Paper collated from year	**2012**
Content	**Stats chapter 14, 15, 16 (Data Collection, Data Processing, Probability) Mechanics chapter 19 (Just Kinematics)**
Marks	**60**
Time	**1 hour 15 minutes**

Q1.

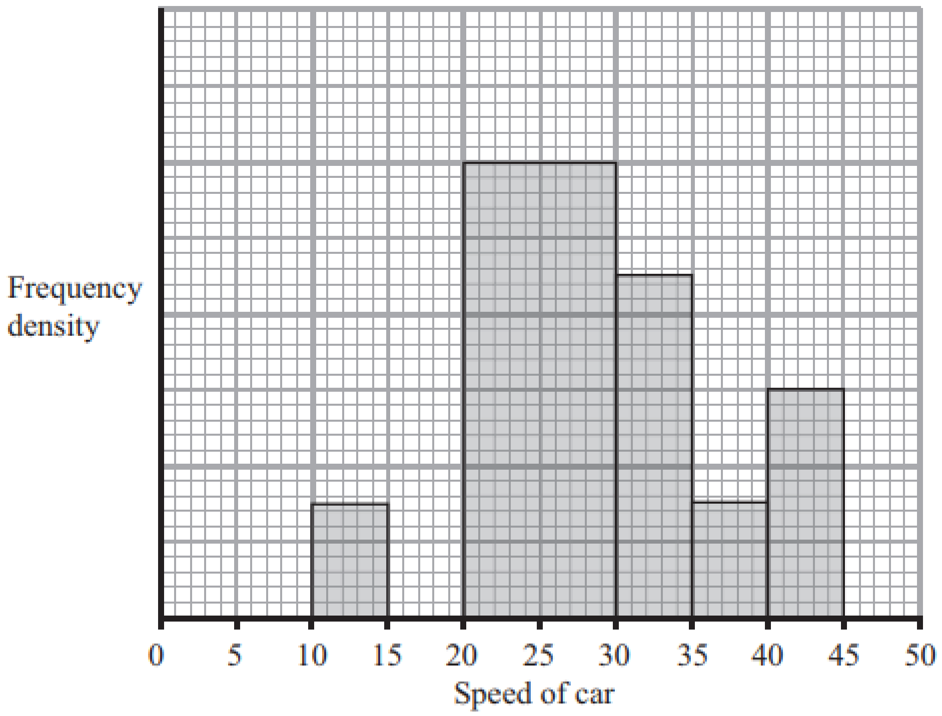


Figure 2

A policeman records the speed of the traffic on a busy road with a 30 mph speed limit. He records the speeds of a sample of 450 cars. The histogram in Figure 2 represents the results.

(a) Calculate the number of cars that were exceeding the speed limit by at least 5 mph in the sample.

(4)

(b) Estimate the value of the mean speed of the cars in the sample.

(3)

(c) Estimate, to 1 decimal place, the value of the median speed of the cars in the sample.

(2)

(d) Comment on the shape of the distribution. Give a reason for your answer.

(2)

(e) State, with a reason, whether the estimate of the mean or the median is a better representation of the average speed of the traffic on the road.

(2)

Q2.

The marks, x, of 45 students randomly selected from those students who sat a mathematics examination are shown in the stem and leaf diagram below.

Mark		Totals
3	6 9 9	(3)
4	0 1 2 2 3 4	(6)
4	5 6 6 6 8	(5)
5	0 2 3 3 4 4	(6)
5	5 5 6 7 7 9	(6)
6	0 0 0 0 1 3 4 4 4	(9)
6	5 5 6 7 8 9	(6)
7	1 2 3 3	(4)

Key	(3|6 means 36)

(a) Write down the modal mark of these students.

(1)

(b) Find the values of the lower quartile, the median and the upper quartile.

(3)

For these students $\sum x = 2497$ and $\sum x^2 = 143\ 369$

(c) Find the mean and the standard deviation of the marks of these students.

(3)

(d) Describe the skewness of the marks of these students, giving a reason for your answer.

(2)

The mean and standard deviation of the marks of all the students who sat the examination were 55 and 10 respectively. The examiners decided that the total mark of each student should be scaled by subtracting 5 marks and then reducing the mark by a further 10 %.

(e) Find the mean and standard deviation of the scaled marks of all the students.

(4)

Q3.

A stone is projected vertically upwards from a point A with speed $u\,\mathrm{m\,s^{-1}}$. After projection the stone moves freely under gravity until it returns to A. The time between the instant that the stone is projected and the instant that it returns to A is $3\frac{4}{7}$ seconds.

Modelling the stone as a particle,

(a) show that $u = 17\frac{1}{2}$,

(3)

(b) find the greatest height above A reached by the stone,

(2)

(c) find the length of time for which the stone is at least $6\frac{3}{5}$ m above A.

(6)

Q4.

A car is moving on a straight horizontal road. At time $t = 0$, the car is moving with speed $20\ \mathrm{m\,s^{-1}}$ and is at the point A. The car maintains the speed of $20\ \mathrm{m\,s^{-1}}$ for 25 s. The car then moves with constant deceleration $0.4\ \mathrm{m\,s^{-2}}$, reducing its speed from $20\ \mathrm{m\,s^{-1}}$ to $8\ \mathrm{m\,s^{-1}}$. The car then moves with constant speed $8\ \mathrm{m\,s^{-1}}$ for 60 s. The car then moves with constant acceleration until it is moving with speed $20\ \mathrm{m\,s^{-1}}$ at the point B.

(a) Sketch a speed-time graph to represent the motion of the car from A to B.

(3)

(b) Find the time for which the car is decelerating.

(2)

Given that the distance from A to B is 1960 m,

(c) find the time taken for the car to move from A to B.

(8)

Q5.

A particle P is projected vertically upwards from a point A with speed u m s^{-1}. The point A is 17.5 m above horizontal ground. The particle P moves freely under gravity until it reaches the ground with speed 28 m s^{-1}.

(a) Show that $u = 21$

(3)

At time t seconds after projection, P is 19 m above A.

(b) Find the possible values of t.

(5)

Mark scheme

Q1.

(a)	One large square = $\frac{450}{"22.5"}$ or one small square = $\frac{450}{"562.5"}$ (o.e. e.g. $\frac{"562.5"}{450}$)	M1	
	One large square = 20 cars or one small square = 0.8 cars or 1 car = 1.25 squares	A1	
	No. > 35 mph is: $4.5\times"20"$ or $112.5\times"0.8"$ (or equivalent e.g. using fd)	dM1	
	= **90** (cars)	A1	(4)
(b)	$[\bar{x}] = \frac{30\times12.5+240\times25+90\times32.5+30\times37.5+60\times42.5}{450}$ $\left[=\frac{12975}{450}\right]$	M1 M1	
	$=28.83...$ or $\frac{173}{6}$ **awrt 28.8**	A1	(3)
(c)	$[Q_2 =]\ 20+\frac{195}{240}\times10$ (o.e.) [Allow use of $(n + 1)$ giving 195.5 instead of 195]	M1	
	= 28.125 [Use of $(n + 1)$ gives 28.145…] **awrt 28.1**	A1	(2)
(d)	$Q_2 < \bar{x}$ | [Condone $Q_2 \approx \bar{x}$]	B1ft	
	So positive skew | [so (almost) symmetric]	dB1ft	(2)
(e)	[If chose skew in (d)] **median (Q_2)** or [If chose symmetric in (d)] **mean ($\bar{x}$)**	B1	
	Since the data is skewed median not affected by extreme values | Since it uses all the data	dB1	(2)
			[13]

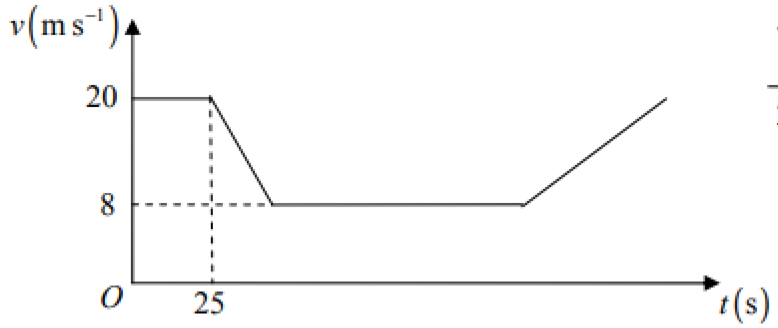
Q2.

(a)	60	B1 (1)
(b)	$Q_1 = 46$ $Q_2 = 56$ $Q_3 = 64$	B1 B1 B1 (3)
(c)	mean = 55.48…. or $\frac{2497}{45}$ awrt 55.5	B1
	sd = $\sqrt{\frac{143369}{45}-\left(\frac{2497}{45}\right)^2}$	M1
	= 10.342… (s = 10.459..) anything which rounds to 10.3 (or s = 10.5)	A1 (3)
(d)	Mean < median < mode or $Q_2 - Q_1 > Q_3 - Q_2$ with or without their numbers or median closer to upper quartile (than lower quartile) or (mean-median)/sd <0;	B1
	negative skew;	B1dep (2)
(e)	mean = $(55-5)\times 0.9$	M1
	= 45	A1
	sd = 10×0.9	M1
	= 9	A1 (4) **Total 13**

Q3

$v = u + at(\uparrow) \Rightarrow 0 = u - g(\frac{25}{14})$	M1 M(A)1
$u = 17\frac{1}{2}$ ✱	A1
	(3)
$v^2 = u^2 + 2as(\uparrow) \Rightarrow 0^2 = 17.5^2 - 2gs$	M1
$s = 15.6$ (m) or 16 (m)	A1
	(2)
$s = ut + \frac{1}{2}at^2(\uparrow) \Rightarrow 6.6 = 17.5t - \frac{1}{2}gt^2$	M1
$4.9t^2 - 17.5t + 6.6 = 0$	A1
$t = \frac{17.5 \pm \sqrt{(17.5^2 - 129.36)}}{9.8} = \frac{17.5 \pm 13.3}{9.8}$	DM1
$t = 3.142..$ (22/7) or $0.428...$(3/7)	A1
$T = t_2 - t_1 = 2.71$ (2.7)	DM1 A1 (6)
OR	
$v^2 = u^2 + 2as(\uparrow) \Rightarrow v^2 = 17.5^2 - 2g\text{x}6.6$	
$v = \pm 13.3$	
$v = u + at(\uparrow) \Rightarrow \pm 13.3 = 17.5 - gt$	M1A1
$t = \frac{17.5 \pm 13.3}{9.8}$	DM1
$= 3.14..$ (22/7) or $0.428..$(3/7)	A1
$T = 3.14.. - 0.428.. = 2.71$ or 2.7	DM1 A1 (6)
OR	
$v^2 = u^2 + 2as(\uparrow) \Rightarrow v^2 = 17.5^2 - 2g\text{x}6.6$ or $0^2 = u^2 - 2g\text{x}(15.625 - 6.6)$	
$v = 13.3$ $u = 13.3$	
$v = u + at(\uparrow) \Rightarrow 0 = 13.3 - gt$	M1 A1
$t = \frac{13.3}{g}$	DM1 A1
$T = 2 \text{ x } \frac{13.3}{g} = 2.7$ or 2.71	DM1 A1 (6)
	11

Q4

(a)	 20, 8, 25	B1 B1 B1 **(3)**
(b)	$v = u + at \Rightarrow 8 = 20 - 0.4t$ $t = 30$ (s)	M1 A1 **(2)**
(c)	1960 = (25 x 20) +(30 x 8) + (½ x 30 x 12) + (60 x 8) + 8 x t + ½ x t x 12	M1A3 **ft** (2 ,1, 0)
	1960 = 500 + 240 + 180 + 480 + 14t	DM1 A1
	T = 115 + 40	DM1
	= 155	A1
	N.B. SEE ALTERNATIVES	**(8)** **[13]**

Q5

(a)	$v^2 = u^2 + 2as \Rightarrow 28^2 = u^2 + 2\times 9.8\times 17.5$ Leading to $u = 21$ ✱ cso	M1 A1 A1 **(3)**
(b)	$s = ut + \frac{1}{2}at^2 \Rightarrow 19 = 21t - 4.9t^2$	M1 A1
	$4.9t^2 - 21t + 19 = 0$ $t = \dfrac{21 \pm \sqrt{21^2 - 4\text{x}4.9\text{x}19}}{9.8}$	
	t = 2.99 or 3.0 t = 1.30 or 1.3	DM1 A1 A1 **(5)**
(c)	N2L $4g - 5000 = 4a$	M1 A1