Paper collated from year	**2011**
Content	**Stats chapter 14, 15, 16** **(Data Collection, Data Processing, Probability)** **Mechanics chapter 19** **(Just Kinematics)**
Marks	**58**
Time	**1 hour 15 minutes**

1. At time $t = 0$ a ball is projected vertically upwards from a point O and rises to a maximum height of 40 m above O. The ball is modelled as a particle moving freely under gravity.

(a) Show that the speed of projection is 28 m s^{-1}.

(3)

(b) Find the times, in seconds, when the ball is 33.6 m above O.

(5)

2. Keith records the amount of rainfall, in mm, at his school, each day for a week. The results are given below.

2.8 5.6 2.3 9.4 0.0 0.5 1.8

Jenny then records the amount of rainfall, x mm, at the school each day for the following 21 days. The results for the 21 days are summarised below.

$$\sum x = 84.6$$

(a) Calculate the mean amount of rainfall during the whole 28 days.

(2)

Keith realises that he has transposed two of his figures. The number 9.4 should have been 4.9 and the number 0.5 should have been 5.0
Keith corrects these figures.

(b) State, giving your reason, the effect this will have on the mean.

(2)

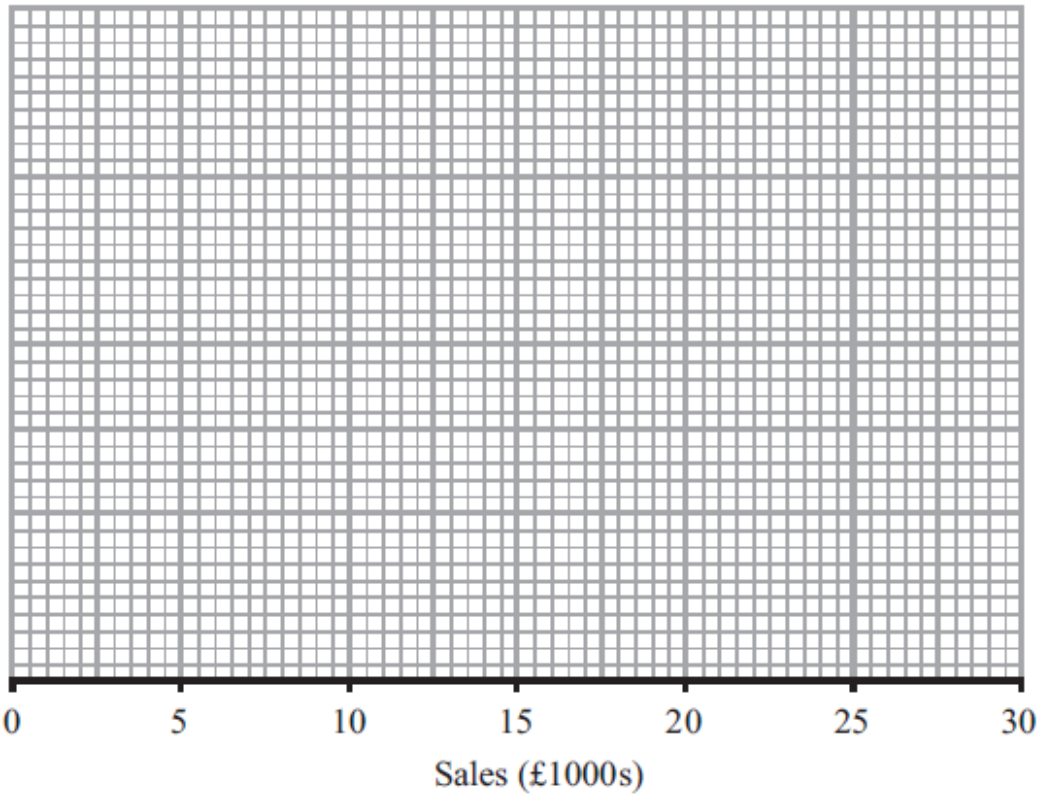
3. Over a long period of time a small company recorded the amount it received in sales per month. The results are summarised below.

	Amount received in sales (£1000s)
Two lowest values	3, 4
Lower quartile	7
Median	12
Upper quartile	14
Two highest values	20, 25

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

(a) On the graph paper below, draw a box plot to represent these data, indicating clearly any outliers.

(5)



(b) State the skewness of the distribution of the amount of sales received. Justify your answer.

(2)

(c) The company claims that for 75% of the months, the amount received per month is greater than £10000. Comment on this claim, giving a reason for your answer.

(2)

4 The table shows information about the time, t minutes correct to the nearest minute, taken by 50 people to complete a race.

Time (minutes)	$t \leqslant 27$	$28 \leqslant t \leqslant 30$	$31 \leqslant t \leqslant 35$	$36 \leqslant t \leqslant 45$	$46 \leqslant t \leqslant 60$	$t \geqslant 61$
Number of people	0	4	28	14	4	0

(i) In a histogram illustrating the data, the height of the block for the $31 \leqslant t \leqslant 35$ class is 5.6 cm. Find the height of the block for the $28 \leqslant t \leqslant 30$ class. (There is no need to draw the histogram.) **[3]**

(ii) The data in the table are used to estimate the median time. State, with a reason, whether the estimated median time is more than 33 minutes, less than 33 minutes or equal to 33 minutes. **[3]**

(iii) Calculate estimates of the mean and standard deviation of the data. **[6]**

(iv) It was found that the winner's time had been incorrectly recorded and that it was actually less than 27 minutes 30 seconds. State whether each of the following will increase, decrease or remain the same:

(a) the mean, **[1]**

(b) the standard deviation, **[1]**

(c) the median, **[1]**

(d) the interquartile range. **[1]**

5. On a randomly chosen day, each of the 32 students in a class recorded the time, t minutes to the nearest minute, they spent on their homework. The data for the class is summarised in the following table.

Time, t	Number of students
10 – 19	2
20 – 29	4
30 – 39	8
40 – 49	11
50 – 69	5
70 – 79	2

(a) Use interpolation to estimate the value of the median.

(2)

Given that

$$\sum t = 1414 \quad \text{and} \quad \sum t^2 = 69378$$

(b) find the mean and the standard deviation of the times spent by the students on their homework.

(3)

(c) Comment on the skewness of the distribution of the times spent by the students on their homework. Give a reason for your answer.

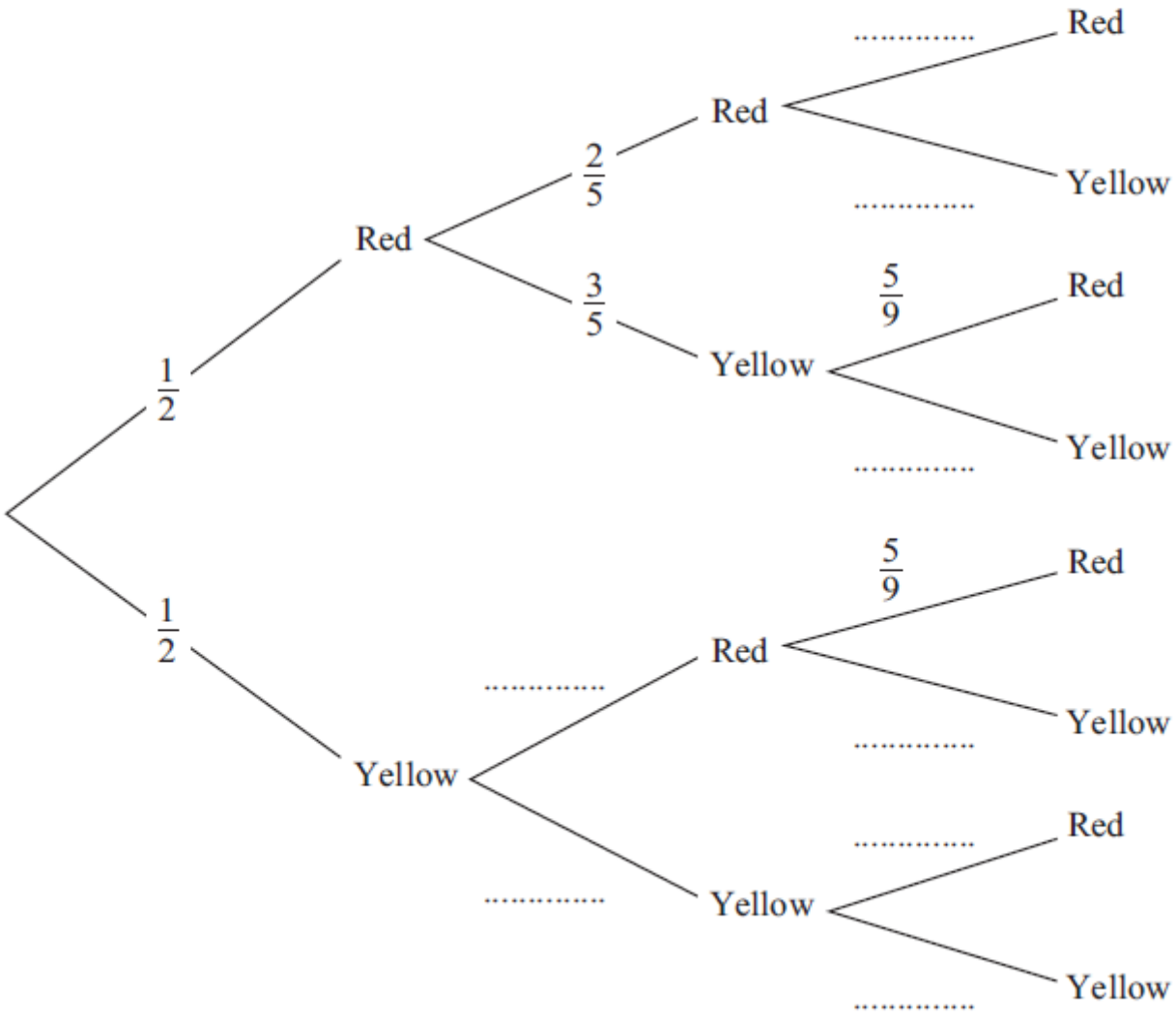
(2)

7. The bag P contains 6 balls of which 3 are red and 3 are yellow.
The bag Q contains 7 balls of which 4 are red and 3 are yellow.
A ball is drawn at random from bag P and placed in bag Q. A second ball is drawn at random from bag P and placed in bag Q.
A third ball is then drawn at random from the 9 balls in bag Q.

The event A occurs when the 2 balls drawn from bag P are of the same colour.
The event B occurs when the ball drawn from bag Q is red.

(a) Complete the tree diagram shown below.

(4)



(b) Find P(A)

(3)

(c) Show that $P(B) = \frac{5}{9}$

(3)

(d) Show that $P(A \cap B) = \frac{2}{9}$

(2)

(e) Hence find $P(A \cup B)$

(2)

Mark scheme

1.

(a)

$0^2 = u^2 - 2\text{x}9.8\text{x}40$

$u = 28 \text{ m s}^{-1}$ ** GIVEN ANSWER

M1 A1
A1
(3)

(b)

$33.6 = 28t - \frac{1}{2}9.8t^2$

$4.9t^2 - 28t + 33.6 = 0$

$t = \dfrac{28 \pm \sqrt{28^2 - 4\text{x}4.9\text{x}33.6}}{9.8}$

$= 4$ s or (1.7 s or 1.71 s)

M1 A1

M1
A1 A1
(5)
8

2.

(a)

$2.8 + 5.6 + 2.3 + 9.4 + 0.5 + 1.8 + 84.6 = 107$

mean = 107 / 28 (= 3.821…) **(awrt 3.8)**

M1
A1
(2)

(b)

It will have no effect since
one is 4.5 under what it should be and the other is 4.5 above what it should be.

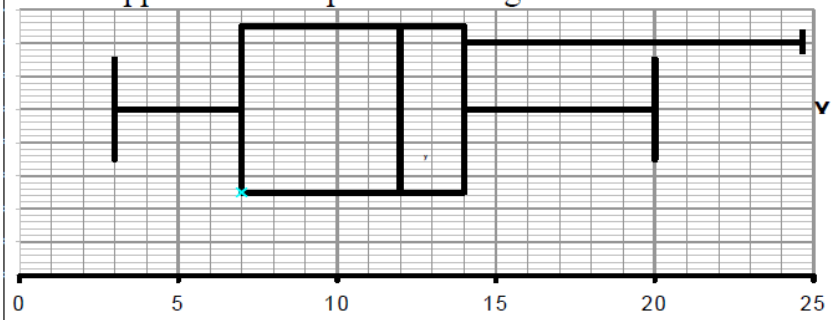
B1
dB1 (2)
[4]

3.

(a)

Outliers
$14 + 1.5\times(14 - 7) = 24.5$
$7 - 1.5\times(14 - 7) = -3.5$

Outlier 25
either upper limit acceptable on diagram



M1
A1

M1

A1ft

B1
(5)

(b)

Since $Q_3 - Q_2 < Q_2 - Q_1$. Allow written explanation
negatively skew

B1
dB1
(2)

(c)

not true
since the lower quartile is 7000 and therefore 75% above 7000 not 10000
or 10 is inside the box or any other sensible comment

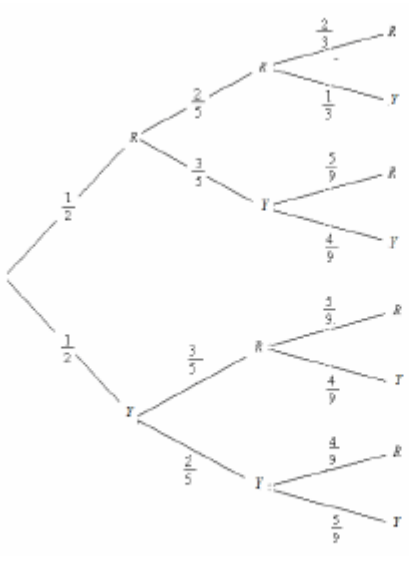
B1
dB1
(2)
[9]

4i	Method is either: Just $4 \div 3$ or $\frac{4}{3}$ or: Use of ratio of correct frequencies AND ratio of widths (correct or 4 and 2)			
4i	$5.6 \times \frac{4}{28} \times \frac{5}{3}$ or $0.8 \times \frac{5}{3}$ or $(5.6 \div \frac{28}{5}) \times \frac{4}{3}$ or $\frac{4}{3}$ or $4 \div 3$ oe $= 1\frac{1}{3}$ or $\frac{4}{3}$ or 1.33 (3 sf) oe	M2 A1 3	M1 for $5.6 \times \frac{4}{28} \times \frac{4}{2}$ or $0.8 \times \frac{4}{2}$ or $(5.6 \div \frac{28}{4}) \times \frac{4}{2}$ or 0.8×2 oe (= 1.6) No wking, ans 1.3: M2A0 Ans 1.6: Check wking but probably M1M0A0	Correct calc'n using 5.6, 28, 4, 5, 3 oe: M2 Correct calc'n using 5.6, 28, 4, 4, 2 oe: M1 ie fully correct method: M2 or: incorrect class widths, otherwise correct method: M1 $\frac{4}{3}$ correctly obtained (or no wking) then further incorrect: M1M0A0 Use of ratio of widths OR freqs but not both: M0 eg $5.6 \times \frac{4}{28}$ (= 0.8) or $5.6 \times \frac{3}{5}$ (= 3.36): M0 $\frac{4}{2} = 2$: M0M0A0
ii	25 or 26 or 25.5 Med is 21st (or 22nd or 21.5th) in 31-35 class or "25 – 4" Can be implied by calc'n Med > 33 or "more than"	B1 B1 B1 3	or 25 & 26 or med in last ≈ 7 in class or 33 ≈ 14th in class or 33 ≈ 18th in whole set Can be implied by diagram indep	May be implied, eg by 21 or 22 or 21.5 Calc'ns need not be correct but need to contain relevant figures for gaining B1B1 The "≈" sign means ± 2
iii	≥ 3 mid-pts attempted $\Sigma fx \div 50$ attempted (= $\frac{1819}{50}$) = 36.38 or 36.4 (3 sf) Σfx^2 attempted (= 68055.5) $\sqrt{\frac{68055.5}{50} - (\frac{1819}{50})^2}$ or $\sqrt{1361.11 - 36.38^2}$ (= √37.6056) = 6.13 (3 sfs)	M1 M1 A1 M1 M1 A1 6	seen or implied ≥ 3 terms. or 36 with correct working ≥ 3 terms. completely correct method except midpts & ft their mean, dep not √(neg)	Not nec'y correct values (29, 33, 40.5, 53) Allow on boundaries. Not class widths Allow on boundaries. Not class widths (3364, 30492, 22963.5, 11236) Allow class widths for this mark only NB mark is not just for "– mean2 ", unlike q5(iii) $\Sigma(fx)^2$: M0M0A0

5.			
	(a)	Median = 32/2 = 16th term (16.5) $\frac{x - 39.5}{49.5 - 39.5} = \frac{16 - 14}{25 - 14}$ or $x = 39.5 + \left(\frac{2}{11} \times 10\right)$ Median = 41.3 (use of $n + 1$ gives 41.8) **(awrt 41.3)**	M1 A1 (2)
	(b)	Mean $= \frac{1414}{32} = 44.1875$ **(awrt 44.2)** Standard deviation $= \sqrt{\frac{69378}{32} - \left(\frac{1414}{32}\right)^2}$ = 14.7 (or s = 14.9)	B1 M1 A1 (3)
	(c)	mean > median therefore positive skew	B1ft B1ft (2) **[7]**

7.

(a)



$\frac{2}{15}$

$\frac{1}{6}$

$\frac{1}{6}$

$\frac{4}{45}$

$\left(\frac{1}{9}\right)$

both $\frac{2}{3},\frac{1}{3}$ B1

$\frac{4}{9}$ B1

both $\frac{3}{5},\frac{2}{5}$ B1

all three of $\frac{4}{9},\frac{4}{9},\frac{5}{9}$ B1

(4)

(b) $P(A)=P(RR)+P(YY)=\frac{1}{2}\times\frac{2}{5}+\frac{1}{2}\times"\frac{2}{5}"=\frac{2}{5}$

B1 for $\frac{1}{2}\times\frac{2}{5}$ (oe) seen at least once

B1 M1 A1

(3)

(c) $P(B)=P(RRR)+P(RYR)+P(YRR)+P(YYR)$

M1 for at least 1 case of 3 balls identified. (Implied by 2nd M1)

M1

$\left(\frac{1}{2}\times\frac{2}{5}\times"\frac{2}{3}"\right)+\left(\frac{1}{2}\times\frac{3}{5}\times\frac{5}{9}\right)+\left(\frac{1}{2}\times"\frac{3}{5}"\times\frac{5}{9}\right)+\left(\frac{1}{2}\times"\frac{2}{5}"\times"\frac{4}{9}"\right)$ $=\underline{\frac{5}{9}}$ (*)

M1,A1cso

(3)

(d) $P(A\cap B)=P(RRR)+P(YYR)$

M1 for identifying both cases and + probs.
may be implied by correct expressions

M1

$=\left(\frac{1}{2}\times\frac{2}{5}\times\frac{2}{3}\right)+\left(\frac{1}{2}\times\frac{2}{5}\times\frac{4}{9}\right)$ $=\underline{\frac{2}{9}}$ (*)

A1cso

(2)

(e) $P(A\cup B)=P(A)+P(B)-P(A\cap B)$

Must have some attempt to use

M1

$="\frac{2}{5}"+\frac{5}{9}-\frac{2}{9}=\underline{\frac{11}{15}}$

A1cao

(2)