Q1.

The table below shows the probability distribution for a discrete random variable X.

x	0	1	2	3	4 or more
P($X = x$)	0.35	0.25	k	0.14	0.1

Find the value of k.

Circle your answer.

0.14 0.16 0.18 1

(Total 1 mark)

Q2.

A school took 225 children on a trip to a theme park.
After the trip the children had to write about their favourite ride at the park from a choice of three.
The table shows the number of children who wrote about each ride.

		Ride written about			
		The Drop	The Beanstalk	The Giant	**Total**
Year group	Year 7	24	45	23	**92**
	Year 8	36	17	22	**75**
	Year 9	20	13	25	**58**
	Total	**80**	**75**	**70**	**225**

Three children were randomly selected from those who went on the trip.

Calculate the probability that one wrote about 'The Drop', one wrote about 'The Beanstalk' and one wrote about 'The Giant'.

(Total 2 marks)

Q3.

A sample of 200 households was obtained from a small town.

Each household was asked to complete a questionnaire about their purchases of takeaway food.
A is the event that a household regularly purchases Indian takeaway food.
B is the event that a household regularly purchases Chinese takeaway food.

It was observed that $P(B|A) = 0.25$ and $P(A|B) = 0.1$
Of these households, 122 indicated that they did **not** regularly purchase Indian or Chinese takeaway food.
A household is selected at random from those in the sample.

Find the probability that the household regularly purchases **both** Indian and Chinese takeaway food.

(Total 6 marks)

Q4.

A teacher in a college asks her mathematics students what other subjects they are studying.

She finds that, of her 24 students:

12 study physics
8 study geography
4 study geography and physics

(a) A student is chosen at random from the class.

Determine whether the event 'the student studies physics' and the event 'the student studies geography' are independent.

(2)

(b) It is known that for the whole college:

the probability of a student studying mathematics is $\frac{1}{5}$

the probability of a student studying biology is $\frac{1}{6}$

the probability of a student studying biology given that they study mathematics is $\frac{3}{8}$

Calculate the probability that a student studies mathematics or biology or both.

(4)

(Total 6 marks)

Q5.

On a rail route between two stations, A and B, 90% of trains leave A on time and 10% of trains leave A late.

Of those trains that leave A on time, 15% arrive at B early, 75% arrive on time and 10% arrive late.

Of those trains that leave A late, 35% arrive at B on time and 65% arrive late.

(a) Represent this information by a fully-labelled tree diagram.

(3)

(b) Hence, or otherwise, calculate the probability that a train:

(i) arrives at B early or on time;

(ii) left A on time, given that it arrived at B on time;

(iii) left A late, given that it was not late in arriving at B.

(7)

(c) Two trains arrive late at B. Assuming that their journey times are independent, calculate the probability that exactly one train left A on time.

(4)

(Total 14 marks)

Q6.

A customer goes into a store to buy a refrigerator and a microwave. From past experience it is known that 10% of the refrigerators and 5% of the microwaves will be found to be defective when tested. The customer chooses one refrigerator and one microwave at random and the items are tested.

(a) Find the probability that:

(i) both items are found to be defective;

(2)

(ii) neither item is found to be defective;

(2)

(iii) exactly one of the items is found to be defective.

(2)

(b) Given that exactly one of the items is found to be defective, find the probability that it is the refrigerator.

(3)

(Total 9 marks)

Q7.

(a) Emma visits her local supermarket every Thursday to do her weekly shopping.

The event that she buys orange juice is denoted by J, and the event that she buys bottled water is denoted by W. At each visit, Emma may buy neither, or one, or both of these items.

(i) Complete the table of probabilities, printed below, for these events, where J' and W' denote the events 'not J' and 'not W' respectively.

(3)

(ii) Hence, or otherwise, find the probability that, on any given Thursday, Emma buys either orange juice or bottled water but not both.

(2)

(iii) Show that:

(**A**) the events J and W are **not** mutually exclusive;

(**B**) the events J and W are **not** independent.

(3)

(b) Rhys visits the supermarket every Saturday to do his weekly shopping. Items that he may buy are milk, cheese and yogurt.

The probability, P(M), that he buys milk on any given Saturday is 0.85.
The probability, P(C), that he buys cheese on any given Saturday is 0.60.
The probability, P(Y), that he buys yogurt on any given Saturday is 0.55.
The events M, C and Y may be assumed to be independent.

Calculate the probability that, on any given Saturday, Rhys buys:

(i) none of the 3 items;

(2)

(ii) exactly 2 of the 3 items.

	J	***J'***	**Total**
W			0.65
W'	0.15		
Total		0.30	1.00

(3)

(Total 13 marks)

Mark schemes

Q1.

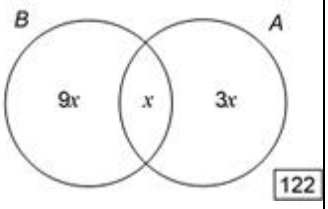
Marking Instructions	AO	Marks	Typical Solution
Circles correct answer	AO1.1b	B1	0.16
			Total 1 mark

Q2.

Marking Instructions	AO	Marks	Typical Solution
Finds P(Drop and Beanstalk and Giant)	AO1.1a	M1	$\frac{80}{225}\times\frac{75}{224}\times\frac{70}{223}$
Multiplies by 6 to obtain correct answer	AO1.1b	A1	$\frac{80}{225}\times\frac{75}{224}\times\frac{70}{223}\times 6 = 0.224$
			Total 2 marks

Q3.

Marking Instructions	AO	Marks	Typical Solution
Uses conditional probability, either ① or ②	AO3.1b	M1	$\frac{P(A\cap B)}{P(A)}=\frac{1}{4}$ ① $\Rightarrow P(A)=4P(A\cap B)$
Obtains both equations ① and ② correctly	AO1.1b	A1	$\frac{P(A\cap B)}{P(B)}=\frac{1}{10}$ ② $\Rightarrow P(B)=10P(A\cap B)$
Evaluates P($A\cup B$) correctly **PI**	AO1.1b	B1	$P(A\cup B)=1-\frac{122}{200}=\frac{39}{100}$
Uses addition law	AO1.1a	M1	$P(A)+P(B)-P(A\cap B)=\frac{39}{100}$ ③
Combines the **three** equations	AO1.1a	M1	$4P(A\cap B)-10P(A\cap B)-P(A\cap B)=\frac{39}{100}$
Obtains correct probability, as a fraction or decimal	AO2.2b	A1	$P(A\cap B)=\frac{3}{100}$

ALT	Produces a relevant Venn diagram	AO3.1b	M1	**OR** 200 
	Labels Venn diagram correctly	AO1.1b	A1	
	Forms correct equation to find x PI	AO1.1b	B1	$9x + x + 3x = 200 - 122$
	Combines terms	AO1.1a	M1	$13x = 78$
	Solves equation	AO1.1a	M1	$x = 6$
	Obtains correct probability	AO2.2b	A1	$P(A \cap B) = \frac{6}{200}$ or 0.03
				Total 6 marks

Q4.

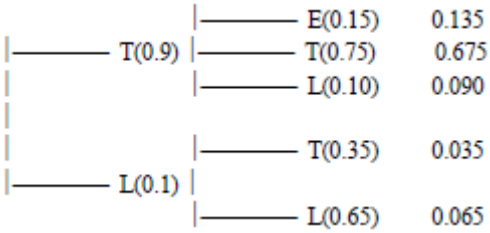
	Marking Instructions	AO	Marks	Typical Solution
(a)	Calculates P(*studies Physics*) × P(*studies Geography*) or Calculates P(*studies Geography* | *studies Physics*) or P(*studies Physics* | *studies Geography*)	AO3.1b	M1	$P(P) \times P(G) = \frac{12}{24} \times \frac{8}{24} = \frac{1}{6}$
	Shows P(*studies Physics*) × P(*studies Geography*) = P(*studies Physics* ∩ *studies Geography*) and correctly concludes that the events are independent or Shows that the appropriate conditional probability is equal to P(*studies Geography*) or P(*studies Physics*) and correctly concludes that the events are independent	AO2.1	R1	$P(P \cap G) = \frac{4}{24} = \frac{1}{6}$ Hence P(P) × P(G) = P(P ∩ G) Therefore events are independent

(b)

Uses conditional probability to calculate P($M \cap B$)	AO3.1b	M1	P($M \cap B$) = P(M) × P(B | M) $= \frac{1}{5} \times \frac{3}{8} = \frac{3}{40}$
Obtains the correct value of P($M \cap B$)	AO1.1b	A1	
Uses the addition rule to calculate P($M \cup B$)	AO1.1a	M1	P(M) + P(B) − P($M \cap B$) $= \frac{1}{5} + \frac{1}{6} - \frac{3}{40}$
Obtains the correct value of P($M \cup B$)	AO1.1b	A1	$= \frac{7}{24}$
			Total 6 marks

Q5.

(a) **A** **B**



Correct shape

B1

Correct labels

B1

Correct probabilities

B1

3

(b) (i) P(E ∪ T @ B) = 0.9 × 0.9 + 0.1 × 0.35

1 – (0.09 + 0.065)

M1

= **<u>0.84 to 0.85</u>**

AWFW *(0.845)*

A1

2

(ii) P(T @ A | T @ B) =

$$\frac{0.9 \times 0.75}{(0.9 \times 0.75 + 0.1 \times 0.35)}$$

P(A | B) ***used in (ii) or (iii)***

M1

$a \div (a + b)$ with at least a correct

m1

$= \frac{0.675}{0.71}$ = **0.95 to 0.951**

AWFW *(0.95070)*

A1

3

(iii) P(L @ A | L′ @ B) = $\frac{0.1\times0.35}{\text{(i)}}$

F on (i)

AF1

$= \frac{0.035}{0.845}$ = **0.04 to 0.042**

AWFW *(0.04142)*

A1

2

(c) P((T @ A | L @ B) ∩ (T′ @ A | L @ B))

$\frac{0.9\times0.1}{1-0.845} \times \frac{0.1\times0.65}{1-0.845} \times 2$

First expression *(18 / 31)*

M1

Second expression *(13 / 31)*

M1

× 2

M1

= **0.486 to 0.49**

AWFW *(0.48699)*

A1

4

[14]

Q6.

(a) (i) P (both) = 0.1 × 0.05 = 0.005

M1A

2

(ii) P (neither) = 0.9 × 0.95 = 0.855

M1A1

2

(iii) P (exactly one) = 0.14

ft wrong values if subtraction from 1 used

M1A1F

2

(b) Formula for conditional prob

Fraction with 0 < N < D < 1 and D correct or equal to c's answer to (a)(iii)

M1

Numerator = 0.1 × 0.95

m1

Denom = 0.14 so ans = $\frac{19}{28}$

ft wrong answer to (a)(iii);
Accept AWRT 0.679 or 0.678

A1F

3

[9]

Q7.

(a) (i)

	J	***J'***	**Total**
W	**0.55**	**0.10**	0.65
W'	0.15	**0.20**	**0.35**
Total	**0.70**	0.30	1.00

B1

0.35 and 0.7*; CAO*

B1

0.55*; CAO*

B1

0.1 and 0.2*; CAO*

Notes:
Use of Venn or tree diagrams **without** table completion ⇒ B0 B0 B0

Accept fractional answers
Do not accept percentages

Printed table not completed but constructed and completed on a different page ⇒ B1 B1 B1 max

3

(ii) P(purchases exactly one)

= P($W \cap J'$) + 0.15
= 0.10 + 0.15

Only c's equivalent to 0.10 ***shown and added to*** *0.15*
Can be implied by ***correct*** *answer*

M1

= **0.25 or 25/100 or 5/20 or 1/4**

CAO

A1

2

(iii) **(A)** P(W U J) = **0.8 &/≠** P(W) + P(J) = **1.35**

or P($W \cap J$) = **0.55** (>0); accept if indicated in a Venn diagram

or P(W) + P(J) = **1.35 >0 or impossible**

Any one of these three ***seen***
Ignore contradictions, explanations & justifications

B1

(B) P(W | J)= 0.55/0.70 = **0.79**

Do ***not*** *accept use of W' and/or J'*
AWRT

B1

&/≠ p(W) = **0.65**

Bdep1

or P(J | W) = 0.55/0.65 = **0.85**

&/≠ P(J) = **0.70**

or P(W) × P(J) = **0.45 to 0.46**

&/≠ P($W \cap J$) = **0.55**

Any one of these three ***seen***
Ignore contradictions, explanations & justifications
AWFW

3

(b) **Do not allow multiplying factors in (b)**

(i) P(0) = 0.15 × 0.40 × 0.45

Can be implied by ***correct*** *answer or*
1 – (0.2265 + 0.466 + 0.2805)

B1

= **0.027 or 27/1000**

CAO

B1

2

(ii) P(2) = **0.85** × **0.60** × **0.45** = 0.2295
+ **0.85** × **0.40** × **0.55** = 0.1870
+ **0.15** × **0.60** × **0.55** = 0.0495

For either method:

At least two bold *expressions correct*

Only one bold *expression correct*

Can be implied by ***correct*** *answer*

M2
(M1)

or

= 1 – (**0.027** + **0.2265** + **0.2805**)

For second method:

Must have '1 –' for any marks

= **0.466 or 466/1000 or 233/500**

CAO; ***do not*** *imply this from (i)*

A1

3

[13]