AQA

Level 3 Certificate
MATHEMATICAL STUDIES
1350/2B

Paper 2B Critical path and risk analysis

Mark scheme

June 2019

Version: 1.0 Final

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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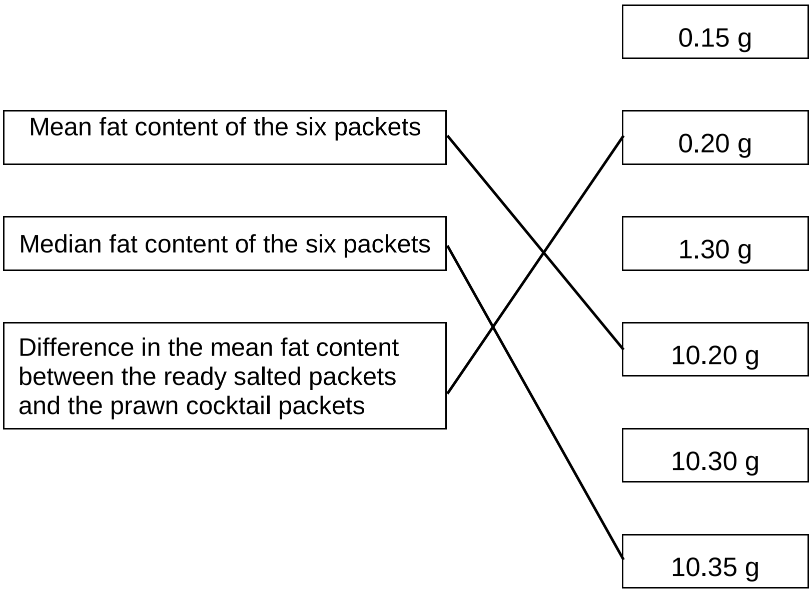
Further copies of this mark scheme are available from aqa.org.uk

Q	Answer	Mark	Comments
1 (a)		B3	B2 for two pairs correctly matched B1 for one pair correctly matched
	Additional Guidance		
	Two lines from one left hand box is choice		

Q	Answer	Mark	Comments
1 (b)	No labels on the (horizontal) x axis Wrong units used (kg used instead of g) One of the bars is incorrect (brand C's ready salted) No title for the graph The scale labelled incorrectly as 9 instead of 0.009 etc Has/should not have a broken axis or does not start at zero	E2	oe E1 for each valid error Condone improvements which imply errors e.g. add a title
	Additional Guidance		
	Ignore any incorrect additional suggestion		

Q	Answer	Mark	Comments
1 (c)	**Alternative method 1**		
	$230 \div 10$	M1	or indicates there are 23 lots of 10p Can be implied by 69 (not 69.12) or their $69.12 \div 23$ or their $69.12 \div 230 \div 10$ or 3.(…)
	$160 \div 25 \times 10.8$ or 69.12	M1	Condone 9.6 instead of 10.8
	their $69.12 \div 23$ or 3.(…) or 3×23 or 69 or their $69.12 \div 3$	M1	
	3.(…) or 3.005(217…) or 3.01 **and** Yes or 69.12 **and** 69 **and** Yes or 23.04 **and** 23 **and** Yes	A1	Allow 3 with method
	Alternative method 2		
	$230 \div 10$	M1	or indicates there are 23 lots of 10p Can be implied by 6.95(…) or 6.96 or 7
	$160 \div 23$ or 6.95(…) or 6.96 or 7	M1	g per 10p 6.96 or 7 implies M2
	$10.8 \div 25 \times$ their 6.95(…) or $0.432 \times$ their 6.95(…)	M1	Condone 9.6 instead of 10.8
	3.(…) or 3.005(217…) or 3.01 **and** Yes	A1	Allow 3 with method

Q	Answer	Mark	Comments
1 (c) Cont.	**Alternative method 3**		
	160 ÷ 25 × 10.8 or 6 × 10.8 + 2 × 2.16 or 16 × 4.32 or 69.12	M1	Condone 9.6 instead of 10.8 Using 10.8g in 25g so 2.16 in 5g or 4.32 in 10g
	10 ÷ 3 or 3.3(3…)	M1	
	their 3.3(3…) × their 69.12 or 230 ÷ their 69.12 or 3.327(….) or 3.328 or 230 ÷ their 3.3(3…) or 69.(0…)	M1	Must convert £2.30 to 230 Must convert £2.30 to 230
	[228, 230.4] **and** 230 **and** Yes or 3.327(….) or 3.328 **and** 3.3(3…) **and** Yes or 60.12 **and** 69.(0…) **and** Yes	A1	Must convert £2.30 to 230
	Additional Guidance		
	Award full marks in all alternative methods for final correct answer with no or some working. Alt 1 gives final answer 3.(…) or 3.005(217…) or 3.01 **and** Yes or 69.12 **and** 69 **and** Yes or 23.04 **and** 23 **and** Yes Alt 2 gives final answer 3.(…) or 3.005(217…) or 3.01 **and** Yes Alt 3 gives final answer [228, 230.4] **and** 230 **and** Yes or 3.327(….) or 3.328 **and** 3.3(3…) **and** Yes or 60.12 **and** 69.(0…) **and** Yes		
	Using 9.6 instead of 10.8 can score M3A0. The corresponding values are as follows; 69.12 → 61.44 3.(…) → 2.67(…) 23.04 → 20.48 [228, 230.4] → [202.7, 205] 3.327(….) → 3.74(…)		

Q	Answer	Mark	Comments
2 (a)	**Main article** Give information about what the scores represent Keep information nearer the graph it refers to Show all data in a table format for ease of comparison Show data/values for years between 2006 and 2012 State what OECD is Write down the scores from previous PISA rather than saying gone up/down from previous **Graphs** Add a vertical axis Add overall average PISA/OECD scores to graph(s) Add a broken axis Correct the title of each graph so it says 'score' not 'ranking' Label or add units to the *x*/*y*/both axes Line up the scores precisely with the horizontal lines State what NI is Start the vertical scales at the same point Show the UK line in each graph for ease of comparison Use common vertical scales (i.e. 460 to 520) or increase height of vertical axis Use scales/grid line so can easily read the values for each year	E3	E1 for each valid improvement Ignore any additional but incorrect suggestions SC1 two errors identified but no suggestions for improvement SC2 three errors identified but no suggestions for improvement e.g. data is not shown in table format no details for years before 2006

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="3">2 (b)</td><td>makes one or more statements implying critical analysis
and
gives 3.24(…)% or 3.25% as final answer with all errors corrected or any correct method shown

statements of critical analysis
1. makes reference to the denominator,
e.g. should be ÷ 493 (not 509) oe
2. recognises that the % sign is placed incorrectly, e.g.
should multiply 0.0314 by 100(%)
or
should not put % sign after 0.0314 oe
or
allow ×100 seen</td><td>B3</td><td>B2 makes two statements implying critical analysis
and
gives no or incorrect final answer
or
B2 gives 3.24(…)% or 3.25% as final answer with all errors corrected or any correct method shown
and
makes no statement implying critical analysis
or
B1 makes one statement implying critical analysis
and
gives no or incorrect final answer
or
B1 gives 3.24(…)% or 3.25% as final answer with no working and no statement implying critical analysis</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="3">No critical analysis can score maximum B2</td></tr>
</table>

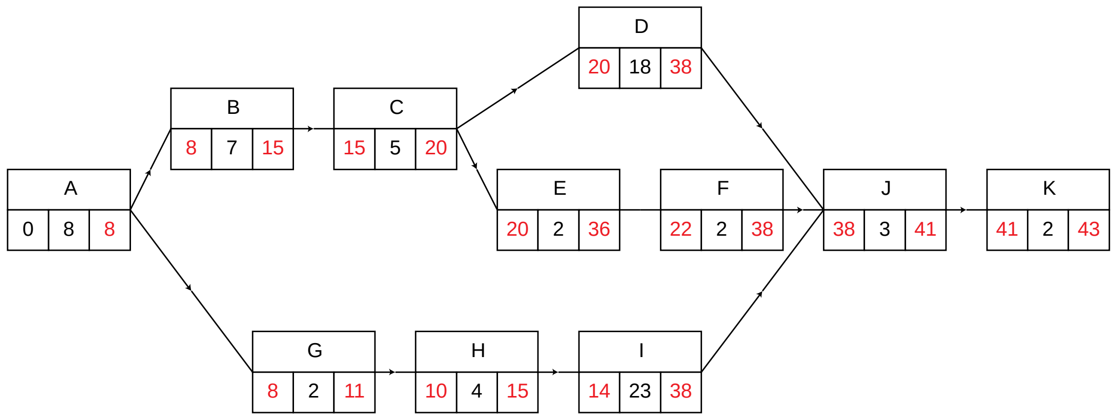
Q	Answer	Mark	Comments
2 (c) (i)	**Alternative method 1** (Simon)		
	493 **and** 478 seen or 493 – 478 or 15	M1	
	15 **and** Yes	A1	
	Alternative method 2 (Simon)		
	[492, 495] **and** [476, 479] seen or [492, 495] – [476, 479] (=[13, 19])	M1	Two chosen numbers must be within the given range
	[13, 19] **and** Yes	A1	
	Alternative method 3 (Simon)		
	Wales is below 480 **and** all the others/England are above 490 **and** Yes	B2	B1 Wales is below 480 and all the others/England are above 490
	Additional Guidance		
	Right answer from wrong method scores M0 A0 eg 509 – 492 = 17 and Yes. 509 is outside [492, 495] and 492 is outside [476, 479]		

Q	Answer	Mark	Comments
2 (c) (ii)	**Alternative method 1** (Rukshana)		
	493 ÷ 506 (×100) or [0.97, 0.9744] or [97, 97.44] or 13 ÷ 506 (×100) or [0.0256, 0.03] or [2.56, 2.57]	M1	oe
	their [0.97, 0.9744] × 493 or 493 – their [0.0256, 0.03] × 493	M1	oe
	[0.97, 0.9744] × 493 = [478, 481] **and** Yes or 493 – [0.0256, 0.03] × 493 = [478, 481] **and** Yes	A1	
	Alternative method 2 (Rukshana)		
	[492, 495] ÷ [505, 508] (×100) or [0.968, 0.98] or [96.8, 98] or [10, 16] ÷ [505, 508] (×100) or [0.0196, 0.0317] or [1.96, 3.17]	M1	oe
	their [0.968, 0.98] × [492, 495] or [492, 495] – their [0.0196, 0.0317] × [492, 495]	M1	oe
	[0.968, 0.98] × [492, 495] = [476, 485) **and** Yes or [492, 495] – [0.0196, 0.0317] × [492, 495] = [485, 485.2] **and** No	A1	
	Additional Guidance		
	[476, 485) → 476 ≤ value < 485		

Q	Answer	Mark	Comments
3 (a)	$\frac{28}{41}$ or 0.68(…) or 68.(…)%	B1	oe

Q	Answer	Mark	Comments
3 (b)	**Alternative method 1**		
	$\frac{65}{41}$ or $\frac{5.4}{41}$ or 65×5.4	M1	For dividing 65 or 5.4 by 41 or Multiplying 65 by 5.4
	$\frac{65}{41} \times 5.4$	M1	oe
	8 560 976 or 8.6 million	A1	awrt 8.6 million
	Alternative method 2		
	$\frac{28+13}{491}\left(=\frac{41}{491}\right)$	M1	
	5.4 million $\div \frac{\text{their } 41}{491}$ (= 64.7 million) **and** $\frac{13+52}{491} \times 64.7$ million	M1	
	8 560 976 or 8.6 million	A1	awrt 8.6 million
	Additional Guidance		
	awrt 8.5 million scores M2A1 if supported by correct working		

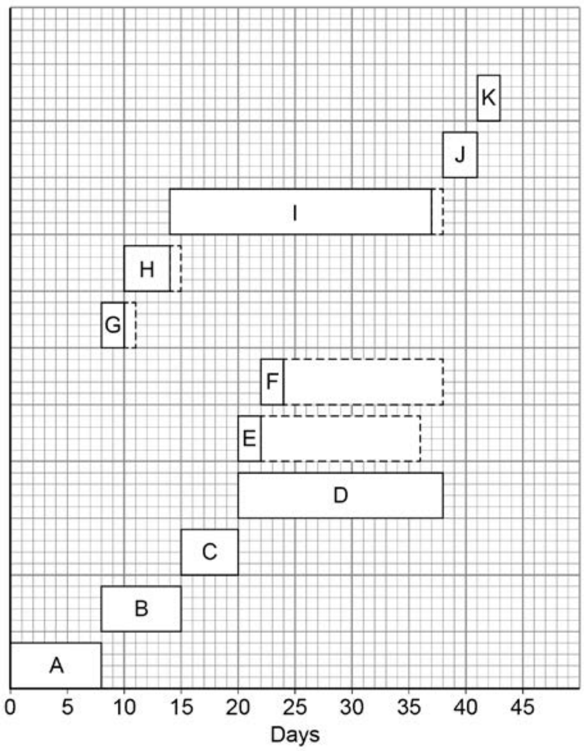
Q	Answer	Mark	Comments
3 (c)	The survey asked adults: the rate in the whole population (including children) may be different The rate in the population may be different than the rate in the sample The sample was relatively small compared to the size of the population The survey data may be out of date and so not representative of the current population	E1	E1 for any reasonable statement
	Additional Guidance		
	‘survey is biased’ scores E0 unless supported with a reason or reference to the population. ‘sample is small’ or ‘needs a bigger sample’ scores E0 unless reference is made to the size of the population (possibly implied) ‘some people may not be aware they have asthma’ or ‘misdiagnosis’ scores E0		

Q	Answer	Mark	Comments
4 (a)	Network of at least five activities **and** four arcs with A, B, C, D and E correctly linked	B1	
	D, F and I only immediate predecessors of J	M1	
	Activity network correct See diagram below	A1	All boxes A to K linked correctly
	Forward pass correct for A, B, C, D and E	M1	
	Forward pass fully correct	A1	
	Backward pass correct as far as D, F and I	M1	Follow through their K
	Backward pass and durations fully correct	A1	
			

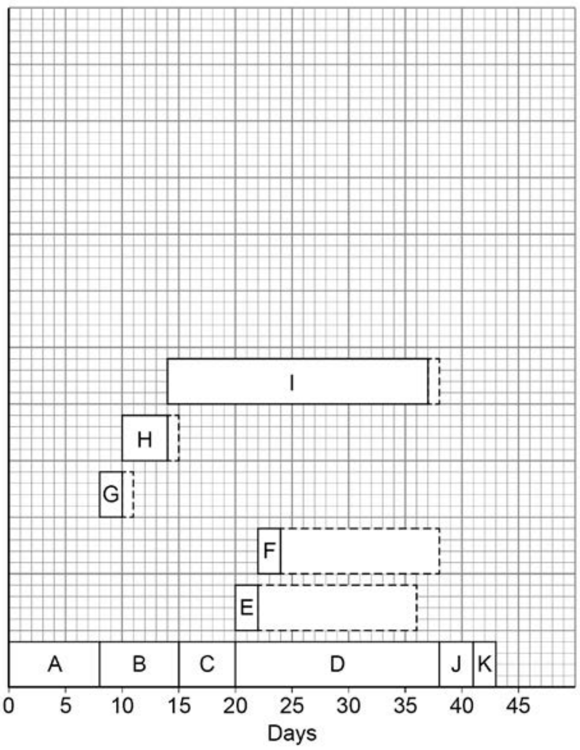
Q	Answer	Mark	Comments
4 (b)	At least 3 tasks plotted correctly with tasks labelled	M1	Durations must be proportional Accept without floats
	Critical tasks plotted accurately	A1	A, B, C, D, J, K (Not necessarily in a single row) Must not have float on any critical activity
	At least 2 floats of correct duration plotted	M1dep	Must have scored first M1 mark
	All correct including timescale evenly spaced **and** units labelled	A1	See diagram in Additional Guidance

Additional Guidance

Cascade diagram:

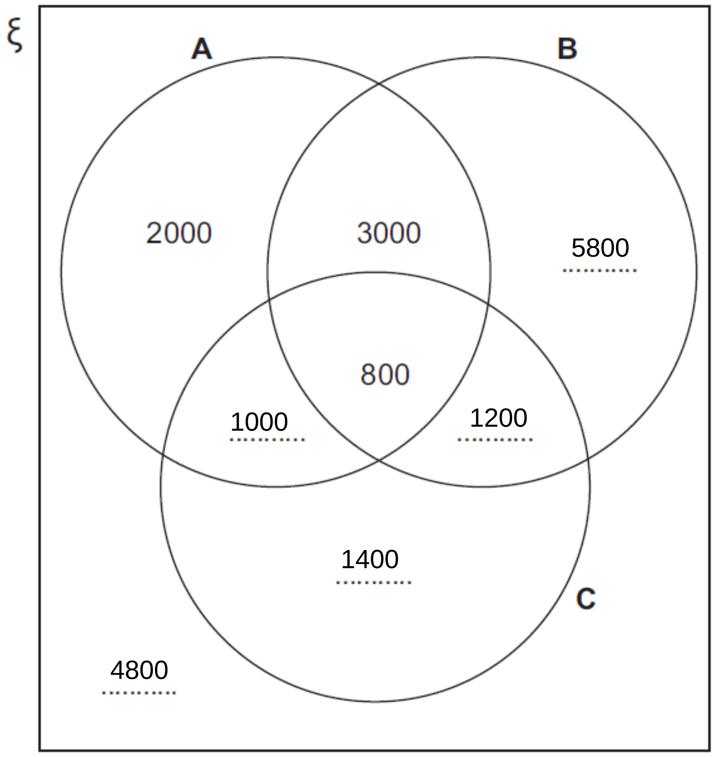


Gantt chart:



Q	Answer	Mark	Comments
4 (c) (i)	1	B1	

Q	Answer	Mark	Comments
4 (c) (ii)	0.35 + 0.30 + 0.06 or 1 – 0.08 – 0.21	M1	P(delay of more than 1 day)
	0.71	A1	oe

Q	Answer	Mark	Comments
5(a)	1000 in correct place	B1	
	1200 in correct place	B1	
	7000 – their 1200 or 5800 in correct place or 2600 – their 1200 or 1400 in correct place	M1	Follow through their answer from second B1
	All correct	A1	Including 4800
	Additional Guidance		
			

Q	Answer	Mark	Comments
5 (b)	4800	B1	ft from **5 (a)** or correct

Q	Answer	Mark	Comments
5 (c)	$\dfrac{\text{their } 5800 + \text{their } 1200}{10800}$ or $\dfrac{7000}{10800}$	M1	ft their **5 (a)** for the numerator Denominator must be 10800
	$\dfrac{35}{54}$	A1ft	Final answer must be a fraction in its lowest terms
	Additional Guidance		
	0.648(…) or 0.65 implies M1A0		

Q	Answer	Mark	Comments
5 (d)	$2 \times \dfrac{\text{their total in set C}}{20000} \times \dfrac{\text{remainder}}{19999}$ or $2 \times \dfrac{4400}{20000} \times \dfrac{15600}{19999}$ or 0.343(2…)	M1	oe Condone omission of $2 \times$ Condone both denominators 20000 Allow (for example) $2 \times \dfrac{44}{200} \times \dfrac{156}{200}$
	0.34	A1ft	ft
	Additional Guidance		
	0.17(16…) implies M1A0		

Q	Answer	Mark	Comments
6 (a)	**Alternative method 1**		
	1 – 0.4 or 0.6	M1	Probability that whales do **not** appear in the 1st week (or any given week)
	0.6 × 0.4 or 1 – 0.4 – 0.36 or 0.24	M1	Probability that whales appear in the 2nd week but not the 1st Can be awarded if a quantity is multiplied by 0.6 and then by 0.4 oe
	0.6 × 0.6 or 1 – 0.4 – 0.24 or 0.36	M1	Probability that whales do not appear in either week Can be awarded if a quantity is multiplied by 0.6 and then by 0.6 oe
	<u>Option B</u> 0.4 × (80 – 200) or 32 (–) 80 or –48	M1	Contribution to expected costs if whales appear Do not accept –48 from 0.24 × –200
	their 0.6 × 50 or 30	M1	Contribution to expected costs if whales do not appear (in thousands or otherwise throughout)
	their –48 + 30 or –18	M1	Calculates expected cost of Option B by adding their two contributions Do not accept –18 from 0.6 × –30

Q	Answer	Mark	Comments
6 (a) Cont.	<u>Option C</u> their 0.24 × (130 – 200) or 31.2 (–) 48 or –16.8	M1	Contribution to expected cost if whales appear in 2nd week
	their 0.36 × 100 or 36	M1	Contribution to expected cost if whales do not appear in either week
	their –48 + their –16.8 + their 36 or –28.8	M1	Calculates expected cost of Option C by adding their three contributions Or: expected profit from Option C = expected profit from Option B + expected profit from staying an extra week if necessary = 18 + 0.6 × 18
	(Option A) £0 **and** (Option B) £18 000 **and** (Option C) £28 800	A1	Expected gains for **all** three options
	Recommends Option C	E1ft	ft their gains if all three are stated

Q	Answer	Mark	Comments
6 (a) Cont.	**Alternative method 2**		
	1 – 0.4 or 0.6	M1	Probability that whales do not appear in the 1st week (or any given week)
	0.6 × 0.4 or 1 – 0.4 – 0.36 or 0.24	M1	Probability that whales appear in the 2nd week but not the 1st Can be awarded if a quantity is multiplied by 0.6 and then by 0.4 oe
	0.6 × 0.6 or 1 – 0.4 – 0.24 or 0.36	M1	Probability that whales do not appear in either week Can be awarded if a quantity is multiplied by 0.6 and then by 0.6 oe
	<u>Option B</u> 0.4 × 50 + 0.4 × 30 + 0.6 × 50 or 20 + 12 + 30 or 62	M1	Expected cost (in thousands or otherwise throughout)
	0.4 × 200 or 80	M1	Expected profit
	their 80 – their 62 or 18	M1	Expected gain

Q	Answer	Mark	Comments
6 (a) Cont.	Option C 0.4 × 50 + 0.4 × 30 + their 0.24 × 100 + their 0.24 × 30 + 0.36 × 100 or 20 + 12 + 24 + 7.2 + 36 or 99.2	M1	Expected cost
	0.4 × 200 + their 0.24 × 200 or 128	M1	Expected profit
	their 128 – their 99.2 or 28.8	M1	Expected gain
	(Option A) £0 **and** (Option B) £18 000 **and** (Option C) £28 800	A1	Expected gains for **all** three options
	Recommends Option C	E1ft	ft their gains if all three are stated

Q	Answer	Mark	Comments
6 (a) Cont.	**Alternative method 3**		
	1 – 0.4 or 0.6	M1	Probability that whales do not appear in the 1st week (or any given week)
	0.6 × 0.4 or 1 – 0.4 – 0.36 or 0.24	M1	Probability that whales appear in the 2nd week but not the 1st Can be awarded if a quantity is multiplied by 0.6 and then by 0.4 oe
	0.6 × 0.6 or 1 – 0.4 – 0.24 or 0.36	M1	Probability that whales do not appear in either week Can be awarded if a quantity is multiplied by 0.6 and then by 0.6 oe
	<u>Option B</u> 0.4 × (200 – 30) or 68	M2	Expected profit from seeing whales in the 1st week, not including fixed costs M1 for either 0.4 × 200 or 0.4 × (–)30
	their 68 – 50 or 18	M1	Expected gain (Expected profit subtract fixed costs)

Q	Answer	Mark	Comments
6 (a) Cont.	<u>Option C</u> 0.24 × 170 or 40.8	M1	Expected profit from seeing whales in the 2nd week, not including fixed costs
	0.4 × 50 or 20 or 0.6 × 100 or 60	M1	Expected fixed cost of staying for one week Expected fixed cost of staying for two weeks
	their 68 + their 40.8 – their 20 – their 60 or 28.8	M1	Expected gain (Expected profit from seeing whales in 1st week or 2nd week subtract expected fixed costs of staying for 1 or 2 weeks)
	(Option A) £0 **and** (Option B) £18 000 **and** (Option C) £28 800	A1	Expected gains for **all** three options
	Recommends Option C	E1ft	ft their gains if all three are stated
	Additional Guidance		
	Accept working where signs are reversed consistently throughout (stating expected gains rather than costs, for example).		
	Probabilities may be seen in tree diagrams.		

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="3">6 (b)</td><td>don’t want to risk losing £100 000
cannot afford to pay the upfront costs
want to get home
the choice may be incompatible with deadlines
they may not have enough resources to stay
they may want to go to another site with a higher probability of whales
changing conditions
more up-to-date information becomes available
the producer doubts the validity of the estimates or expected costs
another benefit (e.g. accolade, lower risk of loss) might become available if the producer makes a different choice</td><td>E1ft</td><td>E1 for any valid reason
ft their answer to 6 (a)</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="3">‘too risky’ scores E0 unless qualified what is at risk
reasons that are contradictory to or unsupported by their 6 (a) score E0</td></tr>
</table>