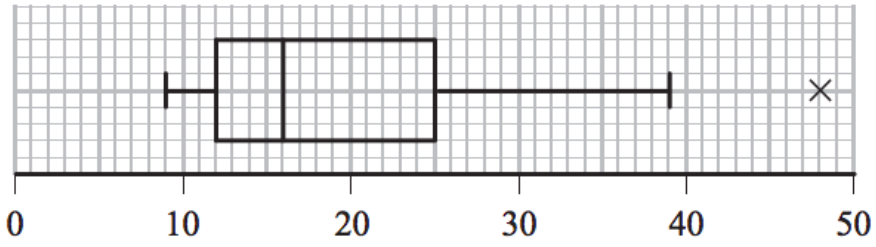
Paper collated from year	2015
Content	Stats chapter 14, 15, 16 (Data Collection, Data Processing, Probability) Mechanics chapter 19 (Just Kinematics)
Marks	60
Time	1 hour 15 minutes

1. Each of 60 students was asked to draw a 20° angle without using a protractor. The size of each angle drawn was measured. The results are summarised in the box plot below.



(a) Find the range for these data.

(1)

(b) Find the interquartile range for these data.

(1)

The students were then asked to draw a 70° angle.
The results are summarised in the table below.

Angle, a, (degrees)	Number of students
$55 \leqslant a < 60$	6
$60 \leqslant a < 65$	15
$65 \leqslant a < 70$	13
$70 \leqslant a < 75$	11
$75 \leqslant a < 80$	8
$80 \leqslant a < 85$	7

(c) Use linear interpolation to estimate the size of the median angle drawn. Give your answer to 1 decimal place.

(2)

(d) Show that the lower quartile is 63°

(2)

For these data, the upper quartile is 75°, the minimum is 55° and the maximum is 84°

An outlier is an observation that falls either
more than 1.5 × (interquartile range) above the upper quartile or
more than 1.5 × (interquartile range) below the lower quartile.

(e) (i) Show that there are no outliers for these data.

(ii) Draw a box plot for these data on the grid on page 3.

(5)

(f) State which angle the students were more accurate at drawing. Give reasons for your answer.

(3)

2. A college has 80 students in Year 12.

20 students study Biology
28 students study Chemistry
30 students study Physics
7 students study both Biology and Chemistry
11 students study both Chemistry and Physics
5 students study both Physics and Biology
3 students study all 3 of these subjects

(a) Draw a Venn diagram to represent this information.

(5)

A Year 12 student at the college is selected at random.

(b) Find the probability that the student studies Chemistry but not Biology or Physics.

(1)

(c) Find the probability that the student studies Chemistry or Physics or both.

(2)

3. In a quiz, a team gains 10 points for every question it answers correctly and loses 5 points for every question it does not answer correctly. The probability of answering a question correctly is 0.6 for each question. One round of the quiz consists of 3 questions.

The discrete random variable X represents the total number of points scored in one round. The table shows the incomplete probability distribution of X

x	30	15	0	−15
$P(X = x)$	0.216			0.064

(a) Show that the probability of scoring 15 points in a round is 0.432

(2)

(b) Find the probability of scoring 0 points in a round.

(1)

(c) Find the probability of scoring a total of 30 points in 2 rounds.

(3)

(d) Find $E(X)$

(2)

4. A small stone is projected vertically upwards from a point O with a speed of $19.6\,m\,s^{-1}$.

Modelling the stone as a particle moving freely under gravity,

(a) find the greatest height above O reached by the stone,

(2)

(b) find the length of time for which the stone is more than 14.7 m above O.

(5)

5. A train travels along a straight horizontal track between two stations, A and B. The train starts from rest at A and moves with constant acceleration $0.5\ m\ s^{-2}$ until it reaches a speed of $V\ m\,s^{-1}$, $(V < 50)$. The train then travels at this constant speed before it moves with constant deceleration $0.25\ m\ s^{-2}$ until it comes to rest at B.

(a) Sketch in the space below a speed-time graph for the motion of the train between the two stations A and B.

(2)

The total time for the journey from A to B is 5 minutes.

(b) Find, in terms of V, the length of time, in seconds, for which the train is

(i) accelerating,

(ii) decelerating,

(iii) moving with constant speed.

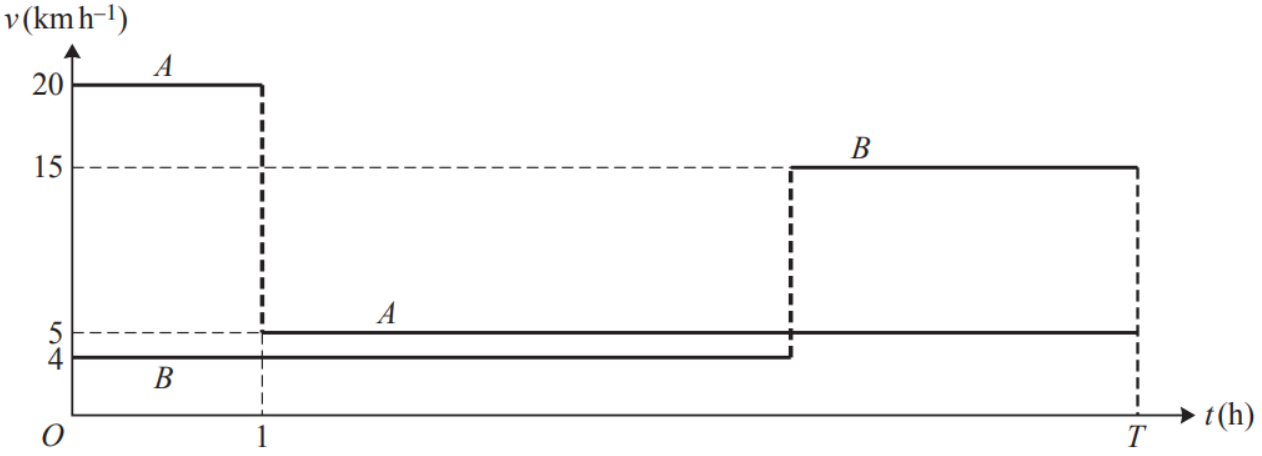
(5)

Given that the distance between the two stations A and B is 6.3 km,

(c) find the value of V.

(6)

6.



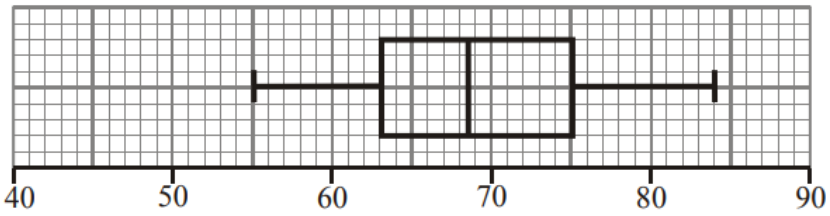
Two travellers A and B make the same journey on a long straight road. Each traveller walks for part of the journey and rides a bicycle for part of the journey. They start their journeys at the same instant, and they end their journeys simultaneously after travelling for T hours. A starts the journey cycling at a steady 20 km h^{-1} for 1 hour. A then leaves the bicycle at the side of the road, and completes the journey walking at 5 km h^{-1}. B begins the journey walking at a steady 4 km h^{-1}. When B finds the bicycle where A left it, B cycles at 15 km h^{-1} to complete the journey (see diagram).

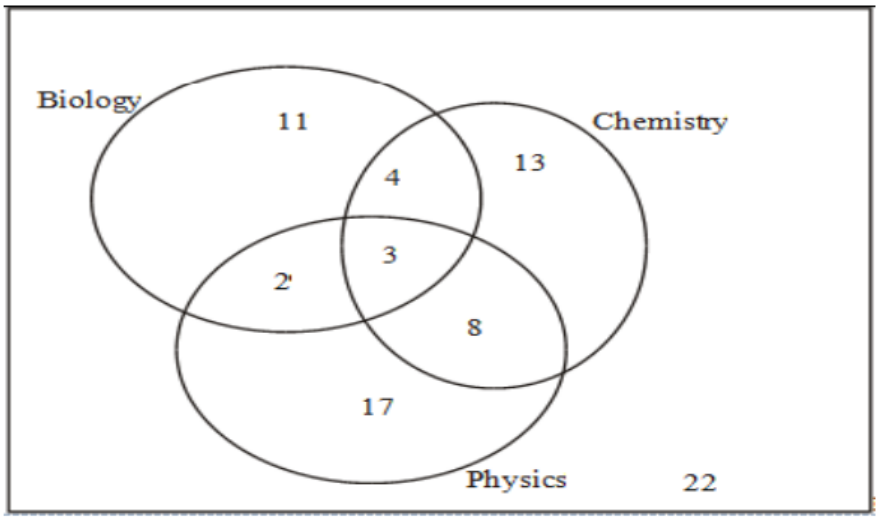
(i) Calculate the distance A cycles, and hence find the period of time for which B walks before finding the bicycle. **[3]**

(ii) Find T. **[3]**

(iii) Calculate the distance A and B each travel. **[2]**

Mark scheme

1. **(a)**	[Range = 48 – 9] = **39**	B1 (1)
(b)	[IQR = 25 – 12]= **13**	B1 (1)
(c)	Median = $65+\frac{[9]}{13}\times 5 = \frac{890}{13}$ = awrt **68.5**° $\left[\text{Condone: } 65+\frac{[9.5]}{13}\times 5 = 68.7\right]$	M1 A1 (2)
(d)	Lower Quartile = $60+\frac{9}{15}\times 5 =$ **63** (*)	M1 A1cso (2)
(e)(i)	$63-1.5\times(75-63)=45$ $75+1.5\times(75-63)=93$ No data above 93 and no data below 45 or 55>45 etc or there are no outliers.	M1A1 A1
(ii)		M1 A1ft (5)
(f)	Median for the 70°angle is closer (to 70°)[than the 20° median is to 20°] The range/IQR for the 70° angle box plot is smaller/shorter Therefore, students were more accurate at drawing the 70° angle.	B1 B1 dB1 (3)
		(14 marks)

2. **(a)**		B1 M1 A1 A1 B1 (5)
(b)	$\frac{'13'}{80}$ or 0.1625	B1ft (1)
(c)	$\frac{28+30-11}{80}$ or $\frac{2+3+4+8+13+17}{80}$ or $1-\frac{(11+22)}{80}=\frac{47}{80}$ or 0.5875	M1 A1 (2)

3. **(a)**	To score 15 points, 2 correct and 1 not correct $[0.6\times0.6\times0.4]+[0.6\times0.4\times0.6]+[0.4\times0.6\times0.6]$ or $3\times(0.6\times0.6\times0.4)$ $=0.432$ **(*)**		M1 A1cso (2)
(b)	$1-(0.216+0.432+0.064)=$ **0.288** or $3\times0.6\times(0.4)^2$		B1 (1)
(c)	[(30, 0), (0, 30) or (15, 15)] $0.216\times'0.288'+'0.288'\times0.216+0.432\times0.432$ **awrt 0.311**		M1 A1ft A1 (3)
(d)	$E(X)=[30\times0.216]+[15\times0.432]+[0\times0.288]+[(-15)\times0.064]$ $E(X)=12$ **12** (only)		M1 A1 (2)

4(a)	$0^2=19.6^2-2\times gH$ $H=19.6$m (20)		M1 A1 (2)
4(b)	$14.7=19.6t-\frac{1}{2}gt^2$ $t^2-4t+3=0$ $(t-1)(t-3)=0$ $t=1$ or 3; Answer 2 s		M1 A1 **DM**1 A1; A1 (5) **7**
4(b)ALT	(their h - 14.7) = ½ g t^2 t =1	**OR** Total = 2 x their 1 = 2 s	$v^2=19.6^2-2$g x 14.7 => v = (±) 9.8 and 0 9.8 – 9.8 t => $t=1$	M1 A1 A1 **DM** 1 A1
4(b)ALT		$v^2=19.6^2-2$g x 14.7 $v=\pm9.8$		M1 A1
	EITHER:	$-9.8=9.8-gT$ $T=2$		**DM**1 A1 A1
	OR:	$0=9.8t$ - ½ g t^2 $t=(0)$ or 2		**DM**1 A1 A1

5.

7(a)		B1 (shape) B1 (V) (2)
(b) **(i) (ii)**	$\frac{V}{t_1}=\frac{1}{2} \Rightarrow t_1=2V$ s; $t_2=4V$ s	M1 A1; A1
(iii)	$t_3=300-2V-4V=300-6V$ s	M1 A1 (5)
(c)	$6300=\frac{V(300+300-6V)}{2}$ or $\frac{1}{2}2V.V+(300-6V).V+\frac{1}{2}4V.V$ $V^2-100V+2100=0$ $(V-30)(V-70)=0$ $V=30$ or 70 $V=30\ (<50)$	M1 **A1 ft** A1 M1 A1 A1 (6) **13**

6.

(i)		A cycles $(=20\times1)=20$ km B walks $=20/4$ h Time $=5$ hours	B1 M1 A1 **[3]**	
(ii)		$20\times1+5(T-1)$ $=4\times5+15(T-5)$ $T=7$ *OR* $5(T-1)$ $=15(T-5)$ $T=7$	B1 M1 A1 **[3]** B1 M1 A1	Total A or B distance correct Equates total distances for A and B A walking distance Equates A walking and B cycling distances
(iii)		Total distance $(A)=20\times1+5(7-1)$ $J=50$ km	M1 A1 **[2]**	Or $(B)\ 4\times5+15\times(7-5)$