



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2021

Marking Scheme

Mathematics

Foundation Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

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State Examinations Commission

Leaving Certificate Examination 2021

Mathematics

Foundation Level

Solutions and Marking Scheme

230 marks

Marking Scheme –Section A and Section B

Structure of the marking scheme

Candidate responses are marked according to different scales, depending on the types of response anticipated. Scales labelled A divide candidate responses into two categories (correct and incorrect). Scales labelled B divide responses into three categories (correct, partially correct, and incorrect), and so on. The scales and the marks that they generate are summarised in this table:

Scale label	A	B	C	D	E
No of categories	2	3	4	5	6
5 mark scales	0, 5	0, 2, 5	0, 2, 3, 5		
10 mark scales	0, 10	0, 5, 10	0, 3, 7, 10	0, 3, 5, 8, 10	
15 mark scales	0, 15	0, 7, 15	0, 5, 10, 15	0, 4, 7, 11, 15	
20 mark scales	0, 20	0, 10, 20	0, 7, 13, 20	0, 5, 10, 15, 20	
25 mark scales	0, 25	0, 12, 25	0, 8, 17, 25	0, 6, 12, 19, 25	0, 5, 10, 15, 20, 25

A general descriptor of each point on each scale is given below. More specific directions in relation to interpreting the scales in the context of each question are given in the scheme, where necessary.

Marking scales – level descriptors

A-scales (two categories)

- incorrect response
- correct response

B-scales (three categories)

- response of no substantial merit
- partially correct response
- correct response

C-scales (four categories)

- response of no substantial merit
- response with some merit
- almost correct response
- correct response

D-scales (five categories)

- response of no substantial merit
- response with some merit
- response about half-right
- almost correct response
- correct response

E-scales (six categories)

- response of no substantial merit
- response with some merit
- response almost half-right
- response more than half-right
- almost correct response
- correct response

In certain cases, typically involving incorrect rounding, omission of units, a misreading that does not oversimplify the work or an arithmetical error that does not oversimplify the work, a mark that is one mark below the full-credit mark may also be awarded. Thus, for example, in *scale 10C*, 9 marks may be awarded.

Summary of mark allocations and scales to be applied

Section A

Question 1

(a)(i)+(ii)	10C
(b)(i)	10C
(b)(ii)	5C
(b)(iii)	5C

Question 2

(a)	10C
(b)	10C
(c)	5C
(d)(i)+(ii)	5C

Question 3

(a)	10C
(b)	10C
(c)(i)+(ii)	10C

Question 4

(a)(i)	10C
(a)(ii)	5B
(b)(i)	5B
(b)(ii)	10C

Question 5

(a)(i)	5B
(a)(ii)	10C
(b)(i)	5C
(b)(ii)	5C
(b)(iii)	5C

Question 6

(a)(i)+(ii)	10C
(b)	10C
(c)(i)	5B
(c)(ii)	5C

Question 7

(a)(i)	10C
(a)(ii)	5C
(b)(i)+(ii)	10C
(b)(iii)	5C

Question 8

(a)(i)	10C
(a)(ii)	5C
(b)(i)+(ii)	10D
(b)(iii)	5C

Section B

Question 9

(a)(i)+(ii)	15C
(b)	5C
(c)(i)	10D
(c)(ii)	10C
(d)+(e)	10D

Question 10

(a)(i)	5B
(a)(ii)	15D
(a)(iii)	5B
(a)(iv)	10C
(b)(i)	5B
(b)(ii)	10C

Question 11

(a)(i)	10C
(a)(ii)+(iii)	10C
(b)(i)+(ii)	15C
(c)(i)	10C
(c)(ii)	5C

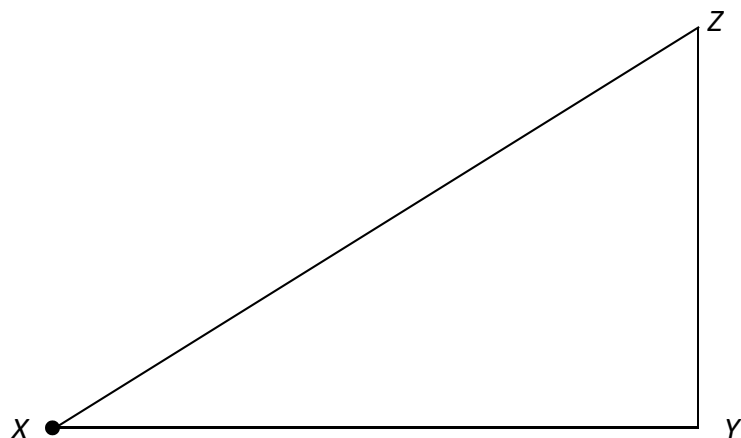
Note: The model solutions for each question are not intended to be exhaustive – there may be other correct solutions. Any Examiner unsure of the validity of the approach adopted by a particular candidate to a particular question should contact his / her Advising Examiner.

Q1	Model Solutions 30 marks	Marking Notes
(a) (i) + (ii)	Mean: $\frac{1 + 2 + 2 + 3 + 3 + 3 + 4 + 5 + 13}{9}$ $= \frac{36}{9} = 4$ Mode: 3	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of relevance e.g. indication of addition of numbers - Mode correct but no work of relevance for mean - Median with work shown <i>High Partial Credit:</i> - Mean fully correct - Mode correct and some correct work in finding mean
(b) (i)	Brand A: 45 hours Brand B: 48 hours	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Shows understanding of median e.g. “middle number” - Finds mean of either or both sets of numbers. <i>High Partial Credit:</i> - One answer correct - Both answers (with some work) within 1 place of correct answer i.e. A: 43 or 52; B: 50 or 45
(b) (ii)	Brand A: $61 - 30 = \mathbf{31}$ hours Brand B: $62 - 34 = \mathbf{28}$ hours	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> - Any work of relevance e.g. 61 and 30 written <i>High Partial Credit:</i> - One answer correct. - Highest and lowest values given but subtraction not done

(b) (iii)	Brand B Reason: Median value is higher, or any reasonable explanation	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> - Any work of relevance e.g. some reasonable comment on merit of the batteries but no choice implied <i>High Partial Credit:</i> - Correct answer but no reason or incorrect reason
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Q2	Model Solutions 30 marks	Marking Notes
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(a)

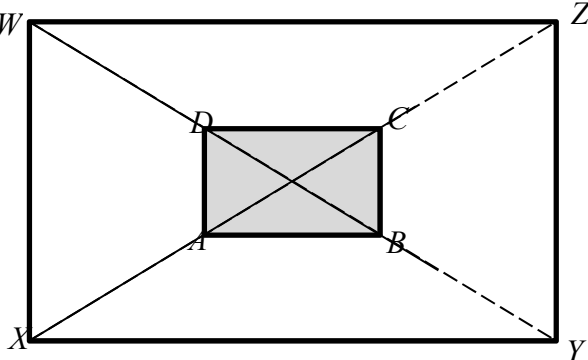


(a)	Tolerance lines: ± 0.2 cm Tolerance angle: $\pm 5^\circ$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of relevance e.g. one line of correct length drawn <i>High Partial Credit:</i> - Triangle drawn with 2 elements correct - Three elements correct but triangle not complete
(b)	$\sqrt{8.5^2 + 5.3^2}$ $= \sqrt{100.34}$ $= 10.01\dots$ = 10 cm	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of relevance e.g. 8.5 or 5.3 squared correctly - Measures length (correctly) from diagram <i>High Partial Credit:</i> - Stops at $\sqrt{8.5^2 + 5.3^2}$ - Stops at 100.34
(c)	$8.5 \times 5 = 42.5 \text{ km}$	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> - Any work of relevance e.g. indicates multiplication by 5 or selects 8.5 <i>High Partial Credit:</i> - Forms correct expression

(d) (i) $42.5 \times 2 = 85 \text{ km}$ + (ii) $85 \times 70 = 5950 \text{ cent}$ $= \text{€}59.50$	Scale 5C (0, 2, 3, 5) Accept worked answer from previous part If scale ignored completely (i.e. works with 8.5) award HPC at most <i>Low Partial Credit:</i> • Any work of relevance <i>High Partial Credit:</i> • One part correct
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Q3	Model Solutions 30 marks	Marking Notes
(a)	$\frac{3}{8}$, 40%, $\frac{5}{12}$, 0.45	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of merit - Highest or lowest identified <i>High Partial Credit:</i> 3 in correct order - Fractions correctly expressed as decimals - Orders highest to lowest
(b)	$9 + 6 = 15$ [or $3 + 2 = 5$ etc] $75 \times \frac{9}{15} = \text{€}45$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of merit e.g. 15 or 5 written 75×9, completed or not <i>High Partial Credit</i> - Finds amount for Wren correctly - Correct expression, $75 \times \frac{9}{15}$ or equivalent but not completed
(c) (i) + (ii)	60 Add bracket before 2 and after 5 or press = sign before pressing x^2	Scale 10C (0,3, 7, 10) <i>Low Partial Credit:</i> - Any work of merit e.g. mentions BEMDAS or similar <i>High Partial Credit</i> - One part correct

Q4	Model Solutions 30 marks	Marking Notes
(a) (i)	Buy-Cycles: $\frac{215 \times 120}{100} = \text{€}258$ or $\text{€}215 + 20\% \text{ of } \text{€}215 = \text{€}215 + \text{€}43 = \text{€}258$ Bikes-4-All: $\frac{330 \times 75}{100} = \text{€}247.50$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any relevant work in either part <i>High Partial credit:</i> - One part correct and some relevant work in other part - Both answers correct but no work shown
(a) (ii)	$258 - 247.50 = \text{€}10.50$	Scale 5B (0, 2, 5) <i>Partial Credit:</i> Subtraction not completed
(b) (i)	$70.59 \times 1200 = \text{84708}$ roubles	Scale 5B (0, 2, 5) <i>Partial Credit:</i> - Multiplication not complete $\frac{1200}{70.59}$ or $\frac{70.59}{1200}$ completed correctly
(b) (ii)	Arrives 11.00 am + 12 = 11.00 pm Wed NY time 11.00pm + 7 = 6.00 am Thursday Moscow time	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Either 12 or 7 added correctly <i>High Partial Credit</i> 7 subtracted, but otherwise correct (4pm Wed)

Q5	Model Solutions 30 marks	Marking Notes
(a) (i)	$11.5 \times 9 = 103.5$ litres	Scale 5B (0, 2, 5) <i>Partial Credit:</i> • Multiplication not complete
(a) (ii)	$130 \times 50 \times 28 = 182000$ $182000 \div 1000 = 182$ litres	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> • $130 \times 50 \times 28$ and stops <i>High Partial Credit:</i> • Leaves answer in cm^3 • $(130 \times 50 \times 28) \div 1000$, not completed or completed incorrectly
(b) (i)	$\frac{12.5}{5} = 2.5$ cm	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> • Any work of merit <i>High Partial Credit:</i> • $\frac{12.5}{5}$ not completed
(b) (ii)	$12.5 \times 3^2 = 112.5 \text{ cm}^2$ $5 \times 3 = 15$ $2.5 \times 3 = 7.5$ $15 \times 7.5 = 112.5 \text{ cm}^2$	Scale 5C (0, 2, 3, 5) Accept answer from (i) in 2 nd method <i>Low Partial Credit:</i> • Any work of merit e.g. 15 and/or 7.5 found <i>High Partial Credit:</i> • 12.5×3^2 not completed
(b) (iii)		Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> • Any one construction line drawn • A diagonal drawn <i>High Partial Credit:</i> • 2 correct construction lines drawn but not intersecting

Q6	Model Solutions 30 marks	Marking Notes
(a) (i) + (ii)	C D	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Attempt at drawing a central symmetry and/or an axial symmetry on diagram <i>High Partial Credit:</i> - One correct - Both symmetries drawn correctly on diagram but not labelled
(b)	$ AB = 12 \times 0.5 = 6 \text{ cm}$ $ BC = 20 \times 0.5 = 10 \text{ cm}$ Area: $\frac{1}{2} \times 6 \times 10 = 30 \text{ cm}^2$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of merit e.g. attempt at counting squares - Draws the triangle - Uses 12 or 20 <i>High partial Credit:</i> - Correct answer without work
(c) (i)	$\frac{350}{1650}$ or $\frac{7}{33}$	Scale 5B (0, 2, 5) <i>Partial Credit:</i> $\frac{1650}{350}$
(c) (ii)	$\tan^{-1} \frac{350}{1650} = 11.97$ $= 12^\circ$	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> $\tan A = \frac{350}{1650}$ - Finds $\tan \frac{350}{1650}$ (11.97) <i>High Partial Credit:</i> $\tan^{-1} \frac{350}{1650}$ written but not evaluated

Q7	Model Solutions 30 marks	Marking Notes
(a) (i)	$4 \times 4 \times 3 = 48 \text{ ways}$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> • Effort at listing • Answer 11 without work shown <i>High Partial Credit:</i> • $4 \times 4 \times 3$ not evaluated • 2 of 3 quantities correct e.g. $4 \times 3 \times 3$ written and evaluated • $4 + 3 + 4 = 11$
(a) (ii)	$3 \times 2 \times 3 = 18 \text{ ways}$	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> • Effort at listing • Answer 8 without work shown <i>High Partial Credit:</i> • $3 \times 2 \times 3$ not evaluated • 2 of 3 quantities correct e.g. $3 \times 4 \times 3$ • $3 + 2 + 3 = 8$

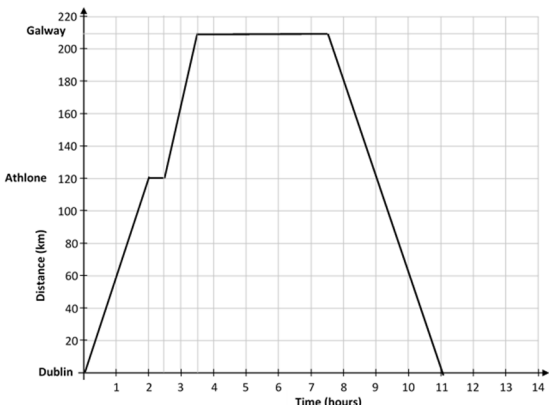
(b) (i) + (ii)	$1 - (0.2 + 0.5) = \mathbf{0.3}$ $0.2 + 0.5 = \mathbf{0.7}$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any relevant work e.g. 0.7 written in (i) <i>High Partial Credit:</i> - One correct answer - Table completed correctly Note: Accept correct answers without supporting work.
(b) (iii)	$120 \times 0.2 = \mathbf{24 \text{ students}}$	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> - Any relevant work <i>High Partial Credit:</i> 120×0.2

Q8	Model Solutions	30 marks	Marking Notes																				
(a) (i)	<table> <tr> <th>Starting number</th><th>Multiply by 5</th><th>Subtract 2 from answer</th><th>Outcome</th></tr> <tr> <td>1</td><td>1×5</td><td>$5 - 2$</td><td>3</td></tr> <tr> <td>2</td><td>2×5</td><td>$10 - 2$</td><td>8</td></tr> <tr> <td>3</td><td>3×5</td><td>$15 - 2$</td><td>13</td></tr> <tr> <td>4</td><td>4×5</td><td>$20 - 2$</td><td>18</td></tr> </table>	Starting number	Multiply by 5	Subtract 2 from answer	Outcome	1	1×5	$5 - 2$	3	2	2×5	$10 - 2$	8	3	3×5	$15 - 2$	13	4	4×5	$20 - 2$	18		
Starting number	Multiply by 5	Subtract 2 from answer	Outcome																				
1	1×5	$5 - 2$	3																				
2	2×5	$10 - 2$	8																				
3	3×5	$15 - 2$	13																				
4	4×5	$20 - 2$	18																				
			Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> • 1 correct entry <i>High Partial Credit:</i> • 2 correct entries • 3 correct outcomes but rest of table not filled in																				
(a) (ii)	$53 + 2 = 55$ $55 \div 5 = 11$ or Continue pattern		Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> • Any relevant work • Some correct effort at trial and error <i>High Partial Credit:</i> • Pattern continued for at least 5 further terms																				

(b) (i) + (ii)	$\frac{80 \times 55}{100} = \mathbf{44} \text{ marks}$ $\frac{120 \times 75}{100} = 90$ $44 + 90 = \mathbf{134} \text{ marks}$	Scale 10D (0, 3, 5, 8, 10) <i>Low Partial Credit:</i> - Any relevant work <i>Mid Partial Credit:</i> 44 or 90 worked out correctly <i>High Partial Credit:</i> - Both sets of marks worked out correctly but not added - A correct answer added to an incorrect answer
(b) (iii)	$80 + 120 = 200 \text{ (total marks)}$ $\frac{134}{200} \times 100 = \mathbf{67\%}$	Scale 5C (0, 2, 3, 5) Accept answer from previous part <i>Low Partial Credit:</i> - Total marks for test found - Answer from (ii) used <i>High Partial Credit:</i> $\frac{134}{200}$ but calculation not completed

Section B

Q9	Model Solutions 50 marks	Marking Notes
(a) (i) $\frac{1}{2}$ hour + (ii) 210 km Tolerance time = ± 10 mins Tolerance distance = ± 5 km		Scale 15C (0, 5, 10, 15) <i>Low Partial Credit:</i> - Any work of merit e.g. some correct indication on graph <i>High Partial Credit:</i> - One correct answer - Correct indications on graph for both parts but answers not specified
(b)	$10 \text{ am} + 3\frac{1}{2} = \mathbf{13:30}$ or 1.30	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> $3\frac{1}{2}$ stated or indicated on graph <i>High Partial Credit:</i> $(10 \text{ am} + 3\frac{1}{2})$ not completed or completed incorrectly

(c) (i)		Scale 10D (0, 3, 5, 8, 10) <i>Low Partial Credit:</i> - One addition only to graph attempted <i>Mid Partial Credit:</i> - One line only correct - Attempt at drawing both additions <i>High Partial Credit:</i> - One addition to graph correct and one outside tolerance ($\pm \frac{1}{4}$ hour) - Orientation of both lines correct but outside tolerance
(c) (ii)	$\frac{210}{3\frac{1}{2}} = 60 \text{ km/h}$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of relevance <i>High Partial Credit</i> $\frac{210}{3\frac{1}{2}}$ not evaluated or evaluated incorrectly
(d) + (e)	Distance: $210 \times 2 = 420 \text{ km}$ $\frac{40}{420} = \text{€}0.095\dots = 9.5\dots\text{cent}$ = 10 cent $1.30 + 4 + 3\frac{1}{2} = 9.00 \text{ pm}$	Scale 10D (0, 3, 5, 8, 10) <i>Low Partial Credit:</i> - Some work of merit <i>Mid Partial Credit:</i> (e) correct - Some correct work in both parts - Substantial work of merit in (d) <i>High Partial Credit:</i> (d) correct (e) correct and some work of merit in (d)

Q10	Model Solutions 50 marks	Marking Notes
(a) (i)	$1.2 \times 2.4 = 2.88 \text{ m}^2$	Scale 5B (0, 2, 5) <i>Partial Credit:</i> • Area = l x b
(a) (ii)	Area: $2.88 \times 2 \times 2 = 11.52 \text{ m}^2$ $\frac{11.52}{4.5} = 2.56 \rightarrow \mathbf{3 \text{ cans}}$	Scale 15D (0, 4, 7, 11, 15) <i>Low Partial Credit:</i> • $2.88 \times 2 \times 2$ <i>Mid Partial Credit:</i> • Stops at 11.52 m^2 <i>High Partial Credit:</i> • $\frac{11.52}{4.5}$ not evaluated, or evaluated incorrectly
(a) (iii)	$14.5 \times 3 = \mathbf{€43.50}$	Scale 5B (0, 2, 5) Accept answer from (ii) <i>Partial Credit:</i> • 14.5×3 not evaluated
(a) (iv)	$1.2 + 2.4 + 1.2 + 2.4 = \mathbf{7.2 \text{ m}}$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> • Some relevant addition <i>High Partial Credit:</i> • $1.2 + 2.4 + 1.2 + 2.4$

(b) (i)	1.77 m	Scale 5B (0, 2, 5) <i>Partial Credit:</i> • Indicates division by 100 • Multiplies (correctly) by 100
(b) (ii)	$\frac{73}{(1.77)^2} = 23.3$ $= \mathbf{23}$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> • One figure correctly inserted <i>High Partial Credit:</i> • Both figures correctly inserted but calculation incorrect or not completed • Figures inverted, $\frac{1.77}{(73)^2}$ but this calculation completed correctly

Q 11	Model Solutions 50 marks	Marking Notes
(a) (i)	$17 + 26 + 18 = 61\%$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any one of the 3 correct % identified <i>High partial credit:</i> 3 correct % identified but not added. 17 + 26 identified and added correctly
(a) (ii) + (iii)	$3 + 8 = 11\%$ Median is 50 $17 + 26 = 43 < 50$ $17 + 26 + \underline{18} = 61 > 50$ Median is in 3 rd group i.e. in 40 – 60 thousand income group	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> - Any work of merit in either part <i>High partial credit:</i> - One part correct - Substantial work of merit in both parts
(b) (i) (ii)	$360 - (90 + 54 + 72 + 18 + 18)$ $360 - 252 = 108^\circ$ $\frac{72}{360} \times 100 = 20\%$	Scale 15C (0, 5, 10, 15) <i>Low Partial Credit:</i> - Any work of merit in either part <i>High partial credit:</i> - One part correct - Substantial work of merit in both parts

(c) (i)	$\frac{42000 \times 20}{100} = 8400$ $8400 - 3300 = \text{€}5100$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit:</i> • 8400 and stops <i>High Partial Credit:</i> • 8400 – 3300 not evaluated or evaluated incorrectly • $(42000 - 3300) \times 20\% = 7740$
(c) (ii)	Deductions: $5100 + 1680 + 1190 = 7970$ Take-home pay: $42000 - 7970 = \text{€}34030$	Scale 5C (0, 2, 3, 5) Accept answer from (c)(i) <i>Low Partial Credit:</i> • One or 2 deductions from Gross • Total deductions evaluated <i>High partial credit:</i> • $42000 - 7970$ not evaluated or evaluated incorrectly

