Paper collated from year	**2007**
Content	**Stats chapter 14, 15, 16** **(Data Collection, Data Processing, Probability)** **Mechanics chapter 19** **(Just Kinematics)**
Marks	**62**
Time	**1 hour 15 minutes**

1 A ball is released from rest at a height h metres above ground level. The ball hits the ground 1.5 seconds after it is released. Assume that the ball is a particle that does not experience any air resistance.

(a) Show that the speed of the ball is $14.7\,\mathrm{m\,s^{-1}}$ when it hits the ground. *(2 marks)*

(b) Find h. *(2 marks)*

(c) Find the distance that the ball has fallen when its speed is $5\,\mathrm{m\,s^{-1}}$. *(3 marks)*

2 Fig. 1 is the velocity-time graph for the motion of a body. The velocity of the body is $v\,\mathrm{m\,s^{-1}}$ at time t seconds.

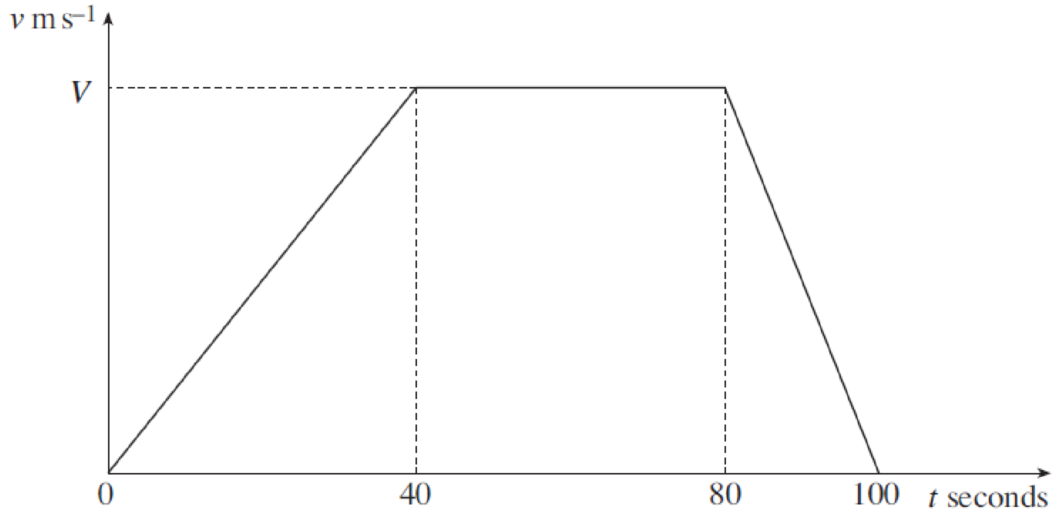


Fig. 1

The displacement of the body from $t = 0$ to $t = 100$ is 1400 m. Find the value of V. [4]

3 Fig. 7 is a sketch of part of the velocity-time graph for the motion of an insect walking in a straight line. Its velocity, $v\,\mathrm{m\,s^{-1}}$, at time t seconds for the time interval $-3 \leqslant t \leqslant 5$ is given by

$$v = t^2 - 2t - 8.$$

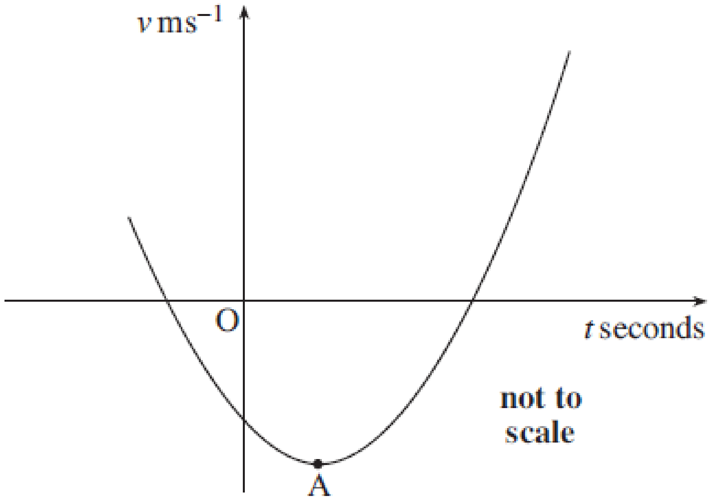


Fig. 7

(i) Write down the velocity of the insect when $t = 0$. [1]

(ii) Show that the insect is instantaneously at rest when $t = -2$ and when $t = 4$. [2]

(iii) Determine the velocity of the insect when its acceleration is zero.

Write down the coordinates of the point A shown in Fig. 7. [5]

(iv) Calculate the distance travelled by the insect from $t = 1$ to $t = 4$. [5]

(v) Write down the distance travelled by the insect in the time interval $-2 \leqslant t \leqslant 4$. [1]

(vi) How far does the insect walk in the time interval $1 \leqslant t \leqslant 5$? [3]

4 In a factory, machines A, B and C are all producing metal rods of the same length. Machine A produces 35% of the rods, machine B produces 25% and the rest are produced by machine C. Of their production of rods, machines A, B and C produce 3%, 6% and 5% defective rods respectively.

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

(3)

(b) Find the probability that a randomly selected rod is

(i) produced by machine A and is defective,

(ii) is defective.

(5)

5 The random variable X has probability function

$$P(X = x) = \frac{(2x-1)}{36} \qquad x = 1, 2, 3, 4, 5, 6.$$

(a) Construct a table giving the probability distribution of X.

(3)

Find

(b) $P(2 < X \leqslant 5)$,

(2)

6 Summarised below are the distances, to the nearest mile, travelled to work by a random sample of 120 commuters.

Distance (to the nearest mile)	Number of commuters
0–9	10
10–19	19
20–29	43
30–39	25
40–49	8
50–59	6
60–69	5
70–79	3
80–89	1

For this distribution,

(a) describe its shape,

(1)

(b) use linear interpolation to estimate its median.

(2)

The mid-point of each class was represented by x and its corresponding frequency by f giving

$$\Sigma fx = 3550 \quad \text{and } \Sigma fx^2 = 138020$$

(c) Estimate the mean and the standard deviation of this distribution.

(3)

One coefficient of skewness is given by

$$\frac{3(\text{mean} - \text{median})}{\text{standard deviation}}.$$

(d) Evaluate this coefficient for this distribution.

(3)

(e) State whether or not the value of your coefficient is consistent with your description in part (a). Justify your answer.

(2)

(f) State, with a reason, whether you should use the mean or the median to represent the data in this distribution.

(2)

(g) State the circumstance under which it would not matter whether you used the mean or the median to represent a set of data.

(1)

7

A teacher recorded, to the nearest hour, the time spent watching television during a particular week by each child in a random sample. The times were summarised in a grouped frequency table and represented by a histogram.

One of the classes in the grouped frequency distribution was 20–29 and its associated frequency was 9. On the histogram the height of the rectangle representing that class was 3.6 cm and the width was 2 cm.

(a) Give a reason to support the use of a histogram to represent these data.

(1)

(b) Write down the underlying feature associated with each of the bars in a histogram.

(1)

(c) Show that on this histogram each child was represented by 0.8 cm^2.

(3)

The total area under the histogram was 24 cm^2.

(d) Find the total number of children in the group.

(2)

Mark scheme

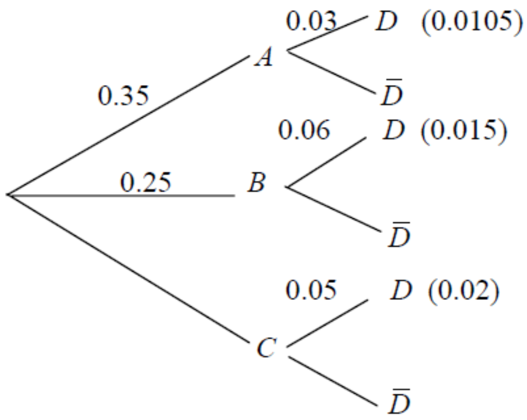
Q	Solution	Marks	Total	Comments
1(a)	$v = 0 + 1.5 \times 9.8$	M1		Use of constant acceleration equation to find v
	$= 14.7 \text{ ms}^{-1}$	A1	2	AG Correct v from correct working $1.5 \times 9.8 = 14.7$ is not enough on its own
(b)	$h = \frac{1}{2} \times 9.8 \times 1.5^2$	M1		Use of constant acceleration equation with $a = 9.8$ to find h
	$= 11.0$ m (to 3 sf)	A1	2	Correct h Allow 11 m; ignore negative signs
(c)	$5^2 = 0^2 + 2 \times 9.8s$	M1		Use of constant acceleration equation with $u = 0$ to find s
		A1		Correct equation
	$s = \frac{25}{19.6} = 1.28$ m (to 3 sf)	A1	3	Correct s Accept 1.27
	OR $t = \frac{5}{9.8} = 0.510$ $s = \frac{1}{2}(0+5)\frac{5}{9.8} = 1.28$ m **OR** $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^2 = 1.28$ m			

Q	Solution	Marks	Comments	Total
2	**either**	M1	Attempt at area. If not trapezium method at least one part area correct. Accept equivalent.	
	$70V$ obtained	A1	Or equivalent – need not be evaluated.	
	So $70V = 1400$	M1	Equate **their** $70V$ to 1400. Must have attempt at complete areas or equations.	
	and $V = 20$	A1	cao	
	or	M1	Attempt to find areas in terms of ratios (at least one correct)	
		A1	Correct total ratio – need not be evaluated. (Evidence may be 800 or 400 or 200 seen).	
		M1	Complete method. (Evidence may be 800/40 or 400/20 or 200/10 seen).	
	$V = 20$	A1	cao [Award 3/4 for 20 seen WWW]	
				4

Q7				
(i)	$8\ \text{m s}^{-1}$ (in the negative direction)	B1	Allow $\pm$ and no direction indicated	1
(ii)	$(t+2)(t-4)=0$ so $t = -2$ or 4	M1 A1	Equating v to zero and solving or subst If subst used then both must be clearly shown	2
(iii)	$a = 2t - 2$ $a = 0$ when $t = 1$ $v(1) = 1 - 2 - 8 = -9$ so $9\ \text{m s}^{-1}$ in the negative direction $(1, -9)$	M1 A1 F1 A1 B1	Differentiating Correct Accept -9 but not 9 without comment FT	5
(iv)	$\int_1^4 \left(t^2 - 2t - 8\right)\,dx$ $= \left[\frac{t^3}{3} - t^2 - 8t\right]_1^4$ $= \left(\frac{64}{3} - 16 - 32\right) - \left(\frac{1}{3} - 1 - 8\right)$ $= -18$ distance is 18 m	M1 A1 M1 A1 A1	Attempt at integration. Ignore limits. Correct integration. Ignore limits. Attempt to sub correct limits and subtract Limits correctly evaluated. Award if -18 seen but no need to evaluate Award even if -18 not seen. Do not award for -18. cao	5
(v)	$2 \times 18 = 36$ m	F1	Award for $2\times$ **their** (iv).	1
(vi)	$\int_4^5 \left(t^2 - 2t - 8\right)\,dx = \left[\frac{t^3}{3} - t^2 - 8t\right]_4^5$ $= \left(\frac{125}{3} - 25 - 40\right) - \left(-\frac{80}{3}\right) = 3\frac{1}{3}$ so $3\frac{1}{3} + 18 = 21\frac{1}{3}$ m	M1 A1 A1	$\int_4^5$ attempted or, otherwise, complete method seen. Correct substitution Award for $3\frac{1}{3}$ + **their** (positive) (iv)	3
				17

4

(a)



Correct tree shape — M1

A, B and C and 0.35 and 0.25 — A1

D (x3) and 0.03, 0.06, 0.05 — A1 (3)

(May be implied by seeing $\mathrm{P}(A \cap D)$ etc at the ends)

(b)(i) $\mathrm{P}(A \cap D) = 0.35 \times 0.03$, $= \underline{\mathbf{0.0105}}$ or $\frac{21}{2000}$ — M1, A1

$\mathrm{P}(C) = 0.4$ (anywhere) — B1

(ii) $\mathrm{P}(D) =$ (i) + 0.25x 0.06 + (0.4x0.05) — M1

$= \underline{\mathbf{0.0455}}$ or $\frac{91}{2000}$ — A1 (5)

(c) $\mathrm{P}(C|D) = \frac{\mathrm{P}(C \cap D)}{\mathrm{P}(D)}$, $= \frac{0.4 \times 0.05}{\text{(ii)}}$ — M1, A1ft

$= 0.43956\ldots$ or $\frac{40}{91}$ — $\underline{\mathbf{0.44}}$ or awrt $\underline{\mathbf{0.440}}$ — A1 (3)

[Correct answers only score full marks in each part] — **11 marks**

5

(a) N.B. Part (a) doesn't have to be in a table, could be a list $\mathrm{P}(X = 1) = \ldots$etc — B1, B1, B1

x	1	2	3	4	5	6
$\mathrm{P}(X = x)$	$\frac{1}{36}$	$\frac{3}{36}$	$\frac{5}{36}$	$\frac{7}{36}$	$\frac{9}{36}$	$\frac{11}{36}$

0.0278, 0.0833, 0.139, 0.194, 0.25, 0.306 (Accept awrt 3 s.f) (3)

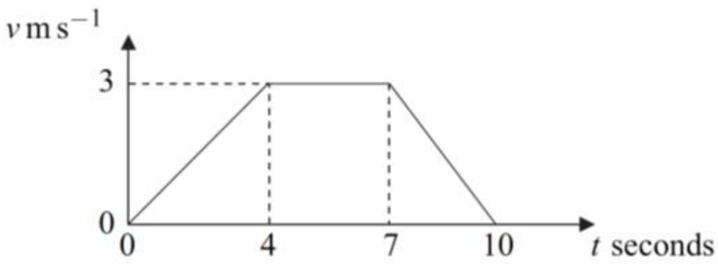
(b) $\mathrm{P}(3) + \mathrm{P}(4) + \mathrm{P}(5) =$, $\underline{\frac{21}{36} \text{ or } \frac{7}{12}}$ $\underline{\text{or awrt } 0.583}$ — M1, A1 (2)

6	(a)	Positive skew (both bits)	B1	(1)
	(b)	$19.5 + \frac{(60-29)}{43} \times 10$, $= 26.7093....$ awrt **<u>26.7</u>**	M1, A1	(2)
		(N.B. Use of 60.5 gives 26.825… so allow awrt 26.8)		
	(c)	$\mu = \frac{3550}{120} = 29.5833...$ or $29\frac{7}{12}$ awrt **<u>29.6</u>**	B1	
		$\sigma^2 = \frac{138020}{120} - \mu^2$ or $\sigma = \sqrt{\frac{138020}{120} - \mu^2}$	M1	
		$\sigma = 16.5829...$ or $(s = 16.652...)$ awrt **<u>16.6</u>** (or s = 16.7)	A1	(3)
	(d)	$\frac{3(29.6 - 26.7)}{16.6}$	M1A1ft	
		= 0.52…. awrt **<u>0.520</u>** (or with s awrt 0.518)	A1	(3)
		(N.B. 60.5 in (b) ...awrt 0.499[or with s awrt 0.497])		
	(e)	0.520 > 0 correct statement about their (d) being >0 or < 0	B1ft	
		So it is consistent with (a) ft their (d)	dB1ft	(2)
	(f)	Use <u>Median</u>	B1	
		Since the data is skewed <u>or</u> less affected by outliers/extreme values	dB1	(2)
	(g)	If the data are <u>symmetrical</u> or <u>skewness is zero</u> or <u>normal/uniform distribution</u>	B1	(1)
		(“mean =median” or “no outliers” or “evenly distributed” all score B0)		**14 marks**

7	(a)	Time is a <u>continuous</u> variable <u>or</u> data is in a <u>grouped</u> frequency table	B1	(1)
	(b)	Area is proportional to frequency <u>or</u> $A \propto f$ or $A = kf$	B1	(1)
	(c)	$3.6 \times 2 = 0.8 \times 9$	M1	
			dM1	
		1 child represented by 0.8	A1 cso	(3)
	(d)	(Total) = $\frac{24}{0.8}$, = **<u>30</u>**	M1, A1	(2)
				7 marks

Paper collated from year	2008
Content	Stats chapter 14, 15, 16 (Data Collection, Data Processing, Probability) Mechanics chapter 19 (Just Kinematics)
Marks	60
Time	1 hour 15 minutes

1. The diagram shows a velocity–time graph for a lift.



(a) Find the distance travelled by the lift.

(3)

(b) Find the acceleration of the lift during the first 4 seconds of the motion. **(2)**

AQA June 2008 M1 Q-1

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2. A firework rocket starts from rest at ground level and moves vertically. In the first 3 s of its motion, the rocket rises 27 m. The rocket is modelled as a particle moving with constant acceleration a m s^{-2}. Find

(a) the value of a,

(2)

(b) the speed of the rocket 3 s after it has left the ground.

(2)

After 3 s, the rocket burns out. The motion of the rocket is now modelled as that of a particle moving freely under gravity.

(c) Find the height of the rocket above the ground 5 s after it has left the ground.

(4)

Edexcel January 2008 M1 Q-2

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3. At time $t = 0$, a particle is projected vertically upwards with speed u m s^{-1} from a point 10 m above the ground. At time T seconds, the particle hits the ground with speed 17.5 m s^{-1} . Find

(a) the value of u,

(3)

(b) the value of T.

(4)

Edexcel June 2008 M1 Q-2

4. A car moves along a horizontal straight road, passing two points A and B. At A the speed of the car is 15 m s^{-1}. When the driver passes A, he sees a warning sign W ahead of him, 120 m away. He immediately applies the brakes and the car decelerates with uniform deceleration, reaching W with speed 5 m s^{-1}. At W, the driver sees that the road is clear. He then immediately accelerates the car with uniform acceleration for 16 s to reach a speed of V m s^{-1} ($V > 15$). He then maintains the car at a constant speed of V m s^{-1}. Moving at this constant speed, the car passes B after a further 22 s.

(a) Sketch, in the space below, a speed-time graph to illustrate the motion of the car as it moves from A to B.

(3)

(b) Find the time taken for the car to move from A to B.

(3)

The distance from A to B is 1 km.

(c) Find the value of V.

(5)

Edexcel January 2008 M1 Q-3

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5. Cotinine is a chemical that is made by the body from nicotine which is found in cigarette smoke. A doctor tested the blood of 12 patients, who claimed to smoke a packet of cigarettes a day, for cotinine. The results, in appropriate units, are shown below.

Patient	A	B	C	D	E	F	G	H	I	J	K	L
Cotinine level, x	160	390	169	175	125	420	171	250	210	258	186	243

[You may use $\sum x^2 = 724\ 961$]

(a) Find the mean and standard deviation of the level of cotinine in a patient's blood.

(4)

(b) Find the median, upper and lower quartiles of these data.

(3)

A doctor suspects that some of his patients have been smoking more than a packet of cigarettes per day. He decides to use $Q_3+1.5(Q_3-Q_1)$ to determine if any of the cotinine results are far enough away from the upper quartile to be outliers.

(c) Identify which patient(s) may have been smoking more than a packet of cigarettes a day. Show your working clearly.

(4)

Edexcel January 2008 S1 Q-2

6. Josh is going to use the large data set to investigate the cloud cover in Heathrow in 1987. He takes a simple random sample of all of the data points available.

(a) Write down the unit that the Large Data Set measures cloud cover in. **(1)**

The large data set has 184 data points for the daily mean total cloud in Heathrow in 1987.

(b) Explain how Josh can use simple random sampling to obtain 30 of these data points for analysis. **(3)**

(c) State one advantage of Josh using a sample of the available data points as opposed to all of the data points. **(1)**

crashMATHS practice paper2 SetA Q-1

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7. The following shows the results of a wine tasting survey of 100 people.

96 like wine A,
93 like wine B,
96 like wine C,
92 like A and B,
91 like B and C,
93 like A and C,
90 like all three wines.

(a) Draw a Venn Diagram to represent these data. **(6)**

Find the probability that a randomly selected person from the survey likes

(b) none of the three wines, **(1)**

(c) wine A but not wine B, **(2)**

(d) any wine in the survey except wine C, **(2)**

(e) exactly two of the three kinds of wine. **(2)**

Edexcel January 2008 S1 Q-5

Mark scheme

1.	(a)	$s = \frac{1}{2}(3+10)\times 3$	M1 A1		Finding distance by summing 3 areas or using formula for the area of a trapezium Correct equation/3 correct expressions for the areas
		$= 19.5$ m	A1	3	Correct total distance
	(b)	$a = \frac{3}{4} = 0.75$ ms^{-2}	B1	1	Correct acceleration as a decimal or as a fraction

2.	(a)	$27 = 0 + \frac{1}{2}.a.3^2 \quad \Rightarrow \quad a = \underline{6}$	M1 A1 (2)
	(b)	$v = 6 \times 3 = \underline{18 \text{ m s}^{-1}}$	M1 A1 f.t. (2)
	(c)	From $t = 3$ to $t = 5$, $s = 18 \times 2 - \frac{1}{2} \times 9.8 \times 2^2$	M1 A1 f.t.
		Total ht. $= s + 27 = \underline{43.4 \text{ m}, \ 43 \text{ m}}$	M1 A1 (4)

3. (a) $v^2 = u^2 + 2as \quad \Rightarrow \quad 17.5^2 = u^2 + 2 \times 9.8 \times 10$ — M1 A1

Leading to $u = 10.5$ — A1 **(3)**

(b) $v = u + at \quad \Rightarrow \quad 17.5 = -10.5 + 9.8T$ — M1 A1 f.t.

$T = 2\frac{6}{7}$ (s) — DM1 A1 **(4)**

[7]

Alternatives for (b)

$$s = (\frac{u+v}{2})T \Rightarrow 10 = (\frac{17.5 + -10.5}{2})T$$ M1A1 f.t.

$$\frac{20}{7} = T$$ DM1A1 (4)

OR $s = ut + \frac{1}{2}at^2 \quad \Rightarrow \quad -10 = 10.5t - 4.9t^2$ — M1 A1 f.t.

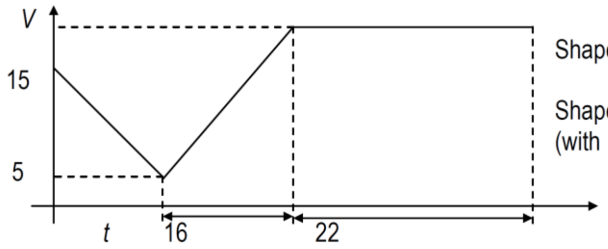
Leading to $T = 2\frac{6}{7}, \left(-\frac{5}{7}\right)$ Rejecting negative — DM1 A1 **(4)**

(b) can be done independently of (a)

$s = vt - \frac{1}{2}at^2 \quad \Rightarrow \quad -10 = -17.5t + 4.9t^2$ — M1 A1

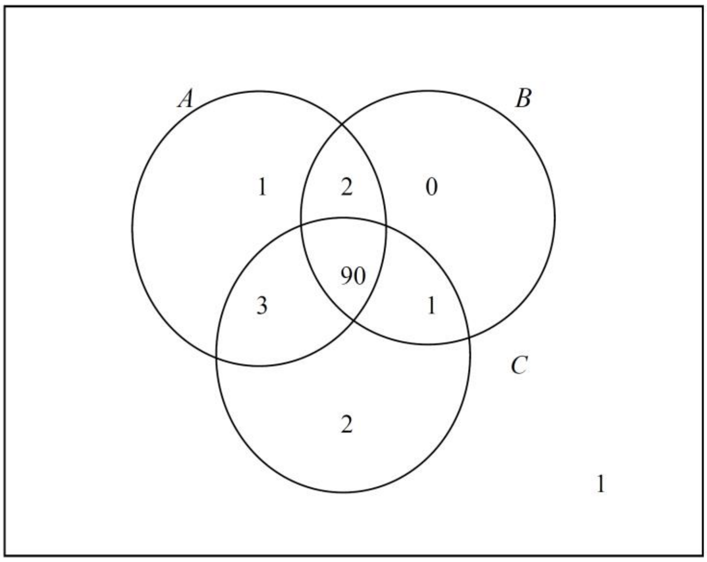
Leading to $T = 2\frac{6}{7}, \frac{5}{7}$ — DM1

For final A1, second solution has to be rejected. $\frac{5}{7}$ leads to a negative u. — A1 **(4)**

4.	(a)	 Shape 'V' Shape for last 22s (with $V > 15$) Figures	B1 B1 B1 (3)
	(b)	$\tfrac{1}{2}(15 + 5) \times t = 120$ $\Rightarrow t = 12 \rightarrow T = 12 + 16 + 22 = \underline{50 \text{ s}}$	M1 M1 A1 (3)
	(c)	$120 + \underline{\tfrac{1}{2}(V + 5).16} + 22V = 1000$ Solve: $30V = 840 \Rightarrow V = \underline{28}$	M1 B1 A1 DM1 A1 (5)

5.	(a)	mean is $\frac{2757}{12}, = 229.75$	AWRT 230	**M1, A1**
		sd is $\sqrt{\frac{724961}{12} - (229.75)^2}, = 87.34045$	AWRT 87.3	**M1, A1**
			[Accept s = AWRT 91.2]	**(4)**
	(b)	Ordered list is: 125, 160, 169, 171, 175, 186, 210, 243, 250, 258, 390, 420		
		$Q_2 = \frac{1}{2}(186 + 210) = 198$		**B1**
		$Q_1 = \frac{1}{2}(169 + 171) = 170$		**B1**
		$Q_3 = \frac{1}{2}(250 + 258) = 254$		**B1**
				(3)
	(c)	$Q_3 + 1.5(Q_3 - Q_1) = 254 + 1.5(254 - 170), = 380$	Accept AWRT (370-392)	**M1, A1**
		Patients *F* (420) and *B* (390) are outliers.		**B1ft B1ft**
				(4)

6.	(a)	Okta(s)	Correct unit	B1
				(1)
	(b)	enumerate the data points *and* describes how enumerated list will be used to obtain a sample of data points	Point 1	B1
		explains how to deal with repeats	Point 2	B1
		explains how to obtain a sample of size 30	Point 3	B1
				(3)
	(c)	smaller amount of data to process / analyse	Correct reason	B1
				(1)

7. (a)	Accept decimals or probs. in Venn diagram		3cc 90,3,2,1 1,(0),2 1 outside Box	**M1** **A1** **M1A1** **A1** **B1** **(6)**
(b)		P(none)=0.01		**B1ft** **(1)**
(c)		P(*A* but not *B*)=0.04		**M1 A1ft** **(2)**
(d)		P(any wine but *C*)=0.03		**M1A1ft** **(2)**
(e)		P(exactly two)=0.06		**M1A1ft** **(2)**

Paper collated from year	2010
Content	Stats chapter 14, 15, 16 (Data Collection, Data Processing, Probability) Mechanics chapter 19 (Just Kinematics)
Marks	62
Time	1 hour 15 minutes

1 An athlete runs along a straight road. She starts from rest and moves with constant acceleration for 5 seconds, reaching a speed of $8\,\mathrm{m\,s^{-1}}$. This speed is then maintained for T seconds. She then decelerates at a constant rate until she stops. She has run a total of 500 m in 75 s.

(a) In the space below, sketch a speed-time graph to illustrate the motion of the athlete.
(3)

(b) Calculate the value of T.
(5)

2 Two cars P and Q are moving in the same direction along the same straight horizontal road. Car P is moving with constant speed $25\,\mathrm{m\,s^{-1}}$. At time $t = 0$, P overtakes Q which is moving with constant speed $20\,\mathrm{m\,s^{-1}}$. From $t = T$ seconds, P decelerates uniformly, coming to rest at a point X which is 800 m from the point where P overtook Q. From $t = 25\,\mathrm{s}$, Q decelerates uniformly, coming to rest at the same point X at the same instant as P.

(a) Sketch, on the same axes, the speed-time graphs of the two cars for the period from $t = 0$ to the time when they both come to rest at the point X.
(4)

(b) Find the value of T.
(8)

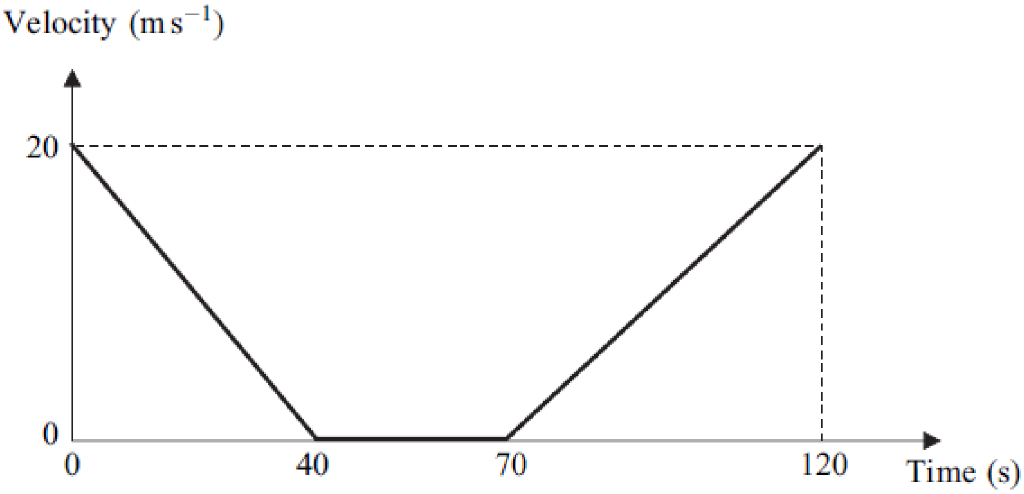
3 A particle P is projected vertically downwards from a fixed point O with initial speed $4.2\,\mathrm{m\,s^{-1}}$, and takes 1.5 s to reach the ground. Calculate

(i) the speed of P when it reaches the ground, **[2]**

(ii) the height of O above the ground, **[2]**

(iii) the speed of P when it is 5 m above the ground. **[2]**

4 A bus slows down as it approaches a bus stop. It stops at the bus stop and remains at rest for a short time as the passengers get on. It then accelerates away from the bus stop. The graph shows how the velocity of the bus varies.



Assume that the bus travels in a straight line during the motion described by the graph.

(a) State the length of time for which the bus is at rest. *(1 mark)*

(b) Find the distance travelled by the bus in the first 40 seconds. *(2 marks)*

(c) Find the total distance travelled by the bus in the 120-second period. *(2 marks)*

(d) Find the average speed of the bus in the 120-second period. *(2 marks)*

(e) If the bus had not stopped but had travelled at a constant $20\,\mathrm{m\,s^{-1}}$ for the 120-second period, how much further would it have travelled? *(2 marks)*

5

The 19 employees of a company take an aptitude test. The scores out of 40 are illustrated in the stem and leaf diagram below.

	2|6 means a score of 26	
0	7	(1)
1	88	(2)
2	4468	(4)
3	2333459	(7)
4	00000	(5)

Find

(a) the median score,

(1)

(b) the interquartile range.

(3)

The company director decides that any employees whose scores are so low that they are outliers will undergo retraining.

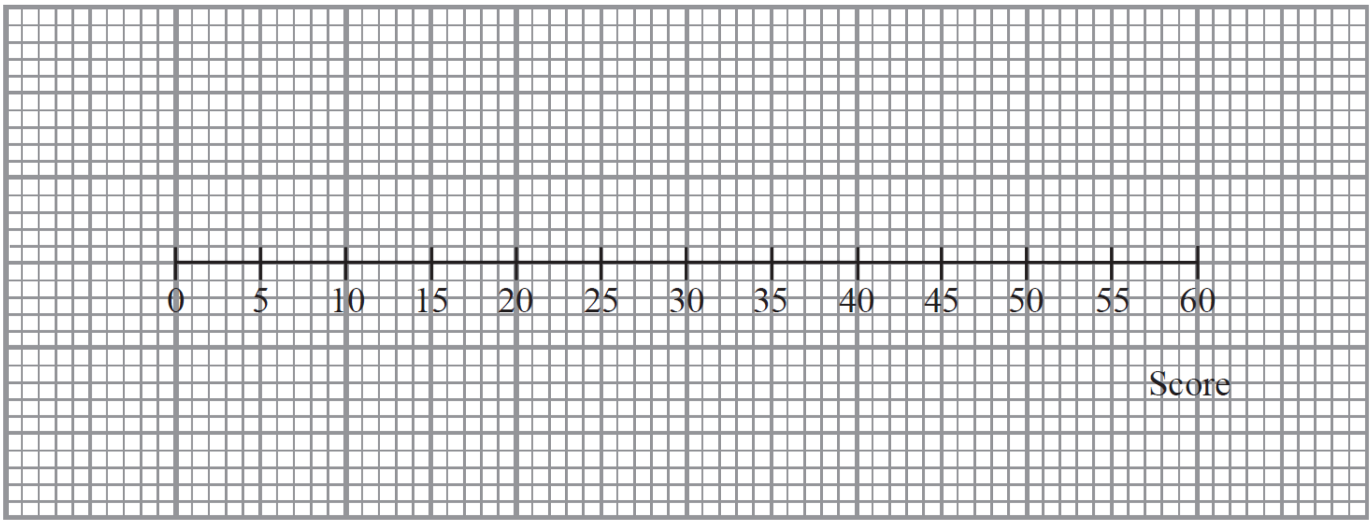
An outlier is an observation whose value is less than the lower quartile minus 1.0 times the interquartile range.

(c) Explain why there is only one employee who will undergo retraining.

(2)

(d) On the graph paper on page 5, draw a box plot to illustrate the employees' scores.

(3)



6 The birth weights, in kg, of 1500 babies are summarised in the table below.

Weight (kg)	Midpoint, $x$kg	Frequency, f
0.0 – 1.0	0.50	1
1.0 – 2.0	1.50	6
2.0 – 2.5	2.25	60
2.5 – 3.0		280
3.0 – 3.5	3.25	820
3.5 – 4.0	3.75	320
4.0 – 5.0	4.50	10
5.0 – 6.0		3

[You may use $\sum fx = 4841$ and $\sum fx^2 = 15\,889.5$]

(a) Write down the missing midpoints in the table above.
(2)

(b) Calculate an estimate of the mean birth weight.
(2)

(c) Calculate an estimate of the standard deviation of the birth weight.
(3)

(d) Use interpolation to estimate the median birth weight.
(2)

(e) Describe the skewness of the distribution. Give a reason for your answer.
(2)

7 There are 180 students at a college following a general course in computing. Students on this course can choose to take up to three extra options.

112 take systems support,
70 take developing software,
81 take networking,
35 take developing software and systems support,
28 take networking and developing software,
40 take systems support and networking,
4 take all three extra options.

(a) In the space below, draw a Venn diagram to represent this information.

(5)

A student from the course is chosen at random.

Find the probability that this student takes

(b) none of the three extra options,

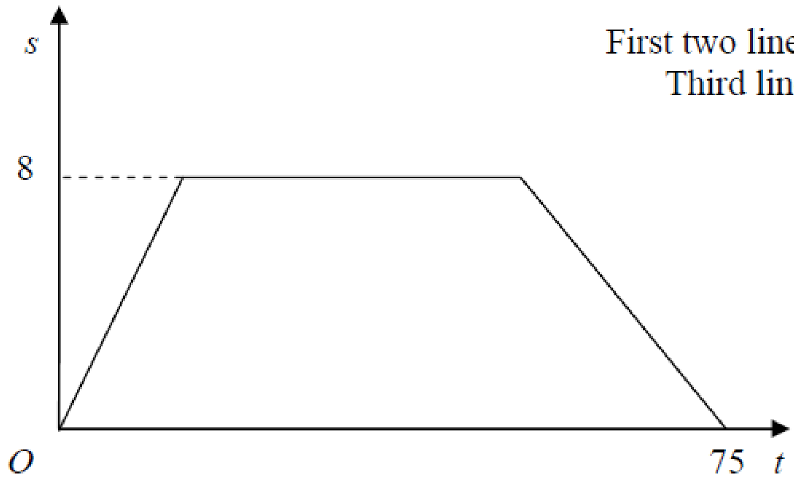
(1)

(c) networking only.

(1)

Mark-scheme

1 (a)



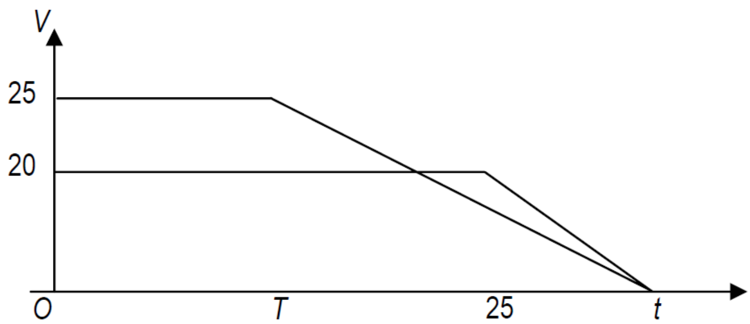
First two line segments — B1
Third line segment — B1
8, 75 — B1 (3)

(b)
$$\frac{1}{2}\times 8\times(T+75)=500$$ M1 A2 (1,0)

Solving to $T=50$ — DM1 A1 (5)

[8]

2 (a)



Shape (both) — B1
Cross — B1
Meet on t-axis — B1
Figures 25,20,T,25 — B1

(4)

(b)
For Q: $20\left(\frac{t+25}{2}\right)=800$ — M1 A1

$t=55$ — **DM1** A1

For P: $25\left(\frac{T+55}{2}\right)=800$ — M1 A1

solving for T: $T=9$ — **DM1** A1 (8)

[12]

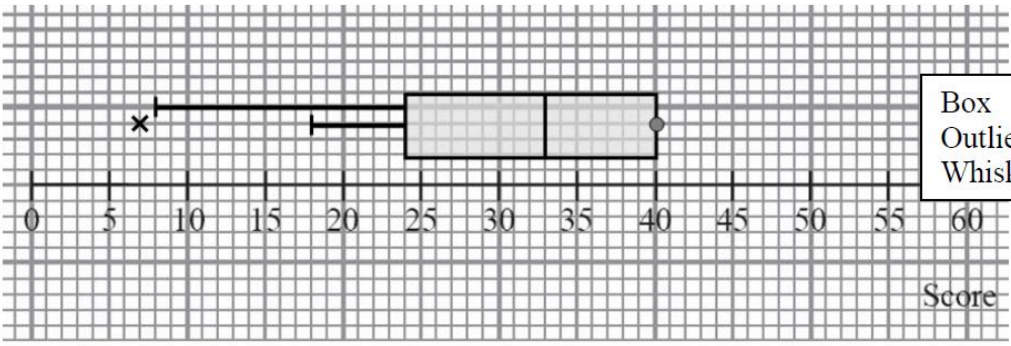
3

$v = 4.2 + 9.8 \times 1.5$ $v = 18.9\ ms^{-1}$.	M1 A1 [2]	Uses $v = u + gt$ 18.9(15) from $g = 9.81$
$s = 4.2 \times 1.5 + 9.8 \times 1.5^2/2$ or $18.9^2 = 4.2^2 + 2 \times 9.8s$ $s = 17.325$ m	M1 A1 [2]	Uses $s = ut + gt^2/2$ or $v^2 = u^2 + 2gs$ Accept 17.3
$v^2 = 4.2 + 2 \times 9.8 \times (17.3(25) - 5)$ $v = 16.1\ ms^{-1}$	M1 A1 [2]	$18.9^2 = u^2 + 2 \times 9.8 \times 5$ $u = 16.1\ ms^{-1}$. Accept answers close to 16.1 from correct working

4

	Solution	Marks	Total	Comments
(a)	30 seconds	B1	1	B1: Correct statement of time.
(b)	$s_1 = \frac{1}{2} \times 40 \times 20 = 400$ m	M1 A1	2	M1: A method for calculating the first distance. Must see 40 and $\frac{1}{2}$. A1: Correct distance.
	OR			
	$s_1 = \frac{1}{2} \times (20+0) \times 40 = 400$ m	(M1) (A1)		
	OR			
	$a = -\frac{20}{40} = -\frac{1}{2}$ $0^2 = 20^2 + 2\left(-\frac{1}{2}\right)s$ $s = 20^2 = 400$ m	 (M1) (A1)		Note on third method: Must see $-\frac{1}{2}$ or $-\frac{20}{40}$ plus attempt to find distance for M1.
(c)	$s_2 = \frac{1}{2} \times 50 \times 20 = 500$ m	M1		M1: Method for finding the second distance and calculating the total distance.
	OR			
	$s_2 = \frac{1}{2} \times (0+20) \times 50 = 500$ m	(M1)		
	OR			
	$a = \frac{20}{50} = \frac{2}{5}$ $20^2 = 0^2 + 2\left(\frac{2}{5}\right)s$ $s = 20^2 \times \frac{5}{4} = 500$ m	 (M1)		Note on third method: Must see $\frac{2}{5}$ or $\frac{20}{50}$ plus attempt to find distance.
	Total = 400 + 500 = 900 m	A1F	2	A1F: Correct total distance. Award the follow through mark for correct addition of 500 and their answer to (b).
(d)	$v_{AVERAGE} = \frac{900}{120} = 7.5\ ms^{-1}$	M1 A1F	2	M1: Their total distance divided by 120 A1F: Correct average speed based on their answer to (c).
(e)	$120 \times 20 - 900 = 1500$ m	M1A1F	2	M1: Multiplication of 20 and 120 to find distance. Note: Award M1 if 2400 seen in this part. A1F: Correct difference based on their answer to (c) provided final answer is positive.
	Total		9	

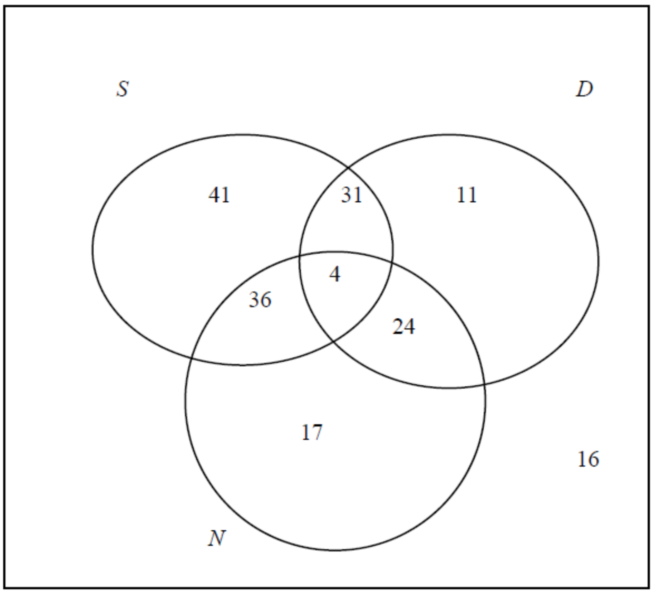
5

(a)	Median is 33	B1 (1)
(b)	$Q_1 = 24, Q_3 = 40, \text{IQR} = 16$	B1 B1 B1ft (3)
(c)	$Q_1 - \text{IQR} = 24 - 16 = 8$	M1
	So 7 is only outlier	A1ft (2)
(d)	 Box Outlier Whisker	B1ft B1 B1ft (3)
	(accept either whisker)	**Total [9]**

6

(a)	2.75 or $2\frac{3}{4}$, 5.5 or 5.50 or $5\frac{1}{2}$	B1 B1 (2)
(b)	Mean birth weight $= \frac{4841}{1500} = 3.227\dot{3}$ **awrt 3.23**	M1 A1 (2)
(c)	Standard deviation $= \sqrt{\frac{15889.5}{1500} - \left(\frac{4841}{1500}\right)^2} = 0.421093\ldots$ or $s = 0.4212337\ldots$	M1 A1ft A1 (3)
(d)	$Q_2 = 3.00 + \frac{403}{820} \times 0.5 = 3.2457\ldots$ (allow 403.5….. $\rightarrow$ 3.25)	M1 A1 (2)
(e)	Mean(3.23)<Median(3.25) (or very close)	B1ft
	Negative Skew (or symmetrical)	dB1ft (2)
		Total [11]

7

(a)	 3 closed curves and 4 in centre Evidence of subtraction 31,36,24 41,17,11 Labels on loops, 16 and box	M1 M1 A1 A1 B1	(5)
(b)	P(None of the 3 options)$=\frac{16}{180}=\frac{4}{45}$	B1ft	(1)
(c)	P(Networking only)$=\frac{17}{180}$	B1ft	(1)

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)

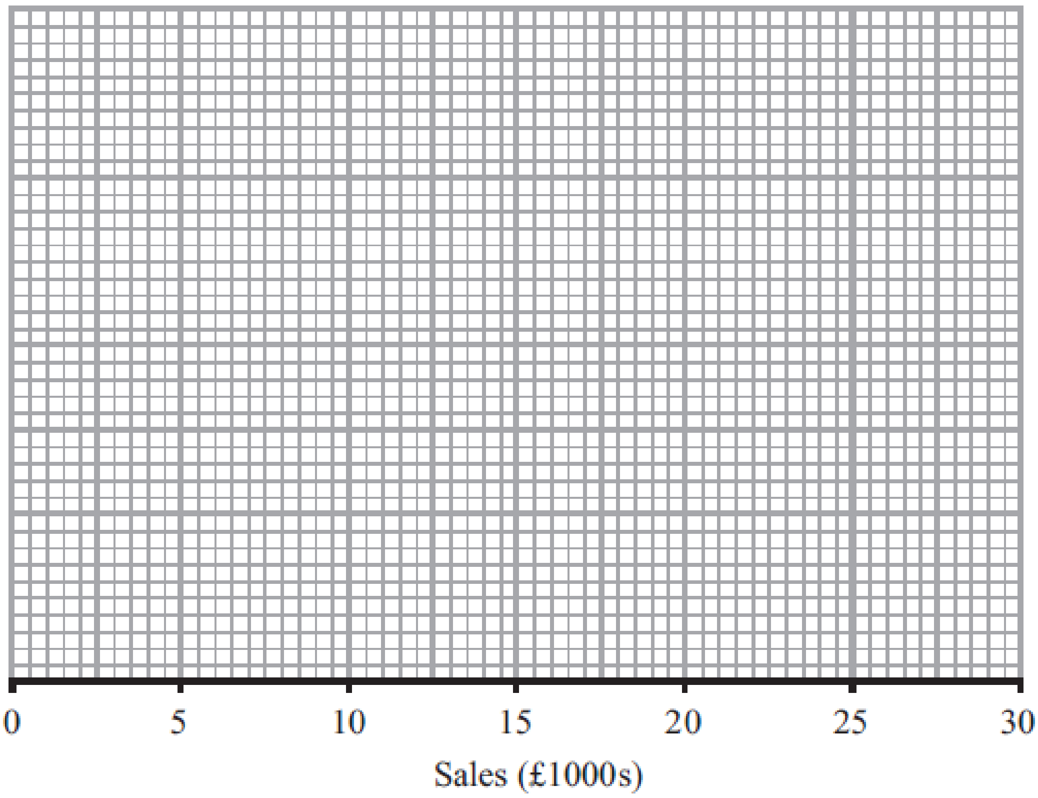
3. Over a long period of time a small company recorded the amount it received in sales per month. The results are summarised below.

	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 £10 000. 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

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

(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.

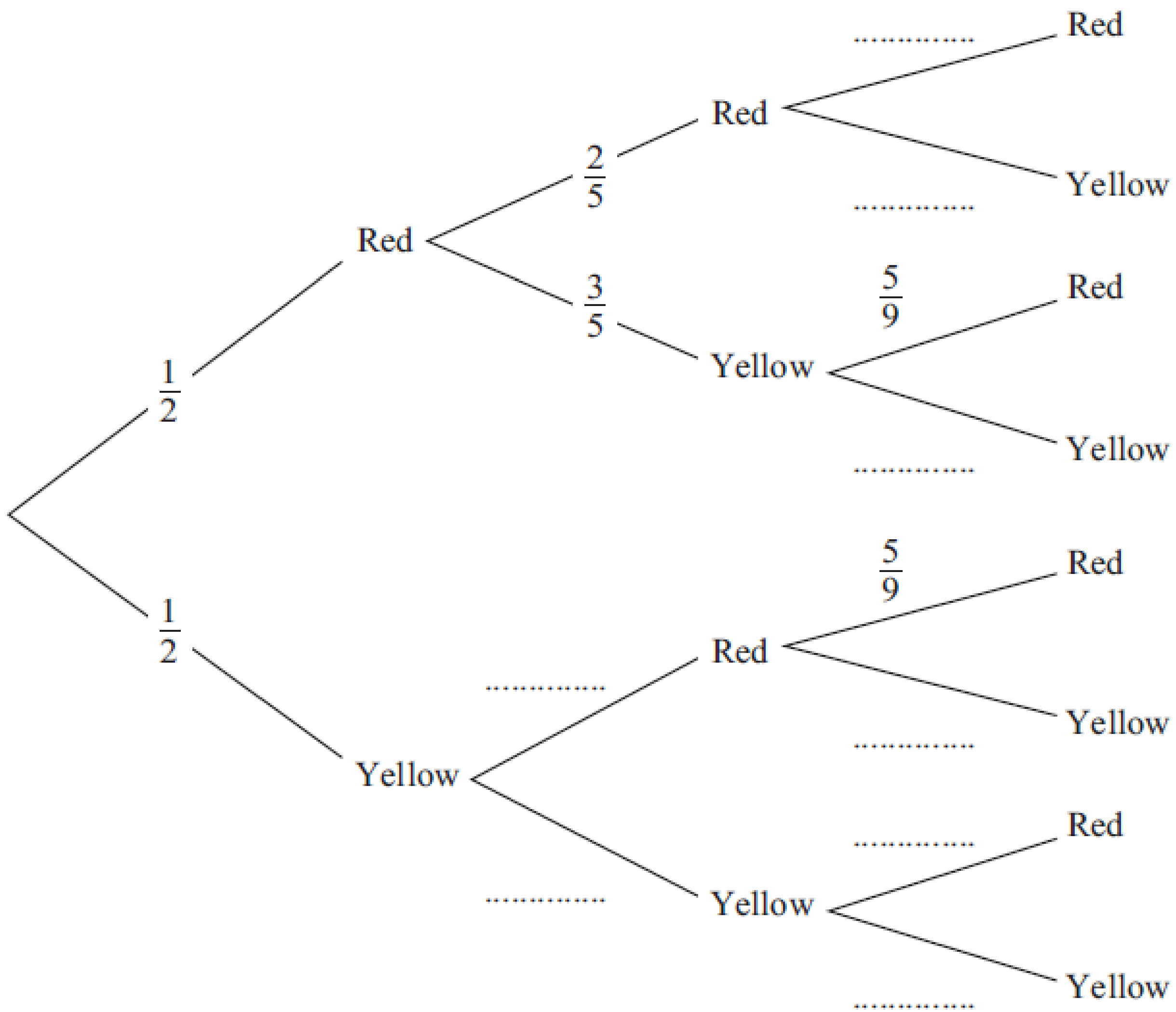
(2)

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)

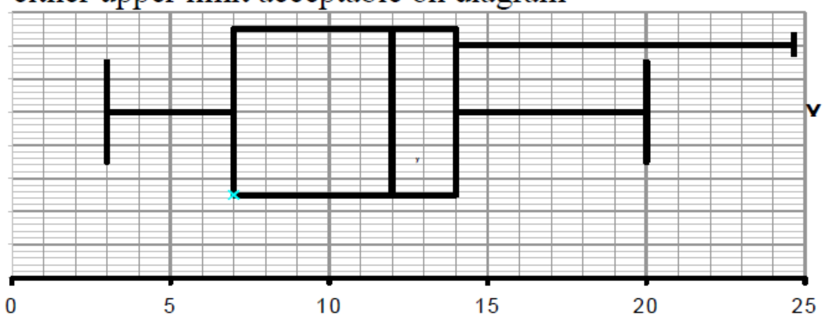
(e) Hence find $P(A \cup B)$

(2)

Mark scheme

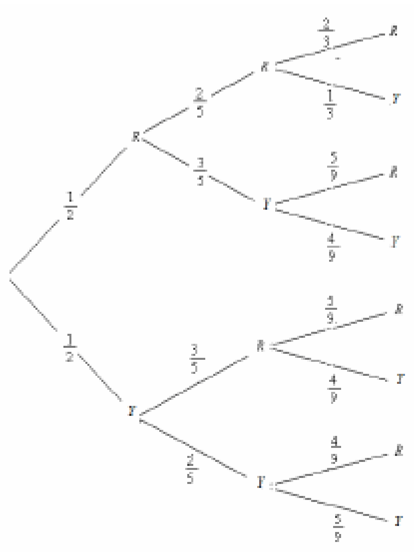
1.		
(a)	$0^2 = u^2 - 2\text{x}9.8\text{x}40$	M1 A1
	$u = 28 \text{ m s}^{-1}$ ** GIVEN ANSWER	A1
		(3)
(b)	$33.6 = 28t - \frac{1}{2}9.8t^2$	M1 A1
	$4.9t^2 - 28t + 33.6 = 0$	
	$t = \dfrac{28 \pm \sqrt{28^2 - 4\text{x}4.9\text{x}33.6}}{9.8}$	M1
	$= 4 \text{ s}$ or $(1.7 \text{ s or } 1.71 \text{ s})$	A1 A1
		(5)
		8

2.		
(a)	$2.8 + 5.6 + 2.3 + 9.4 + 0.5 + 1.8 + 84.6 = 107$	M1
	mean = 107 / 28 (= 3.821…) **(awrt 3.8)**	A1
		(2)
(b)	It will have no effect since	B1
	one is 4.5 under what it should be and the other is 4.5 above what it should be.	dB1 (2)
		[4]

3.		
(a)	Outliers	
	$14 + 1.5\times(14-7) = 24.5$	M1
	$7 - 1.5\times(14-7) = -3.5$	A1
	Outlier 25	
	either upper limit acceptable on diagram	M1
		A1ft B1
	Sales in £'000	(5)
(b)	Since $Q_3 - Q_2 < Q_2 - Q_1$. Allow written explanation	B1
	negatively skew	dB1
		(2)
(c)	not true	B1
	since the lower quartile is 7000 and therefore 75% above 7000 not 10000 or 10 is inside the box or any other sensible comment	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 $\sqrt{1361.11 - 36.38^2}$ $(= \sqrt{37.6056})$ = 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 "– mean^2 ", 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 <u>positive skew</u>	B1ft B1ft	(2) **[7]**

7. (a)	 $\frac{2}{15}$ $\frac{1}{6}$ $\frac{1}{6}$ $\frac{4}{45}$ $\left(\frac{1}{9}\right)$	both $\frac{2}{3}, \frac{1}{3}$ $\frac{4}{9}$ both $\frac{3}{5}, \frac{2}{5}$ all three of $\frac{4}{9}, \frac{4}{9}, \frac{5}{9}$	B1 B1 B1 B1 (4)
(b)	$\mathrm{P}(A) = \mathrm{P}(RR) + \mathrm{P}(YY) = \frac{1}{2}\times\frac{2}{5} + \frac{1}{2}\times"\frac{2}{5}" = \frac{2}{5}$	B1 for $\frac{1}{2}\times\frac{2}{5}$(oe) seen at least once	B1 M1 A1 (3)
(c)	$\mathrm{P}(B) = \mathrm{P}(RRR) + \mathrm{P}(RYR) + \mathrm{P}(YRR) + \mathrm{P}(YYR)$	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)	$\mathrm{P}(A \cap B) = \mathrm{P}(RRR) + \mathrm{P}(YYR)$	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)	$\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \cap B)$ $= "\frac{2}{5}" + \frac{5}{9} - \frac{2}{9} = \underline{\frac{11}{15}}$	Must have some attempt to <u>use</u>	M1 A1cao (2)

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.

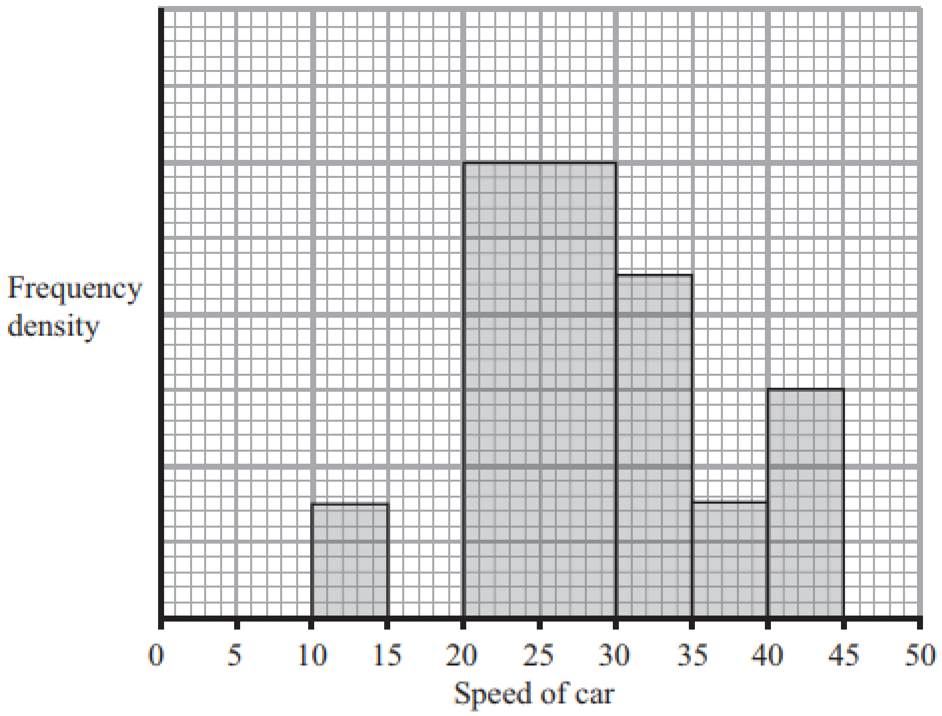


Figure 2

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 $u\,\text{m s}^{-1}$. 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 m s^{-1} and is at the point A. The car maintains the speed of 20 m s^{-1} for 25 s. The car then moves with constant deceleration 0.4 m s^{-2}, reducing its speed from 20 m s^{-1} to 8 m s^{-1}. The car then moves with constant speed 8 m s^{-1} for 60 s. The car then moves with constant acceleration until it is moving with speed 20 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 = $\frac{450}{"22.5"}$ <u>or</u> one small square = $\frac{450}{"562.5"}$ (o.e. e.g. $\frac{"562.5"}{450}$)	M1	
	One large square = 20 cars <u>or</u> one small square = 0.8 cars <u>or</u> 1 car = 1.25 squares	A1	
	No. > 35 mph is: $4.5\times"20"$ <u>or</u> $112.5\times"0.8"$ (or equivalent e.g. using fd)	dM1	
	= **<u>90</u>** (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	
	$=28.83...$ <u>or</u> $\frac{173}{6}$ **awrt <u>28.8</u>**	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 <u>28.1</u>**	A1	(2)
(d)	$Q_2 < \bar{x}$ So <u>positive skew</u> | [Condone $Q_2 \approx \bar{x}$] [so (almost) <u>symmetric</u>]	B1ft dB1ft	(2)
(e)	[If chose <u>skew</u> in (d)] **median (Q_2)** Since the data is skewed or median not affected by extreme values | [If chose <u>symmetric</u> in (d)] **mean ($\bar{x}$)** Since it uses all the data	B1 dB1	(2)
			[13]

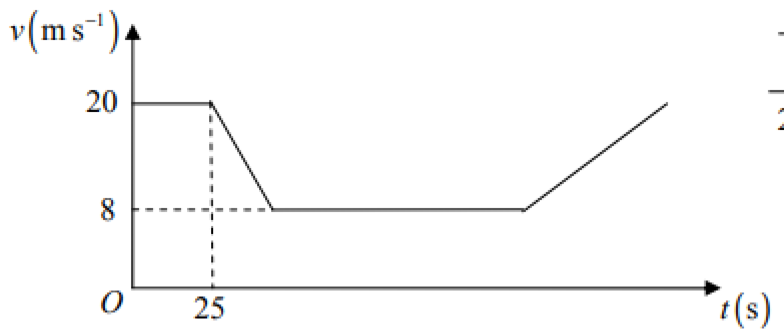
Q2.

(a)	60	B1
		(1)
(b)	$Q_1 = 46$	B1
	$Q_2 = 56$	B1
	$Q_3 = 64$	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
$s = 15.6 \quad (\text{m}) \quad$ 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
$t = \dfrac{17.5 \pm \sqrt{(17.5^2 - 129.36)}}{9.8} = \dfrac{17.5 \pm 13.3}{9.8}$	DM1
$t = 3.142..$ (22/7) or 0.428…(3/7)	A1
$T = t_2 - t_1 = 2.71 \quad (2.7)$	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
$t = \dfrac{17.5 \pm 13.3}{9.8}$	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 $0^2 = u^2 - 2g\text{x}(15.625 - 6.6)$	
$v = 13.3$ $\quad u = 13.3$	
$v = u + at(\uparrow) \Rightarrow 0 = 13.3 - gt$	M1 A1
$t = \dfrac{13.3}{g}$	DM1 A1
$T = 2 \text{ x } \dfrac{13.3}{g} = 2.7$ 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)		
$1960 = (25 \text{ x } 20) + (30 \text{ x } 8) + (\frac{1}{2} \text{ x } 30 \text{ x } 12) + (60 \text{ x } 8) + 8 \text{ x } t + \frac{1}{2} \text{ x } t \text{ x } 12$		M1A3 **ft** (2 ,1, 0)
$1960 = 500 + 240 + 180 + 480 + 14t$		DM1 A1
$T = 115 + 40$ $= 155$		DM1 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

Paper collated from year	**2014**
Content	**Stats chapter 14, 15, 16 (Data Collection, Data Processing, Probability) Mechanics chapter 19 (Just Kinematics)**
Marks	**60**
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

$$m = \quad -467 + 0.74v$$

(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)

(d) Given that the biscuit is broken, find the probability that it was not made by machine K.

(3)

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.

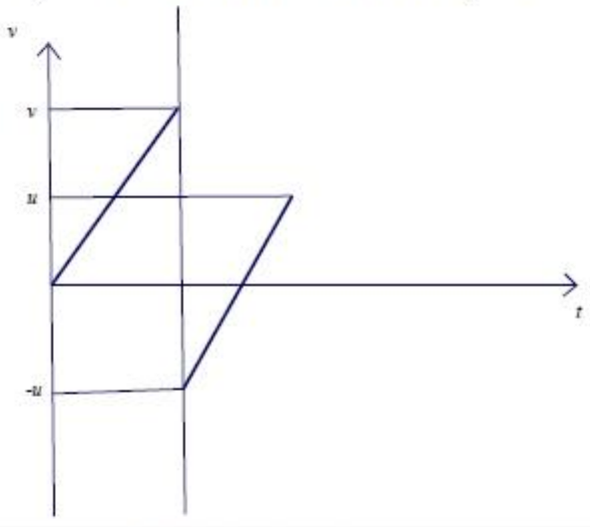
(4)

Mark scheme

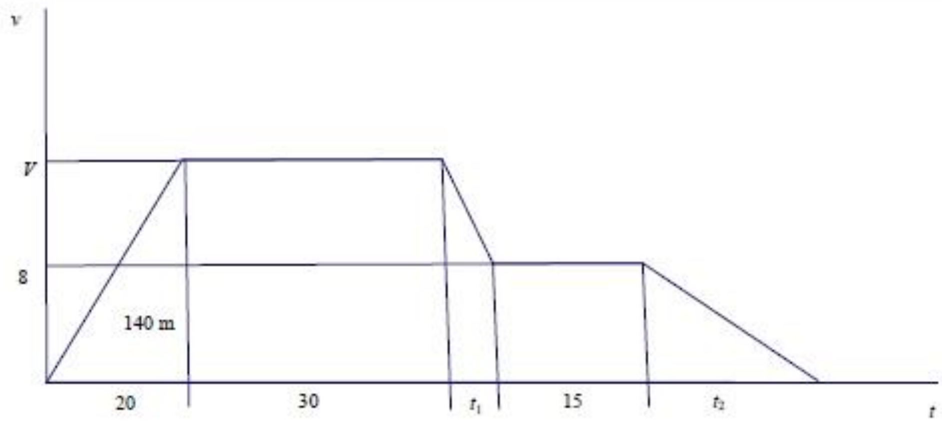
Q1.

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

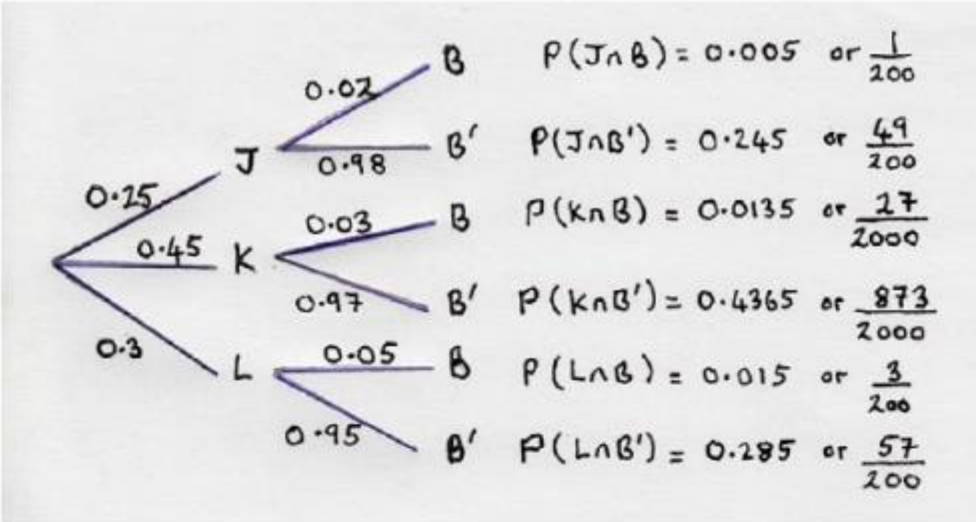
Q2.

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) **DM1A1** (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)	$0.25\times0.98,$ $\quad$ $= \mathbf{0.245}$ (or exact equiv. e.g. $\frac{49}{200}$)	M1A1 **(2)**
(c)	$0.25\times0.02+0.45\times0.03+0.3\times0.05,$ $\quad$ $= \mathbf{0.0335}$ (or exact equiv. e.g. $\frac{67}{2000}$)	M1A1 **(2)**
(d)	$[\mathrm{P}(J\cup L\mid B)] = \dfrac{0.25\times0.02+0.3\times0.05}{0.0335}$ $\quad$ <u>or</u> $\quad$ $\dfrac{0.0335-0.45\times0.03}{0.0335}$ $= 0.5970...$ $\quad$ awrt **0.597** (or $\frac{40}{67}$ or exact equiv.)	M1A1ft A1 **(3)**

Q5.

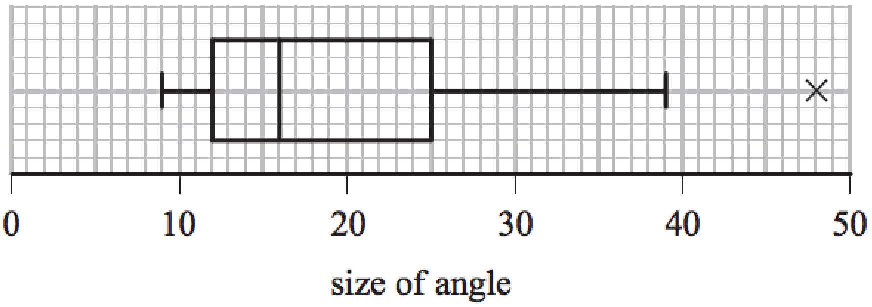
Question Number	Scheme	Marks
(a)	70 – 80 group - width **0.5** (cm)	B1
	1.5 cm^2 is 10 customers <u>or</u> 3.75cm^2 is 25 customers <u>or</u> $0.5c = 3.75$ <u>or</u> $\frac{2.5}{\frac{1}{3}}$	M1
	70 – 80 group - height **7.5** (cm)	A1
		(3)
(b)	Median $= (70) + \frac{13.5}{25} \times 10$ allow $(n+1) = (70) + \frac{14}{25} \times 10$	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 $= \dfrac{60.8+20}{1.4}$ <u>or</u> $60.8 = 1.4x - 20$ (o.e.)	M1
	$= 57.7142\ldots$ awrt **57.7**	A1
	standard deviation $= \dfrac{6.60}{1.4}$ <u>or</u> $6.60 = 1.4x$	M1
	$= 4.7142\ldots$ awrt **4.71**	A1
		(4)
		Total 4

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
$\mathrm{P}(X=x)$	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 $\mathrm{E}(X)$

(2)

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

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 $0.5\ \mathrm{m\ s^{-2}}$ until it reaches a speed of $V\ \mathrm{m s^{-1}}$, ($V < 50$). The train then travels at this constant speed before it moves with constant deceleration $0.25\ \mathrm{m\ s^{-2}}$ 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.

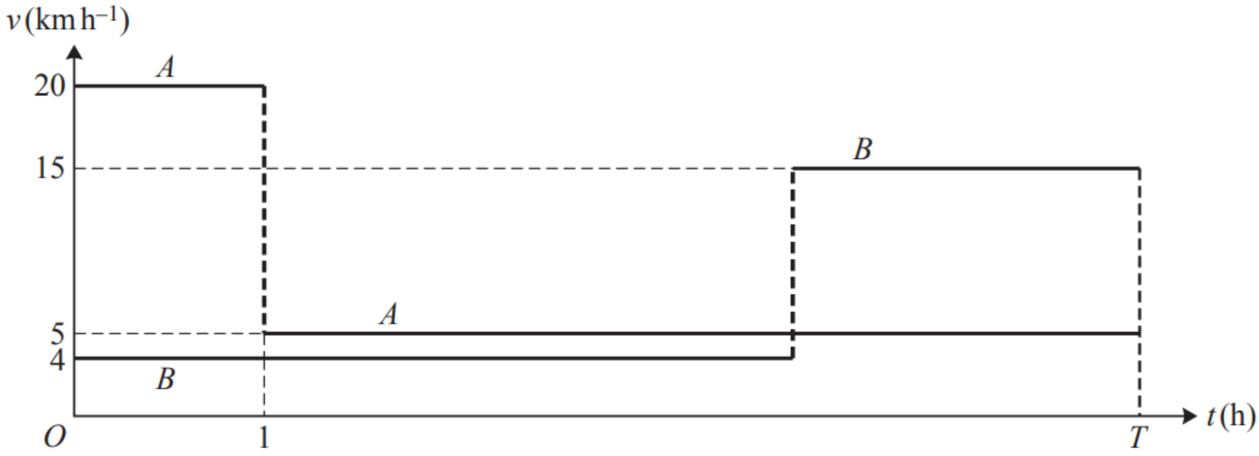
(5)

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

(c) find the value of V.

(6)

6.



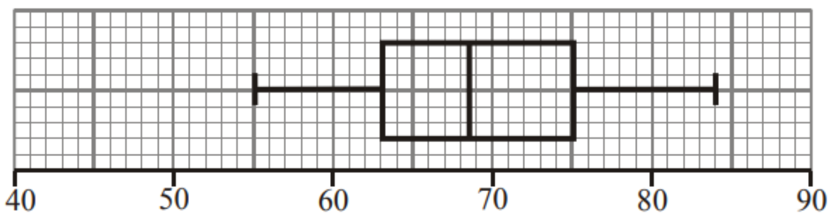
Two travellers A and B make the same journey on a long straight road. Each traveller walks for part of the journey and rides a bicycle for part of the journey. They start their journeys at the same instant, and they end their journeys simultaneously after travelling for T hours. A starts the journey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

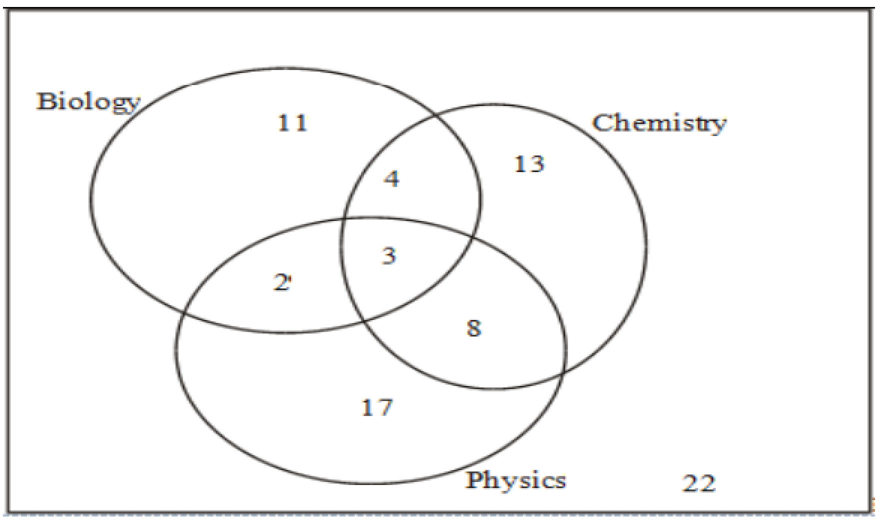
(i) Calculate the distance A cycles, and hence find the period of time for which B walks before finding the bicycle. **[3]**

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

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

Mark scheme

1. (a)	[Range = 48 – 9] = **<u>39</u>**	B1 (1)
(b)	[IQR = 25 – 12]= **<u>13</u>**	B1 (1)
(c)	Median = $65+\frac{[9]}{13}\times 5=\frac{890}{13}=$ awrt **<u>68.5</u>**° $\left[\text{Condone: } 65+\frac{[9.5]}{13}\times 5=68.7\right]$	M1 A1 (2)
(d)	Lower Quartile = $60+\frac{9}{15}\times 5=$ **<u>63</u>** **(*)**	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 <u>or</u> 55>45 etc <u>or</u> 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)	$\frac{'13'}{80}$ <u>or</u> 0.1625	B1ft (1)
(c)	$\frac{28+30-11}{80}$ or $\frac{2+3+4+8+13+17}{80}$ or $1-\frac{(11+22)}{80}=\frac{47}{80}$ <u>or</u> 0.5875	M1 A1 (2)

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

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

5. 7(a)		B1 (shape) B1 (V) (2)
(b) (i) (ii) (iii)	$\frac{V}{t_1} = \frac{1}{2} \Rightarrow t_1 = 2V$ s; $t_2 = 4V$ s $t_3 = 300 - 2V - 4V = 300 - 6V$ s	M1 A1; A1 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 × 1) = 20 km B walks = 20/4 h Time = 5 hours	B1 M1 A1 **[3]**	
(ii)		20 × 1 + 5(T – 1) = 4 × 5 + 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 × 1 + 5(7 – 1) J = 50 km	M1 A1 **[2]**	Or (B) 4 × 5 + 15 × (7 – 5)