculate outliers in data sets and clean data.
		(3)		
2d	The scale **must** be the same as for school *A*. **Figure 1**  	**B1**	1.1b	2nd Draw and interpret box plots.
	Box & whiskers 30, 37, 50	**B1**	1.1b	
	25, 55	**B1**	1.1b	
		(3)		

2e	Three comparisons in context. Comment on comparing averages. For example, children from school *A* took less time **on average**. Comment comparing consistency of times. For example, there is less variation in the times for school *A* than school *B.* Comment on comparing symmetry: For example,both positive skew (or neither symmetrical or median closer to LQ (o.e.) for both). (Most children took a short time with a few taking longer.) Comment on comparing outliers. For example, school *A* has two children whose times are outliers (or errors) where as school *B* has no outliers.	**B3**	2.2b	4th Compare data sets using a range of familiar calculations and diagrams.
		(3)		
				(13 marks)

Notes

2c

Allow horizontal line through box.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	Find total frequency = å width ´ frequency density = (5 × 2) + (4 × 4) + (4 × 6) + (7 × 5) + (15 × 1) = 100 P(Takes longer than 18 mins) $= \frac{35+15}{\text{“100”}} = \frac{50}{100} = \frac{1}{2}$ or equivalent.	**M1** **A1** **M1** **A1**	3.1a 1.1b 3.1a 1.1b	2nd Calculate probabilities from relative frequency tables and real data.
		(4)		
3b	$\frac{1}{3}$ ´ 15 = 5 P(Takes less than 30 mins) $= \frac{10+16+24+35+5}{100} = \frac{90}{100} = \frac{9}{10}$ or equivalent.	**M1** **M1** **A1**	2.2b 1.1b 1.1b	2nd Calculate probabilities from relative frequency tables and real data.
		(3)		
				(7 marks)

Notes

3a

M1 for attempt to find total frequency by adding at least three “width × frequency density” terms (which may contain errors).Alternative: M1 for $\frac{2}{3} \times 15 = 10$. M1 for $1 - \frac{\text{"10"}}{\text{"100"}}$. A1 for $\frac{9}{10}$ o.e.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4	H_0: $p = 0.25$, H_1: $p > 0.25$	**B1**	2.5	5th Carry out 1-tail tests for the binomial distribution.
	Let X represent the number of seeds that germinate. (Under $H_{0)}$ $X \sim B(25, 0.25)$	**M1**	3.4	
	$P(X \geqslant 10) = 1 - P(X \leqslant 9) = 0.0713$	**M1**	1.1b	
	> 0.05	**A1**	1.1b	
	10 is not in critical region therefore insufficient evidence to reject H_0.	**B1**	2.2b	
	There is insufficient evidence at the 5% level to suggest that the book has underestimated the probability. (o.e.)	**B1**	3.2a	
				(6 marks)
Notes				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	States or implies that $s = -80$	**B1**	3.1b	5th Use equations of motion to solve problems involving vertical motion.
	States or implies that $a = -9.8$	**B1**	3.1b	
	Writes $v^2 = u^2 + 2as$ or makes a substitution $v^2 = (16)^2 + 2(-9.8)(-80)$	**M1**	3.1b	
	Finds $v = 43$ (m s^{-1}). Accept 42.7 (m s^{-1}).	**A1**	1.1b	
		(4)		
5b	States or implies that $s = 5$ m.	**B1**	3.1b	5th Use equations of motion to solve problems involving vertical motion.
	Simplifies $5 = 16t - 4.9t^2$ to obtain $4.9t^2 - 16t + 5 = 0$	**M1**	1.1b	
	Makes an attempt to use the quadratic formula: $t = \frac{16 \pm \sqrt{(-16)^2 - 4(4.9)(5)}}{2(4.9)}$	**M1**	1.1b	
	Solves to find $t = 0.35\ldots$ (s). Accept awrt 0.35 (s).	**A1**	1.1b	
	Solves to find $t = 2.91\ldots$ (s). Accept awrt 2.92 (s).	**A1**	1.1b	
	States that the ball is above 85 m for 2.56… (s). Accept awrt 2.6 (s).	**B1**	3.2a	
		(6)		
5c	States or implies that at the greatest height $v = 0$	**B1**	3.1b	5th Use equations of motion to solve problems involving vertical motion.
	Finds the value of u: $u = \frac{1}{5}(42.7...) = 8.54...$ (m s^{-1}). Accept awrt 8.5 (m s^{-1}).	**M1**	3.1b	
	Writes $v^2 = u^2 + 2as$ or makes a substitution $(0)^2 = (8.54...)^2 + 2(-9.8)(s)$	**M1**	3.1b	
	Finds $s = 3.72...$(m). Accept awrt 3.7 (m).	**A1 ft**	1.1b	
		(4)		
				(14 marks)

Notes

5c

Award ft marks for a correct answer using their answer from part **a**.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6a	States that $a = -4$. $6 - 2 + a = 0$ may be seen.	**B1**	1.1b	4th Understand Newton's first law and the concept of equilibrium.
	States that $b = -5$. $-4 + 9 + b = 0$ may be seen.	**B1**	1.1b	
		(2)		
6b	States that $\mathbf{R} = 2\mathbf{i} - 9\mathbf{j}$ (N).	**M1**	1.1b	4th Calculate resultant forces using vectors.
	States that the magnitude of $\mathbf{R} = \sqrt{(2)^2 + (-9)^2}$	**M1**	1.1b	
	States $R = \sqrt{85}$ (N) or $R = 9.21\ldots$ (N). Accept awrt 9.2 (N).	**A1**	1.1b	
		(3)		
6c	States $\tan\theta = \frac{9}{2}$	**M1**	1.1b	4th Calculate resultant forces using vectors.
	Finds the value of θ: $\theta = 77.47\ldots(°)$. Accept awrt $\theta = 77.5$ (°).	**A1 ft**	1.1b	
		(2)		
				(7 marks)

Notes

6b

Award second method mark and accuracy mark for a correct answer using their R.

6c

Award ft marks for correct answer using their **R** vector from part **a**.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7a	$a = \frac{v-u}{t}$ seen or implied.	**M1**	3.1b	5th Use equations of motion to solve problems in familiar contexts.
	Finds the value of a: $a = \frac{20-6}{35} = \frac{14}{35} = 0.4\ \text{m s}^{-2}$	**A1**	1.1b	
		(2)		
7b	Use the fact that $\frac{t_1}{t_2} = \frac{4}{3}$ to write $3t_1 = 4t_2$ or $3t_1 - 4t_2 = 0$ or equivalent.	**M1**	1.1b	5th Use equations of motion to solve problems in familiar contexts.
	States or implies that $t_1 + t_2 = 35$	**M1**	3.1b	
	Solves to find $t_1 = 20$ or $t_2 = 15$. Could use substitution or simultaneous equations. Does not need to find both values for mark to be awarded as either value can be used going forward.	**A1**	1.1b	
	Use $v = u + at$ to write either $x = 6 + 0.4(20)$ or $20 = x + 0.4(15)$	**M1**	2.2a	
	Finds $x = 14$ (m s^{-1}).	**A1ft**	1.1b	
		(5)		
7c	States or implies that $s = \left(\frac{u+v}{2}\right)t$	**M1**	2.2a	5th Use equations of motion to solve problems in familiar contexts.
	Finds the value of s: $s = \left(\frac{6+20}{2}\right)(35) = 455$ (m).	**A1**	1.1b	
		(2)		
				(9 marks)

Notes

7b

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