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 $8\,\text{m s}^{-1}$. 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 $25\,\text{m s}^{-1}$. At time $t = 0$, P overtakes Q which is moving with constant speed $20\,\text{m s}^{-1}$. 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 $t = 25$ 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)

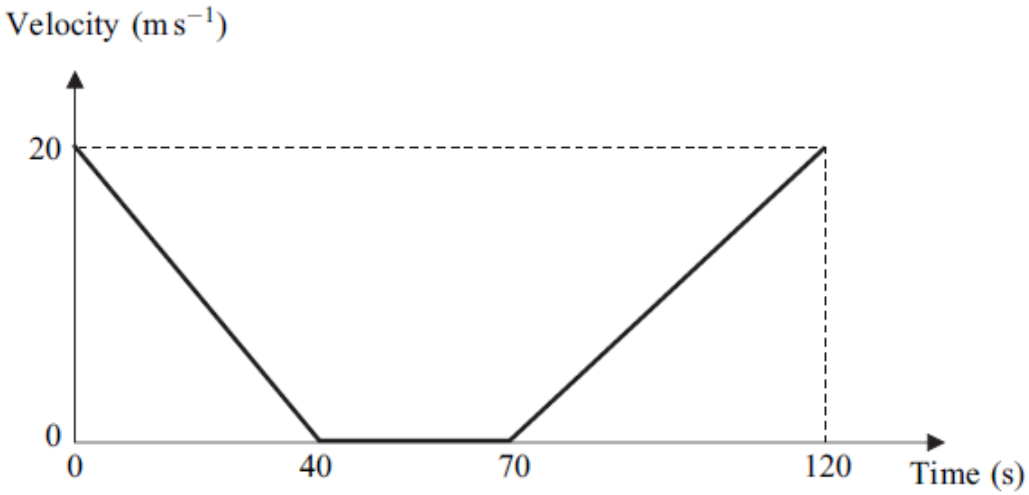
3 A particle P is projected vertically downwards from a fixed point O with initial speed $4.2\,\text{m s}^{-1}$, and takes 1.5 s to reach the ground. Calculate

(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 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.

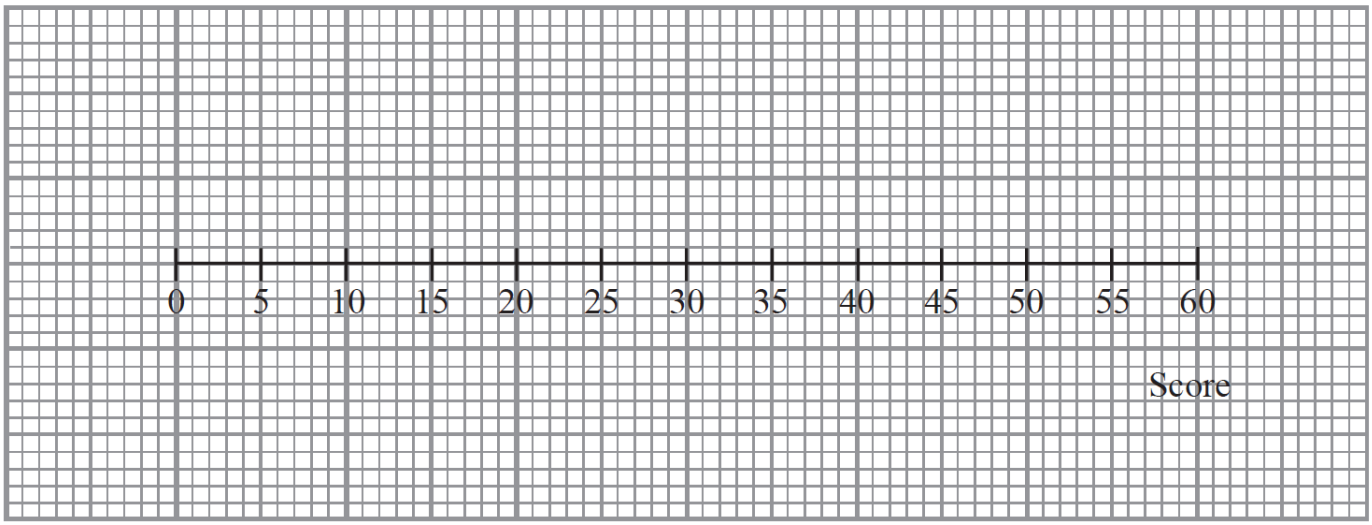
An outlier is an observation whose value is less than the lower quartile minus 1.0 times the interquartile range.

(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 $\sum fx^2 = 15889.5$]

(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)

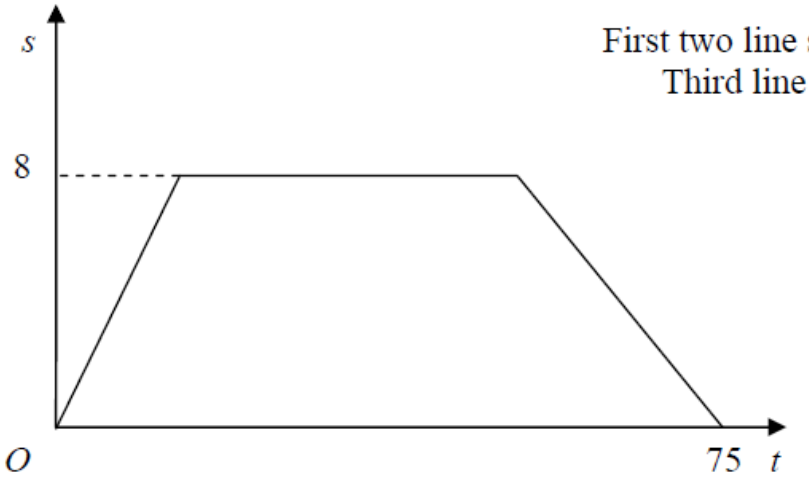
(c) networking only.

(1)

Mark-scheme

1

(a)



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

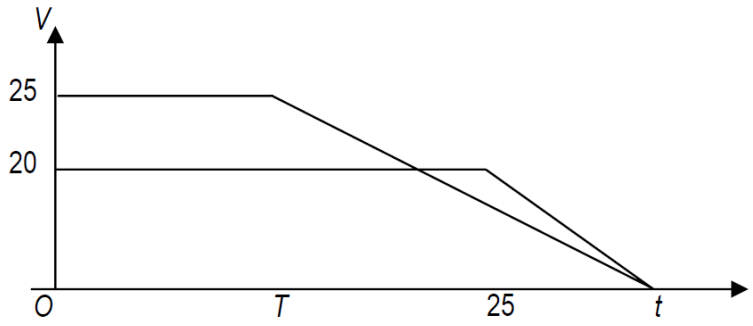
(b) $\frac{1}{2}\times 8\times(T+75)=500$ M1 A2 (1,0)

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]

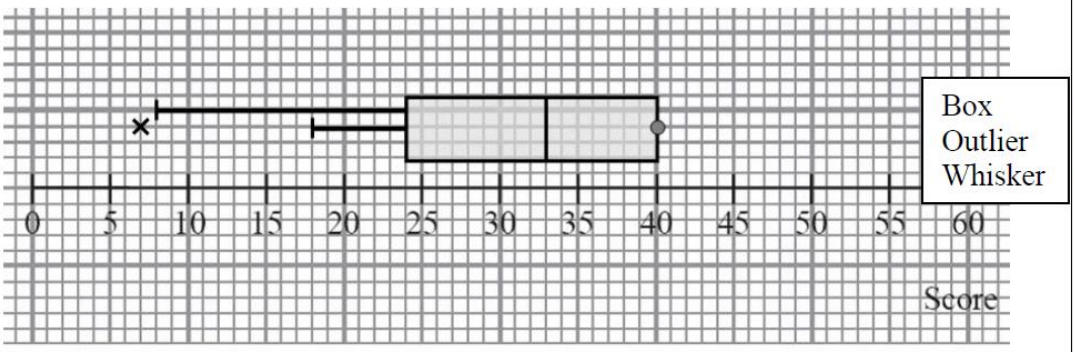
3

$v = 4.2 + 9.8 \times 1.5$ $v = 18.9\ ms^{-1}$.	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			
	$a = -\frac{20}{40} = -\frac{1}{2}$			Note on third method: Must see $-\frac{1}{2}$ or $-\frac{20}{40}$ plus attempt to find distance for M1.
	$0^2 = 20^2 + 2\left(-\frac{1}{2}\right)s$	(M1)		
	$s = 20^2 = 400$ m	(A1)		
(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			
	$a = \frac{20}{50} = \frac{2}{5}$			
	$20^2 = 0^2 + 2\left(\frac{2}{5}\right)s$	(M1)		Note on third method: Must see $\frac{2}{5}$ or $\frac{20}{50}$ plus attempt to find distance.
	$s = 20^2 \times \frac{5}{4} = 500$ m			
	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**	

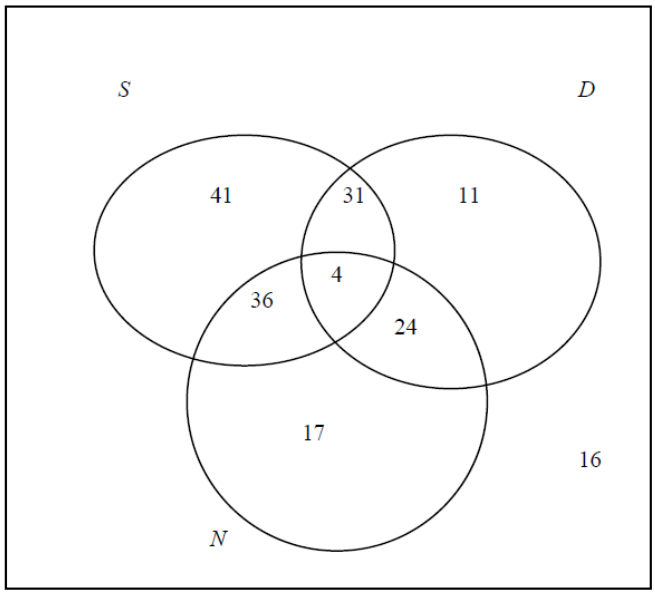
5

(a)	Median is 33	B1 (1)
(b)	$Q_1 = 24, Q_3 = 40, \text{IQR} = 16$	B1 B1 B1ft (3)
(c)	$Q_1 - \text{IQR} = 24 - 16 = 8$ So 7 is only outlier	M1 A1ft (2)
(d)	 (accept either whisker)	B1ft B1 B1ft (3) **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 = $\sqrt{\frac{15889.5}{1500} - \left(\frac{4841}{1500}\right)^2} = 0.421093...$ or $s = 0.4212337...$	M1 A1ft A1 (3)
(d)	$Q_2 = 3.00 + \frac{403}{820} \times 0.5 = 3.2457...$ (allow 403.5….. → 3.25)	M1 A1 (2)
(e)	Mean(3.23)<Median(3.25) (or very close) Negative Skew (or symmetrical)	B1ft 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)