edexcel

Mark Scheme (Results)

January 2016

Pearson Edexcel International GCSE
Mathematics A (4MA0)
Paper 3HR

_

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

January 2016
Publications Code UG043262
All the material in this publication is copyright
© Pearson Education Ltd 2016

_

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme.
  Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- **Types of mark**
  - M marks: method marks
  - A marks: accuracy marks
  - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
  - cao – correct answer only
  - ft – follow through
  - isw – ignore subsequent working
  - SC - special case
  - oe – or equivalent (and appropriate)
  - dep – dependent
  - indep – independent
  - eeoo – each error or omission
  - awrt –answer which rounds to

- **No working**

  If no working is shown then correct answers normally score full marks

  If no working is shown then incorrect (even though nearly correct) answers score no marks.
- **With working**

  If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.
  If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks.
  Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks.
  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.
  If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.
  If there is no answer on the answer line then check the working for an obvious answer.
- **Ignoring subsequent work**

  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.
  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.
  Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.
- **Parts of questions**

  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

International GCSE Maths January 2016 – Paper 3HR Mark scheme

Apart from Questions 6(a), 11, 12 and 19(d) (where the mark scheme states otherwise), the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

Q		Working	Answer	Mark	Notes	
1		$\frac{14.14}{3.5}$	4.04	2	M1 A1	For $\frac{a}{b}$ where a and b are single numbers and $a = 14.14$ and/or $b = 3.5$ Accept $\frac{101}{25}$
						Total 2 marks

2	(a)		$9(2c-3)$	2	B2	Award B1 for $3(6c-9)$
	(b)	$t^2-4t+5t-20$	t^2+t-20	2	M1 A1	For three correct terms out of four or for four terms correct except for signs.
						Total 4 marks

3	(a)		Reflection in $y = 1$	2	B1 B1	For reflection For $y = 1$ Award no marks if not a single transformation.
	(b)	Parallelogram with vertices (3, -3), (9, -3), (6, -6) and (0, -6)		2	B2	Award B1 for any translation of the correct parallelogram.
	(c)	Parallelogram with vertices (-3, 1), (-3, 3), (-2, 4), (-2, 2)		2	B2	Award B1 for a correct rotation through $\pm 90°$ about any centre.
						Total 6 marks

–

4	(a)	$1-0.5-0.15-0.05$	0.3	2	M1 A1	
	(b) (i)	40×0.15	6		M1 A1	Accept 40 × 0.15 × 5 or 6 × 5 or 30
	(ii)	40×0.5 or 20 **and** 40×0.05 or 2 $"20"\times1+"6"\times5+"2"\times10$	70	5	M1 M1 A1	 Dep ft from (i)
		Alternative Method 1 × 0.50 + 5 × 0.15 + 10 × 0.05 or 1.75 "1.75" × 40	70		M1 M1 A1	 Dep
						Total 7 marks

5	(a)	$\pi\times6.5^2$	133	2	M1 A1	 awrt 133
	(b)	$10.5^2-6.5^2$ or $110.25-42.25$ or 68 $\sqrt{10.5^2-6.5^2}$ or $\sqrt{110.25-42.25}$ or $\sqrt{68}$ oe	8.25	3	M1 M1 A1	 awrt 8.25
						Total 5 marks

–

6	(a)	Correct factor tree or repeated division to find factors 2, 2, 2, 3, 5, 5 (condone inclusion of 1's)	$2^3 \times 3 \times 5^2$	3	M2 A1	for finding correct factors (condone the inclusion of 1) M1 for finding a set of factors (with a product of 600) which includes at least 3 of the six prime factors. This may be a factor tree that is incomplete or only correct to this stage, for instance. dep on M2
	(b)	Eg $\frac{5^{12}}{5^3}$ or $\frac{5^{10}}{5}$ or $\frac{5^{11}}{5^2}$	5^9	2	M1 A1	For a correct application of an index law.
						Total 5 marks

7	(a)		$e < 2$	1	B1	Must be the final answer.
	(b)	$5 - 4 < 3e$ or $-3e < 4 - 5$	$e > \frac{1}{3}$	2	M1 A1	Condone use of $\leq$ or = Must be the final answer. Accept $e > 0.333(333\ldots)$
	(c)		1	1	B1	
						Total 4 marks

–

8	(a)	$\frac{163\ (\text{million})}{683\ (\text{million})} \times 100$	23.9	2	M1 A1	Accept 23.8 – 23.9
	(b)	$\frac{17.6}{100} \times 1028(\text{million})$or 180.(928) (million) $\frac{17.6}{100} \times 1028(\text{million}) + 1028$ (million)	1209	3	M1 M1 A1	M2 for 1028 (million) × 1.176 oe Accept 1208 – 1209
	(c)	$\frac{1028\ (\text{million})}{187.6} \times 100$ oe	548	3	M2 A1	M1 for $\frac{1028\ (\text{million})}{187.6}$ or 5.47(9744136…) rounded or truncated to at least 3SF or 1.876 or (100 + 87.6)(%) or 187.6(%) or 187.6% = 1028 (million) or or $1.876x = 1028$ (million) oe or $\frac{x}{1028\ (\text{million})} = \frac{187.6}{100}$ oe awrt 548
						Total 8 marks

–

9	(a)	$\left(\frac{1}{2}(0-4),\frac{1}{2}(2-1)\right)$	$(-2, \frac{1}{2})$	2	M1 A1	Accept $\frac{1}{2}(0-4)$ or $\frac{1}{2}(2-1)$ or one correct coordinate or $(\frac{1}{2}, -2)$
	(b)	$\frac{2-(-1)}{0-(-4)}$ or $\frac{-1-2}{-4-0}$ oe	$\frac{3}{4}$	2	M1 A1	Award M1 for $-\frac{3}{4}$ or $\frac{3}{4}x$ Accept $\frac{3}{4}$ or 0.75
	(c)	$y = "\frac{3}{4}"x + c$ or $y = mx + 2$ oe	$y = \frac{3}{4}x + 2$ oe	2	M1 A1ft	c or m may be letters or any number except $c = 0$, $m = 0$ or $m = 1$ Accept $y - - 1 = \frac{"3"}{4}(x - - 4)$ oe Award M1 A0 for $\frac{"3"}{4}x + 2$
						Total 6 marks

10	(a)		48	1	B1	
	(b)	angle $AOM = 48^o$ and $AM = 8$ (where M is the midpoint of AB) or angle $OAB = 42^o$ (may be shown on diagram) $\sin 48 = \frac{8}{r}$ or $\frac{16}{\sin 96} = \frac{r}{\sin 42}$ or $16^2 = r^2 + r^2 - 2r^2 \cos 96$ oe $r = \frac{8}{\sin 48}$ or $r = \frac{16 \sin 42}{\sin 96}$ or $r = \sqrt{\frac{16^2}{2(1-\cos 96)}}$ oe	10.8	4	M1 M1 M1 A1	For an expression involving r or r^2 Implies first M1 For a correct expression for r awrt 10.8
						Total 5 marks

–

11	Eg $5c = 35$ or $25d = -100$ or $4(-13 - 5d) - 5d = 48$ oe	$c = 7$ $d = -4$	3	M1 A1 A1	For eliminating either variable by using the correct operation or for a correct rearrangement of one equation followed by a substitution into the other equation. Condone 1 arithmetic error. dep on M1 dep on M1
					Total 3 marks

12	$17t - 5t^2 = 12$ $5t^2 - 17t + 12 (= 0)$ Eg $(5t - 12)(t - 1)$ (=0) or $(t =) \frac{--17 \pm \sqrt{(-17)^2 - 4 \times 5 \times 12}}{2 \times 5}$ or $\frac{17 \pm \sqrt{49}}{10}$ or $\frac{17 \pm 7}{10}$	$t = 1$ $t = 2.4$ oe	3	M1 M1 A1	Correct three term quadratic. e.g. $17t - 5t^2 = 12$ For $(5t \pm 12)(t \pm 1)$ or for a correct substitution into the quadratic formula (condone 1 sign error) Condone 17^2 and omission of brackets around -17 Dep on M2
					Total 3 marks

–

13	(a)		$64h^2$	2	B2	B1 for 64 or h^2 written as a product
	(b)	$\frac{a \times a^{\frac{1}{2}}}{a^{\frac{2}{3}}}$ or $\frac{a^{\frac{3}{2}}}{a^{\frac{2}{3}}}$ $a^{\left(1+\frac{1}{2}-\frac{2}{3}\right)}$ or $k=\left(1+\frac{1}{2}-\frac{2}{3}\right)$ oe or $1+\frac{1}{2}=k+\frac{2}{3}$ oe	$\frac{5}{6}$	3	M1 M1 A1	For $\sqrt{a}=a^{\frac{1}{2}}$ or $a\sqrt{a}=a^{\frac{3}{2}}$ or $\sqrt[3]{a^2}=a^{\frac{2}{3}}$ For $a^{\left(1+\frac{1}{2}-\frac{2}{3}\right)}$ or $k=\left(1+\frac{1}{2}-\frac{2}{3}\right)$ oe Accept $0.8\dot{3}$
						Total 5 marks

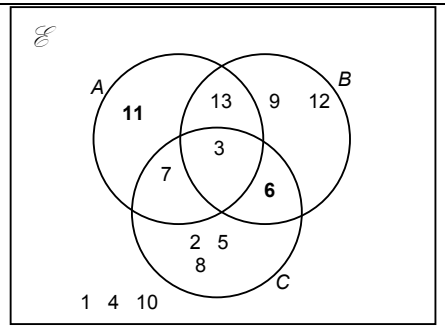
14	(a)		Correct points Curve or line segments through points	2	B1 B1	$\pm\frac{1}{2}$ square ft from points: if at least 4 are correctly plotted or if all points are plotted at the correct height consistently within each interval. Do not penalise omission of curve for $t < 180$
	(b)	74 (approx) corresponding to $t = 230$ 92 – 74 = 18 (approx)	18 (approx)	2	M1 A1	A reading that is clearly intended to correspond to $t = 230$ on a cumulative frequency graph. For correctly subtracting an accurate reading from 92 (allow $\pm\frac{1}{2}$ square for 230 and the reading). If M1 scored, ft from cf graph If no indication of method, ft only from a correct curve.
						Total 4 marks

–

15	(a)	$l^2 = 12^2 + 4^2$ $\pi \times 4 \times \sqrt{12^2 + 4^2}$ or $\pi \times 4 \times \sqrt{160}$ or $\pi \times 4 \times 12.6(4911064\ldots)$ or 50.56π or $\frac{1264}{25}\pi$	159	3	M1 M1 A1	For $12^2 + 4^2$ For a correct expression of the curved surface area. Accept 158 – 159
	(b)	$\frac{12-h}{r} = \frac{12}{4}$ or $4(12 - h) = 12r$ or $\frac{h}{12} = \frac{4-r}{4}$ or $4 : 12 = r : 12 - h$ oe $h = \frac{12(4-r)}{4}$ or $h = 3(4-r)$ or $h = 12 - 3r$	$V = 12\pi r^2 - 3\pi r^3$	3	M1 M1 A1 cso	For $\frac{h}{12} = \frac{r}{4}$ or $4h = 12r$ or $4 : 12 = r : h$ oe $h = 3r$ Dep. For $(V =)\ \pi r^2(12 - 3r)$ Dep on M2
	(c)	$\frac{dV}{dr} = 24\pi r - 9\pi r^2$ $24\pi r - 9\pi r^2 = 0$	$2\frac{2}{3}$	4	B2 M1 A1	B1 for each term. ft their $\frac{dV}{dr} = 0$ Accept $\frac{24}{9}$, $\frac{8}{3}$ oe
						Total 10 marks

–

16	(a)		2.2	1	B1	Accept $\frac{22}{10}$, $\frac{11}{5}$, $2\frac{1}{5}$
	(b)		1	1	B1	
	(c)	$y(x-1) = 2x$ or $yx - y = 2x$ or $x(y-1) = 2y$ or $xy - x = 2y$ $x(y-2) = y$ or $y(x-2) = x$	$\frac{x}{x-2}$	3	M1 M1 A1	oe Eg $\frac{-x}{2-x}$ M2A0 for $\frac{y}{y-2}$
	(d)		2	1	B1	ft from (c) if a rational function with a linear denominator
						Total 6 marks

17	(a)			1	B1	6 and 11 in correct regions Note: Award B0 for any numbers added to incorrect regions
	(b)		{2, 5, 7, 8}	1	B1	ft from Venn diagram Ignore brackets and separators.
	(c)		{9, 12}	1	B1	ft from Venn diagram Ignore brackets and separators.
	(d)		6	1	B1	ft from Venn diagram
						Total 4 marks

–

18	(a)	$\frac{70}{100} \times \frac{30}{100}$ oe	$\frac{21}{100}$ oe	2	M1 A1	 eg $\frac{2100}{10000}$ or 0.21
	(b) (i)	$\frac{10}{100} \times \frac{9}{99}$ oe	$\frac{1}{110}$		M1 A1	 oe eg $\frac{90}{9900}$ or $0.0\dot{0}\dot{9}$
	(b) (ii)	$\frac{2}{100} \times \frac{7}{99}$ or $\frac{7}{100} \times \frac{2}{99}$ or $\frac{14}{9900}$ or $\frac{68}{100} \times \frac{67}{99}$ or $\frac{4556}{9900}$ oe $\frac{2}{100} \times \frac{7}{99} + \frac{7}{100} \times \frac{2}{99} + \frac{68}{100} \times \frac{67}{99}$ oe	$\frac{382}{825}$	5	M1 M1 A1	 Implies first M1 oe Eg $\frac{4584}{9900}$ or $0.463\dot{0}\dot{0}$ Accept 0.463(0303…) rounded or truncated to at least 3 dp
		With replacement method $\frac{2}{100} \times \frac{7}{100}$ or $\frac{14}{10000}$ or $\frac{68}{100} \times \frac{68}{100}$ or $\frac{4624}{10000}$ oe $\frac{2}{100} \times \frac{7}{100} + \frac{7}{100} \times \frac{2}{100} + \frac{68}{100} \times \frac{68}{100}$ or $\frac{1163}{2500}$ or 0.4652 oe			M1 M1	 Implies first M1
						Total 7 marks

–

19	(a)	Vector, with arrow, marked from *P* to point 3 to the right and 8 up.	1	B1	
	(b)	Vector, with arrow, marked from *P* to point 4 to the left and 4 up.	1	B1	
	(c)	**–7a – 2b**	1	B1	oe eg **–7a** + – **2b**
	(d)	Eg $(\overrightarrow{MP} =) \frac{2}{3}(4\mathbf{a} - 2\mathbf{b})$ or $(\overrightarrow{PN} =) \frac{1}{3}(3\mathbf{a} + 4\mathbf{b})$ Eg $(\overrightarrow{MN} =) \frac{2}{3}(4\mathbf{a} - 2\mathbf{b}) + \frac{1}{3}(3\mathbf{a} + 4\mathbf{b})$ or $\frac{1}{3}(3\mathbf{a} + 4\mathbf{b}) - \frac{2}{3}(-4\mathbf{a} + 2\mathbf{b})$ or $\frac{8}{3}\mathbf{a} - \frac{4}{3}\mathbf{b} + \mathbf{a} + \frac{4}{3}\mathbf{b}$ $\frac{11}{3}$	3	M1 M1 A1	Accept $\pm\frac{2}{3}(4\mathbf{a} - 2\mathbf{b})$ or $\pm\frac{1}{3}(3\mathbf{a} + 4\mathbf{b})$ or $\overrightarrow{MN} = \overrightarrow{MP} + \overrightarrow{PN}$ oe For a correct expression for $\overrightarrow{MN}$ Dep on M2 cso Accept exact value only Eg $3\frac{2}{3}$ or $3.\dot{6}$
					Total 6 marks

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London WC2R 0RL