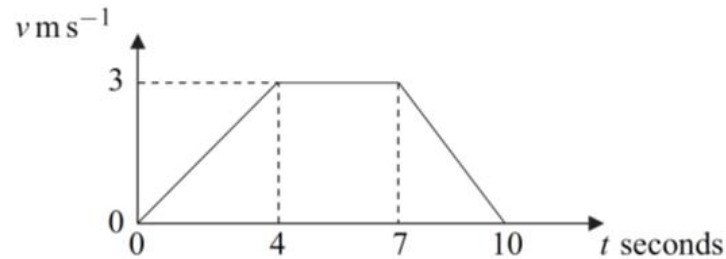| Paper collated from year	2008
Content	Stats chapter 14, 15, 16 (Data Collection, Data Processing, Probability) Mechanics chapter 19 (Just Kinematics)
Marks	60
Time	1 hour 15 minutes

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)**

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)

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)

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)

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)

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)**

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)

Mark scheme

1.	(a)	$s = \frac{1}{2}(3+10)\times 3$	M1		Finding distance by summing 3 areas or using formula for the area of a trapezium
			A1		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)	$27 = 0 + \frac{1}{2}.a.3^2 \implies a = \underline{6}$	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)

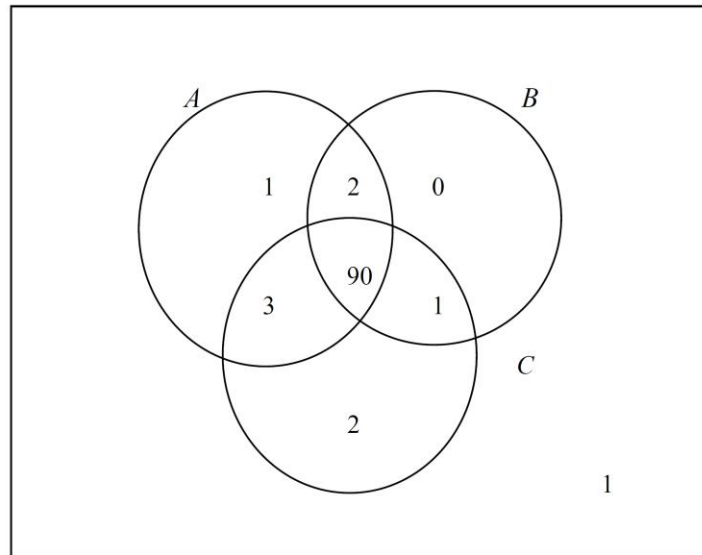|		
3.	(a) $v^2 = u^2 + 2as \implies 17.5^2 = u^2 + 2 \times 9.8 \times 10$	M1 A1
	$\qquad$ Leading to $u = 10.5$	A1 $\qquad$ **(3)**
	(b) $\qquad v = u + at \implies 17.5 = -10.5 + 9.8T$	M1 A1 f.t.
	$\qquad\qquad T = 2\dfrac{6}{7}$ (s)	DM1 A1 **(4)**
	Alternatives for (b)	**[7]**
	$s = (\dfrac{u+v}{2})T \implies 10 = (\dfrac{17.5 + -10.5}{2})T$	M1A1 f.t.
	$\qquad\qquad \dfrac{20}{7} = T$	DM1A1 **(4)**
	OR $\qquad s = ut + \frac{1}{2}at^2 \implies -10 = 10.5t - 4.9t^2$	M1 A1 f.t.
	$\qquad$ Leading to $T = 2\dfrac{6}{7}, \left(-\dfrac{5}{7}\right) \qquad$ Rejecting negative	DM1 A1 **(4)**
	(b) can be done independently of (a)	
	$\qquad s = vt - \frac{1}{2}at^2 \implies -10 = -17.5t + 4.9t^2$	M1 A1
	$\qquad$ Leading to $T = 2\dfrac{6}{7}, \dfrac{5}{7}$	DM1
	For final A1, second solution has to be rejected. $\dfrac{5}{7}$ leads to a negative u.	A1 **(4)**

4.	(a)			
		Shape 'V'		B1
		Shape for last 22s (with $V > 15$)		B1
		Figures		B1 (3)

	(b)			
		$\frac{1}{2}(15 + 5) \times t = 120$		M1
		$\Rightarrow t = 12 \rightarrow T = 12 + 16 + 22 = \underline{50 \text{ s}}$		M1 A1 (3)

	(c)			
		$120 + \frac{1}{2}(V + 5).16 + 22V = 1000$		M1 B1 A1
		Solve: $30V = 840 \Rightarrow V = \underline{28}$		DM1 A1 (5)

5.	(a)			
		mean is $\dfrac{2757}{12}, = 229.75$	AWRT 230	M1, A1
		sd is $\sqrt{\dfrac{724961}{12} - (229.75)^2}, = 87.34045$	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	Point 1	B1
		and		
		describes how enumerated list will be used to obtain a sample of data points		
		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)

3cc	**M1**
90,3,2,1	**A1**
1,(0),2	**M1A1**
1 outside	**A1**
Box	**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)