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# Level 3 Certificate

# MATHEMATICAL STUDIES

# 1350/2B

Paper 2B Critical Path and Risk Analysis

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Mark scheme

June 2021

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Version: 1.2 Final Mark Scheme



2 1 6 A 1 3 5 0 / 2 B / M S

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Q	Answer	Mark	Comments
1 (a)	1 : 3	B1	

Q	Answer	Mark	Comments
1 (b)	<b>Statement 1</b>		
	5810 + 6900 + 7640 or 20 350	M1	
	their 20 350 × 27 000 or 549 450 000 or 500 000 000 ÷ 27 000 or 18 518(...) or 500 000 000 ÷ their 20 350 or 24 570(...)	M1dep	
	549 450 000 <b>and</b> Yes or 18 518(...) <b>and</b> 23 500 <b>and</b> Yes or 24 570(...) <b>and</b> Yes	A1	SC2 543 240 000 <b>and</b> Yes SC1 543 240 000
	<b>Statement 2</b>		
	<b>Alternative method 1</b>		
	2615 ÷ 5810 (× 100) or 0.45(0...) (× 100) or 45(.0...) % and 5450 ÷ 7640 (× 100) or 0.71(3...) (× 100) or 71.(3...) %	M1	
	their 0.45 × 1.5 or 0.675 or their 45 × 1.5 or 67.5 or their 0.71 ÷ their 0.45 or 1.57... or their 71 ÷ their 45 or 1.58	M1dep	oe
	Yes <b>and</b> 1.57 ... or 1.58 or Yes <b>and</b> 0.71 <b>and</b> 0.675 or Yes <b>and</b> 71 <b>and</b> 67.5	A1	

<b>1 (b) cont'd</b>	<b>Alternative method 2</b>		
	5810 ÷ 2615 (× 100) or 2.22(1...) (× 100) or 222(.1...) % and 7640 ÷ 5450 (× 100) or 1.40(1...) (× 100) or 140(.1...) %	M1	
	their 2.22 ÷ 1.5 or 1.48 or their 222 ÷ 150 or 1.48 or their 2.22 ÷ their 1.40 or 1.58... or their 222 ÷ their 140 or 1.58... or 1.59	M1dep	oe
	Yes <b>and</b> 1.58 or 1.59 or Yes <b>and</b> 1.40 <b>and</b> 1.48 or Yes <b>and</b> 140 <b>and</b> 148	A1	
	<b>Additional Guidance</b>		
	Statement 2 award the first M1 seen even if not subsequently used		

Q	Answer	Mark	Comments
2 (a)	<p>Add extra value(s) to the scale (eg every 10% to Chart 1 or add 1.0 to Chart 2)</p> <p>Move the million tonnes label from the title to the vertical axis</p> <p>Label the axes</p> <p>Show actual numbers on the charts</p> <p>Use a grid so values can be read more accurately</p> <p>Explain what 'EU28' on Chart 1 stands for</p> <p>Move the/Add a y-axis on the left-hand side of the graph</p>	E2	<p>E1 for each valid improvement with up to a maximum of E2</p> <p>ignore any additional but incorrect suggestions</p> <p>SC1 two errors identified but no suggestions for improvement</p>

Q	Answer	Mark	Comments
2 (b)	<p>No key for abbreviation WWF/EU</p> <p>Years used for comparison vary each time</p> <p>Some data were not shown/missing (eg other exports to countries)</p> <p>The article is inconsistent with mixed % and numbers/figures</p> <p>The latest estimates available are several years before the publication of the briefing paper and so may be out of date / no longer representative</p> <p>The different streams make it difficult to understand the full picture, especially across the official and WWF figures</p> <p>The term 'waste stream' is undefined</p> <p>Sweden and the Netherlands are not larger than the UK in terms of population Netherlands isn't larger than the UK in terms of area</p> <p>They do not list all the different types of treatment (it just says etc)</p>	E3	<p>oe</p> <p>E1 for each valid reason</p>
<b>Additional Guidance</b>			
Suggested improvements can imply the reason			
Too many percentages and/or figures scores E0			

Q	Answer	Mark	Comments
<b>2 (c)</b>	<b>Ecofriends</b>		
	<b>Alternative method 1</b>		
	122 400 – 53 400 or 69 000	M1	
	their 69 000 $\div$ 122 400 $\times$ 100 (%) or 56.(3...) or 56.4	M1dep	
	56.(3...) or 56.4 (%) <b>and</b> No/false/incorrect/invalid	A1	condone –56.(3...) or –56.4 (%)
	<b>Alternative method 2</b>		
	53 400 $\div$ 122 400 or 0.43(...) or 0.44	M1	
	(1 – their 0.43(...)) $\times$ 100 (%) or 56.(3...) or 56.4	M1dep	
	56.(3...) or 56.4 (%) <b>and</b> No/false/incorrect/invalid	A1	condone –56.(3...) or –56.4 (%)
	<b>Alternative method 3</b>		
	122 400 $\times$ 0.6 or 73 440	M1	oe
	122 400 – their 73 440 or 48 960	M1dep	
	48 960 <b>and</b> No/false/incorrect/invalid	A1	
	<b>Alternative method 4</b>		
	100(%) – 60(%) or 40(%) or 0.4 seen	M1	oe
	122 400 $\times$ their 0.4 or 48 960	M1dep	
48 960 and 53 400 <b>and</b> No/false/incorrect/invalid	A1		

Q	Answer	Mark	Comments
2 (c) cont'd	<b>Greenusers</b>		
	<b>Alternative method 1</b>		
	$1.53 \div 1.24$ or $1.23(\dots)$	M1	oe eg working in tonnes
	$1.53 - \text{their } 1.23(\dots)$	M1dep	
	0.3 or $0.296(\dots)$ (million tonnes) or 296 129 <b>and</b> Yes/true/correct/valid	A1	
	<b>Alternative method 2</b>		
	$(1.53 - 0.3) \times 1.24$ or $1.52(5\dots)$	M2	oe eg working in tonnes
	$1.52(5\dots)$ <b>and</b> Yes/true/correct/valid	A1	
	<b>Alternative method 3</b>		
	$1.53 \div (1.53 - 0.3)$ or $1.243(9\dots)$	M2	oe eg working in tonnes
	$24.3(9\dots)$ or $24.4$ <b>and</b> Yes/true/correct/valid	A1	

Q	Answer	Mark	Comments
2 (d)	No units on $y$ -axis One of the bars is incorrect (Malaysia) No title for the graph Not showing all other countries to make up to 100% The $y$ -axis says 'Amount' rather than 'Percentage' All bars are wrong because the vertical axis states amount	E2	E1 for each valid error identification of errors may be implied by suggestions for improvement
	<b>Additional Guidance</b>		
	Allow two errors in one answer space Ignore incorrect statement if non-contradictory		

Q	Answer	Mark	Comments
3 (a)	7 in correct place	B1	
	2 in correct place	B1ft	ft their 7 if their $7 \leq 9$
	<b>Additional Guidance</b>		

Q	Answer	Mark	Comments
3 (b)	$5 + 3 + 11 + 25 +$ their 7 or 51	M1	ft their 7 from 3 (a)
	$\frac{51}{55}$ or 0.927(...) or 0.93 or 92.7(...) % or 93%	A1ft	ft their 7 from 3 (a) oe fraction, decimal or percentage
	<b>Additional Guidance</b>		
	Ignore an incorrect conversion from a correct fraction		

Q	Answer	Mark	Comments
3 (c)	(the flag) does not have red but/and does have green	E1	any valid description of the event condone "The flag has only green, or green and yellow"
	<b>Additional Guidance</b>		
	Condone "The probability of..." if followed by a correct description of a flag		



Q	Answer	Mark	Comments
3 (d)	Denominator of 45 seen	M1	
	$\frac{32}{45}$ or 0.71(1...) or 71(.1...)%	A1ft	oe fraction, decimal or percentage follow through 2 + 11 + 25 + their 7 for the numerator
	<b>Additional Guidance</b>		
	Ignore an incorrect conversion from a correct fraction		

Q	Answer	Mark	Comments
4 (a) (i)	11	B1	
	<b>Additional Guidance</b>		
	Check diagram for working		

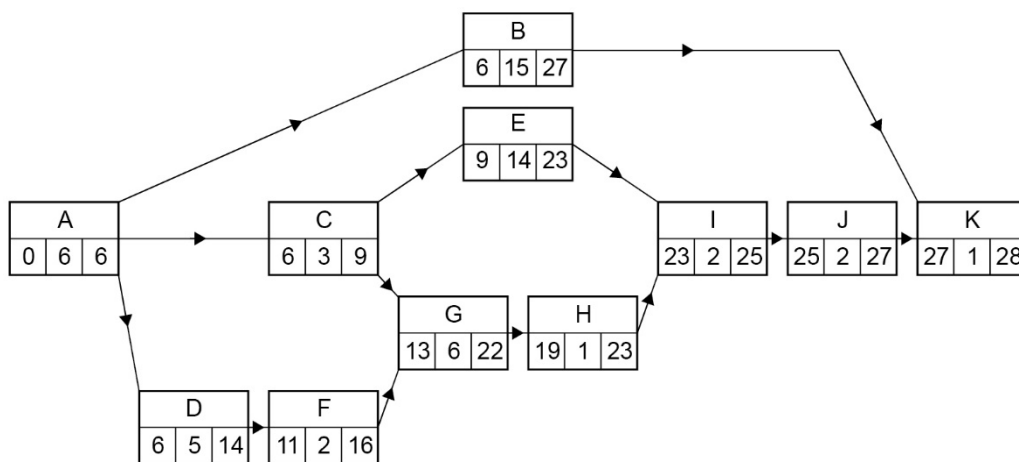
Q	Answer	Mark	Comments
4 (a) (ii)	10	B2	B1 for 24 – 14 or 23 – 10
	<b>Additional Guidance</b>		
	Check diagram for working		

Q	Answer	Mark	Comments
4 (a) (iii)	28 – 7 – 6	M1	
	15	A1	
	<b>Additional Guidance</b>		
	Check diagram for working		

Q	Answer	Mark	Comments
4 (a) (iv)	ADFGHIJK	B1	

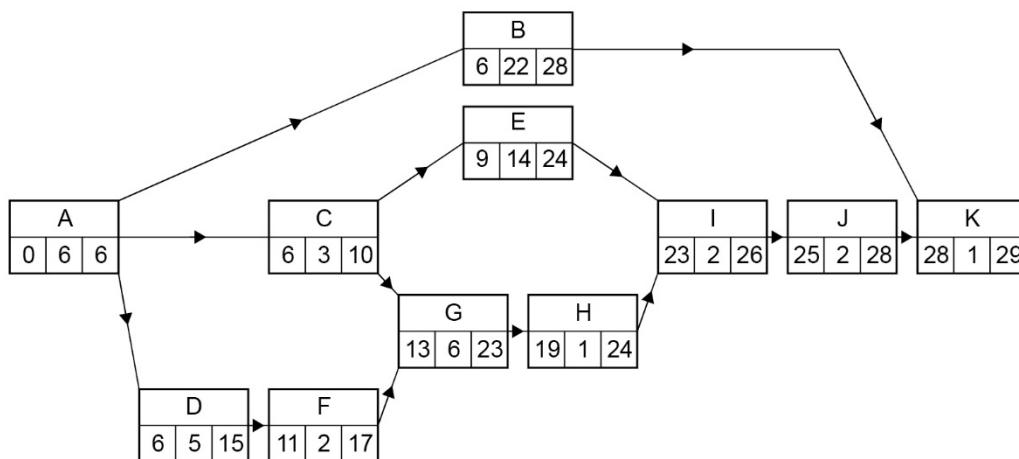
Q	Answer	Mark	Comments
4 (b) (i)	Forward pass correct for E, F, G and H	M1	
	Forward pass fully correct	A1ft	follow through their 15 for B
	Backward pass correct for E, H, I, J and K	M1	
	Backward pass fully correct	A1ft	follow through their 15 for B

**Additional Guidance**



If their duration for B is not 15 you must view their answer to **4(a)(iii)**

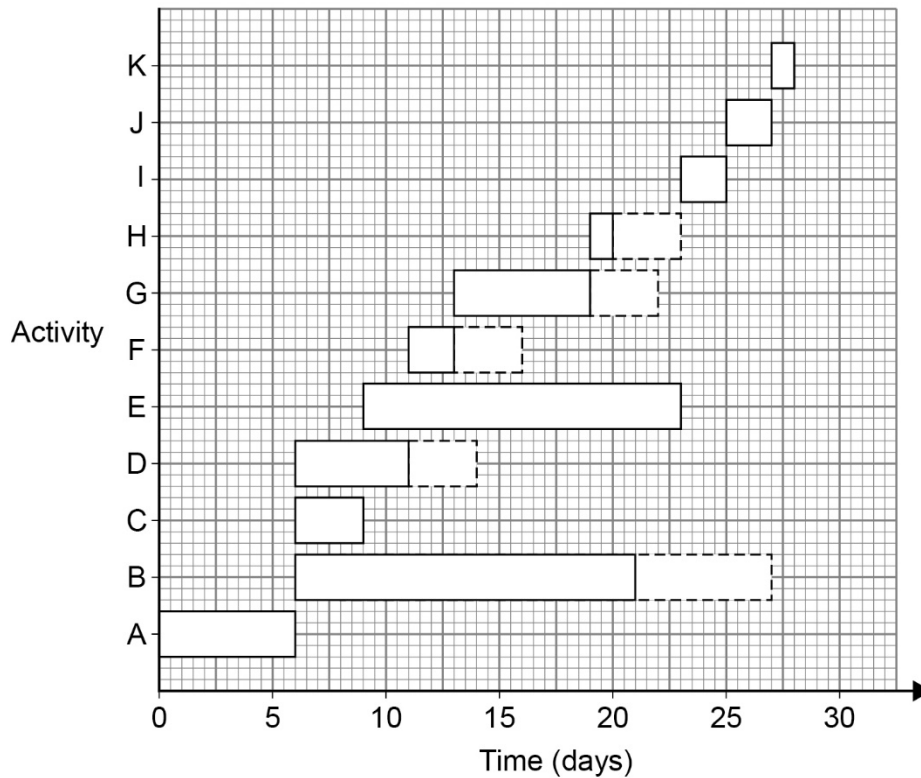
If their duration for B is 22 their network should be



Q	Answer	Mark	Comments
4 (b) (ii)	D, F, G or H	B1	ft their critical path in 4 (a) (iv)
	<b>Additional Guidance</b>		
	One correct and one incorrect is choice		B0
	More than one given and all correct		B1

Q	Answer	Mark	Comments
4 (b) (iii)	At least 3 activities plotted correctly	M1	
	Critical activities plotted accurately	A1ft	ft their activity network ignore additional incorrect floats
	At least 2 floats of correct duration plotted	M1dep	dep on first M1
	Fully correct Gantt chart	A1ft	ft their activity network

**Additional Guidance**



Q	Answer	Mark	Comments
<b>5 (a)</b>	<b>Alternative method 1 (expected cost of one item)</b>		
	0.65 + 3 or 3.65 or 0.95 + 3.2 or 4.15	M1	fixed costs of packaging and delivery
	0.065 × 18 or 1.17 or 0.04 × 18.75 or 0.75	M1	expected cost of replacing damaged items
	their 3.65 + their 1.17 or 4.82	M1	expected cost using the original packaging
	their 4.15 + their 0.75 or 4.90	M1	expected cost using the new packaging
	4.82 <b>and</b> 4.90	A1	expected costs
	<b>Alternative method 2 (expected cost of, eg, 200 items)</b>		
	0.65 + 3 or 3.65 or 0.95 + 3.2 or 4.15	M1	fixed costs of packaging and delivery
	200 × their 3.65 or 730 or 200 × their 4.15 or 830	M1	cost of sending (eg 200) original items follow through any sensible number of items
	200 × 0.065 or 13 or 200 × 0.04 or 8	M1	number of expected damaged items
	their 13 × 18 or 234 or their 8 × 18.75 or 150	M1	expected cost of replacing damaged items
	964 <b>and</b> 980	A1	expected costs from 730 + 234 and 830 + 150

Q	Answer	Mark	Comments
<b>5 (a) cont'd</b>	<b>Alternative method 3 (additional cost of new packaging)</b>		
	3.20 – 3.00 or 0.20 or 0.95 – 0.65 or 0.30	M1	difference in cost per order between using the new and old packaging
	0.20 + 0.30 or 0.50	M1	additional cost per order of using the new packaging
	0.065 × 18 or 1.17 or 0.04 × 18.75 or 0.75	M1	expected cost of a damaged item
	their 1.17 – 0.75 or 0.42	M1	expected saving of using the new packaging
	0.50 > 0.42 or 8p more expensive	A1	oe

Q	Answer	Mark	Comments
5 (b)	<b>Alternative method 1 (expected cost of one item)</b>		
	0.95 – (their 4.90 – their 4.82) or 0.87 or their 4.82 – their 0.75 – 3.20 or 0.87	M1	oe
	87	A1ft	ft from <b>5 (a)</b> condone 87p or 87 pence do not accept 0.87 for A1
	<b>Alternative method 2 (expected cost of, eg, 200 items)</b>		
	0.95 – (980 – 964) ÷ 200 or 0.87	M1	oe
	87	A1ft	ft from <b>5 (a)</b> condone 87p or 87 pence do not accept 0.87 for A1
	<b>Alternative method 3 (additional cost of new packaging)</b>		
	0.95 – their 0.08 or 0.87 or 0.95 – (their 0.50 – their 0.42) or 0.87	M1	oe
	87	A1ft	ft from <b>5 (a)</b> condone 87p or 87 pence do not accept 0.87 for A1
	<b>Additional Guidance</b>		
	May be determined algebraically, eg by solving $c + 320 + 75 = 482$		

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<b>Q</b>	<b>Answer</b>	<b>Mark</b>	<b>Comments</b>
<b>5 (c)</b>	The actual rate of returns may be higher than the 4% estimated by the small trial Assumption of the cost of processing a damaged order may be wrong There may be other costs of using the new packaging that were not considered	E1	any valid reason

Q	Answer	Mark	Comments
6 (a)	$0.8 \times 0.1$	M1	
	0.08	A1	oe fraction, decimal or percentage

Q	Answer	Mark	Comments
6 (b)	<b>Alternative method 1</b>		
	$1 - 0.05$ or 0.95	M1	could be seen on a tree diagram, eg in part 6 (a)
	$(1 - 0.8) \times$ their 0.95 or 0.19	M1	$\frac{56}{\text{their } 0.08} \times 0.2 \times 0.95$ scores M3
	$\frac{56}{\text{their } 0.08}$ or 700	M1	
	their 700 $\times$ their 0.19	M1	
	133	A1ft	ft 6 (a)
	<b>Alternative method 2</b>		
	$1 - 0.05$ or 0.95	M1	could be seen on a tree diagram, eg in part 6 (a)
	$(1 - 0.8) \times$ their 0.95 or 0.19	M1	$\frac{56}{\text{their } 0.08} \times 0.2 \times 0.95$ scores M3
	$\frac{\text{their } 0.19}{\text{their } 0.08}$ or 2.375	M1	
	$56 \times$ their 2.375	M1	
	133	A1ft	ft 6 (a)



Q	Answer	Mark	Comments
<b>6 (b) cont'd</b>	<b>Alternative method 3</b>		
	1 – 0.05 or 0.95	M1	could be seen on a tree diagram, eg in part <b>6 (a)</b>
	$(1 - 0.8) \times$ their 0.95 or 0.19	M1	$56 \times \frac{100}{80} \times \frac{100}{10} \times 0.2 \times 0.95$ scores M3
	$56 \times \frac{100}{80} \times \frac{100}{10}$ or 700	M1	
	their 700 $\times$ their 0.19	M1	
	133	A1	
	<b>Alternative method 4</b>		
	1 – 0.05 or 0.95	M1	could be seen on a tree diagram, eg in part <b>6 (a)</b>
	$56 \times 10$ or 560	M1	
	$560 \times \frac{100}{80} - 560$ or $700 - 560$ or 140	M1	
	their 140 $\times$ their 0.95	M1	
	133	A1	
	<b>Alternative method 5</b>		
	1 – 0.05 or 0.95	M1	could be seen on a tree diagram, eg in part <b>6 (a)</b>
	$56 \times 10$ or 560	M1	
	their $560 \div 4$ or 140	M1	
	their 140 $\times$ their 0.95	M1	
	133	A1	

Q	Answer	Mark	Comments
6 (c)	<b>Alternative method 1</b>		
	$0.8 \times 0.9$ or $0.72$ or $0.2 \times 0.05$ or $0.01$	M1	oe
	$\frac{0.8 \times 0.9}{0.8 \times 0.9 + 0.2 \times 0.05}$ or $\frac{0.72}{0.73}$	M1dep	oe
	$\frac{72}{73}$ or $0.986(\dots)$	A1	oe fraction, decimal or percentage
	<b>Alternative method 2</b>		
	$0.8 \times 0.9 \times 700$ or $504$ or $0.2 \times 0.05 \times 700$ or $7$	M1	oe
	$\frac{504}{504+7}$ or $\frac{504}{511}$	M1dep	oe
	$\frac{72}{73}$ or $0.986(\dots)$	A1	oe fraction, decimal or percentage
	<b>Additional Guidance</b>		
	Ignore rounding or simplifying after correct answer seen		