Paper collated from year	**2014**
Content	**Stats chapter 14, 15, 16** **(Data Collection, Data Processing, Probability)** **Mechanics chapter 19** **(Just Kinematics)**
Marks	57
Time	**1 hour 15 minutes**

Q1.

The table shows data on the number of visitors to the UK in a month, *v* (1000s), and the amount of money they spent, *m* (£ millions), for each of 8 months.

Number of visitors v (1000s)	2450	2480	2540	2420	2350	2290	2400	2460
Amount of money spent m (£ millions)	1370	1350	1400	1330	1270	1210	1330	1350

The regression line has equation

$$m = -467 + 0.74v$$

(a) Interpret the value 0.74 in this equation.

(2)

(b) Use your answer to part (d) to estimate the amount of money spent when the number of visitors to the UK in a month is 2 500 000

(2)

(c) Comment on the reliability of your estimate in part (f). Give a reason for your answer.

(2)

Q2.

A ball of mass 0.3 kg is released from rest at a point which is 2 m above horizontal ground. The ball moves freely under gravity. After striking the ground, the ball rebounds vertically and rises to a maximum height of 1.5 m above the ground, before falling to the ground again. The ball is modelled as a particle.

(a) Find the speed of the ball at the instant before it strikes the ground for the first time.

(2)

(b) Find the speed of the ball at the instant after it rebounds from the ground for the first time.

(2)

(c) Find the magnitude of the impulse on the ball in the first impact with the ground.

(2)

(d) Sketch, in the space provided, a velocity-time graph for the motion of the ball from the instant when it is released until the instant when it strikes the ground for the second time.

(3)

(e) Find the time between the instant when the ball is released and the instant when it strikes the ground for the second time.

(4)

Q3.

A car starts from rest and moves with constant acceleration along a straight horizontal road. The car reaches a speed of V m s^{-1} in 20 seconds. It moves at constant speed V m s^{-1} for the next 30 seconds, then moves with constant deceleration $\frac{1}{2}$ m s^{-2} until it has speed 8 m s^{-1}. It moves at speed 8 m s^{-1} for the next 15 seconds and then moves with constant deceleration $\frac{1}{3}$ m s^{-2} until it comes to rest.

(a) Sketch, in the space below, a speed-time graph for this journey.

(3)

In the first 20 seconds of this journey the car travels 140 m.

Find

(b) the value of V,

(2)

(c) the total time for this journey,

(4)

(d) the total distance travelled by the car.

(4)

Q4.

In a factory, three machines, J, K and L, are used to make biscuits.

Machine J makes 25% of the biscuits.

Machine K makes 45% of the biscuits.

The rest of the biscuits are made by machine L.

It is known that 2% of the biscuits made by machine J are broken, 3% of the biscuits made by machine K are broken and 5% of the biscuits made by machine L are broken.

(a) Draw a tree diagram to illustrate all the possible outcomes and associated probabilities.

(2)

A biscuit is selected at random.

(b) Calculate the probability that the biscuit is made by machine J and is not broken.

(2)

(c) Calculate the probability that the biscuit is broken.

(2)

Q5.

The times, in seconds, spent in a queue at a supermarket by 85 randomly selected customers, are summarised in the table below.

Time (seconds)	Number of customers, f
0 – 30	2
30 – 60	10
60 – 70	17
70 – 80	25
80 – 100	25
100 – 150	6

A histogram was drawn to represent these data. The 30 – 60 group was represented by a bar of width 1.5 cm and height 1 cm.

(a) Find the width and the height of the 70 – 80 group.

(3)

(b) Use linear interpolation to estimate the median of this distribution.

(2)

Given that x denotes the midpoint of each group in the table and

$$\sum fx = 6460 \qquad \sum fx^2 = 529\,400$$

(c) calculate an estimate for

(i) the mean,
(ii) the standard deviation,
for the above data.

(3)

One measure of skewness is given by

$$\text{coefficient of skewness} = \frac{3(\text{mean} - \text{median})}{\text{standard deviation}}$$

(d) Evaluate this coefficient and comment on the skewness of these data.

(3)

Q6.

The mark, x, scored by each student who sat a statistics examination is coded using

$$y = 1.4x - 20$$

The coded marks have mean 60.8 and standard deviation 6.60

Find the mean and the standard deviation of x.

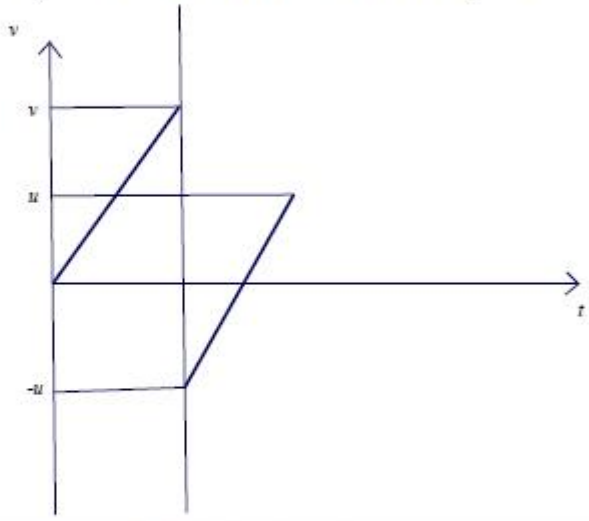
(4)

Mark scheme

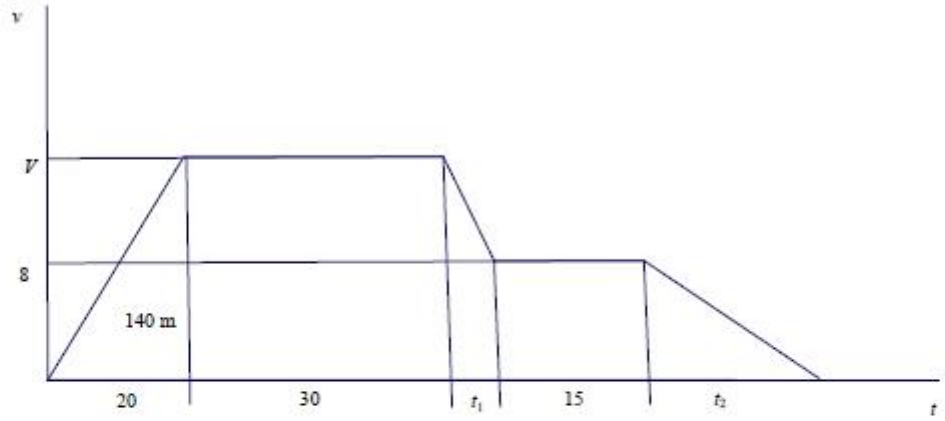
Q1.

(e)	b is the money (spent) per visitor. (i.e. definition of a rate in words.)[ignore values] So each 1000 visitors generates an extra £0.74 million or each visitor spends £740 oe	B1 B1ft (2)
(f)	$m = -467 + 0.74 \times 2500$ $m = 1383$ (£ million) awrt 1380	M1 A1 (2)
(g)	As 2500 is within the range of the data set or it involves interpolation. The value of money spent is reliable	B1 dB1 (2)
		Total 13

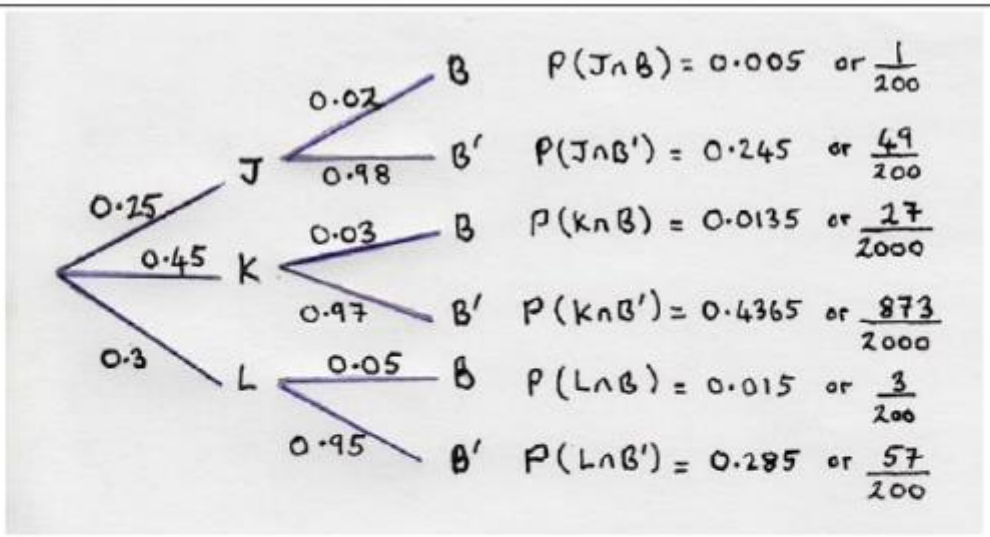
Q2.

Question Number	Scheme	Marks
a	Using $v^2 = u^2 + 2as$: $v^2 = 4g$, $v = \sqrt{4g}$ or 6.3 or 6.26 (m s^{-1})	M1,A1 (2)
b	Rebounds to 1.5 m, $0 = u^2 - 3g$, $u = \sqrt{3g}$, 5.4 or 5.42 (m s^{-1})	M1A1 (2)
c	Impulse = $0.3(6.3 + 5.4) = 3.5$ (Ns)	M1A1 (2)
d	If speed downwards is taken to be positive:  First line Second line $-u, u,$	B1 B1 B1 (3)
e.	Use of suvat to find t_1 or t_2, $\sqrt{4g} = gt_1 \quad t_1 = \sqrt{\frac{4}{g}} = 0.64$ s $\sqrt{3g} = gt_2 \quad t_2 = \sqrt{\frac{3}{g}} = 0.55$ s Total time = $t_1 + 2t_2 = 1.7$ s or 1.75 s	M1A1 (t_1 or t_2) **DM**1A1 (4) **[13]**

Q3.

Question Number	Scheme	Marks
(a)		B1 $0 < t < 50$ B1 $50 < t$ B1 (V,8,15, 20,30) (3)
(b)	Use area under graph or *suvat* to form an equation in V only. $140 = \frac{1}{2} \times 20 \times V$ $V = 14$	M1 A1 (2)
(c)	$8 = V - \frac{1}{2}t_1$ (and /or $0 = 8 - \frac{1}{3}t_2$) $t_1 = 12$, (and/or $t_2 = 24$) Total time = $20 + 30 + t_1 + 15 + t_2 = 101$ (seconds)	M1 A1 **DM**1 A1 (4)
(d)	Total distance = $140 + 30V + \frac{V+8}{2}t_1 + 15 \times 8 + \frac{1}{2} \times 8 \times t_2$ $= 140 + 30 \times 14 + 11 \times 12 + 15 \times 8 + 24 \times 4$ =908 (m)	M1A2 **ft** A1 (4)

Q4.

Question Number	Scheme	Marks
(a)		M1 A1 (2)
(b)	0.25×0.98, $= \mathbf{0.245}$ (or exact equiv. e.g. $\frac{49}{200}$)	M1A1 (2)
(c)	$0.25\times0.02+0.45\times0.03+0.3\times0.05$, $= \mathbf{0.0335}$ (or exact equiv. e.g. $\frac{67}{2000}$)	M1A1 (2)

Q5.

Question Number	Scheme	Marks
(a)	70 – 80 group - width **0.5** (cm)	B1
	1.5 cm^2 is 10 customers <u>or</u> 3.75cm^2 is 25 customers <u>or</u> $0.5c = 3.75$ <u>or</u> $\frac{2.5}{\frac{1}{3}}$	M1
	70 – 80 group - height **7.5** (cm)	A1
		(3)
(b)	Median $= (70) + \frac{13.5}{25} \times 10$ allow $(n+1) = (70) + \frac{14}{25} \times 10$	M1
	$=$ **75.4** (or if using $(n+1)$ allow 75.6)	A1
		(2)
(c)	$\left[\text{Mean} = \frac{6460}{85}\right] =$ **76**	B1
	$\sigma = \sqrt{\frac{529400}{85} - 76^2}$	M1
	$= 21.2658\ldots\ldots$ $(s = 21.3920)$ **awrt 21.3**	A1
		(3)
(d)	Coeff` of skewness $= \frac{3(76-75.4)}{21.2658\ldots} = 0.08464\ldots$ **awrt 0.08** (awrt 0.06 for 75.6)	M1 A1
	There is (very slight) positive skew or the data is almost symmetrical (or both) <u>Any</u> mention of "correlation" is B0	B1ft
		(3)
		Total 11

Q6.

Question Number	Scheme	Marks
	mean $= \frac{60.8+20}{1.4}$ or $60.8 = 1.4x - 20$ (o.e.)	M1
	$= 57.7142\ldots$ awrt **57.7**	A1
	standard deviation $= \frac{6.60}{1.4}$ or $6.60 = 1.4x$	M1
	$= 4.7142\ldots$ awrt **4.71**	A1
		(4)
		Total 4