PROOF USING LOGIC

Pearson Edexcel - Tuesday 21 May 2019 - Paper 1 (Non-Calculator) Higher Tier

1.

13	Proof shown	C2	for complete argument, eg $n(n-1)$ is the product of two consecutive integers and must be even as either n or $n-1$ must be even **or** gives correct reasoning for n odd **and** n even n odd: odd × odd = odd and odd – odd = even n even: even × even = even and even – even = even **or** n odd: $(2n+1)^2 - (2n+1) = 4n^2 + 2n = 2(2n^2 + n)$ n even: $(2n)^2 - (2n) = 4n^2 - 2n = 2(2n^2 - n)$	
		(C1	for factorising, eg $n(n-1)$ **OR** gives correct reasoning for n odd **or** n even **OR** gives a partial explanation using n odd **and** n even, eg odd^2 – odd = even and even^2 – even = even)	

Pearson Edexcel - Thursday 8 November 2018 - Paper 2 (Calculator) Higher Tier

2.

21	proof	C1	uses cyclic quad eg if $CAB = x$ then $CRO = 180 - x$ (Opposite angles of a cyclic quadrilateral add up to 180°.)	Underlined words need to be shown; reasons need to be linked to their method; any reasons not linked do not credit.
		C1	establishes relationship outside a circle eg $ORB = x$ (Angles on a straight line add up to 180)	Correct method can be implied from angles on the diagram if no ambiguity or contradiction.
		C1	uses properties of a circle eg $RO = OB$ (both radii) so $ABC = x$ (Base angles of an isosceles triangle are equal.)	
		C1	Complete proof and conclusion	Full reasons given without any redundant reasons and correct reasoning throughout.

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3.

12	Statement supported by algebra	B1	writing a general expression for an odd number eg $2n+1$	Could be $2n-1$, $2n+3$, etc
		M1	(dep) for expanding ("odd number")^2 with at least 3 out of 4 correct terms	Note that $4n^2 + 4n + 2$ or $2n^2 + 4n + 1$ in expansion of $(2n+1)^2$ is to be regarded as 3 correct terms
		A1	for correct simplified expansion, eg $4n^2 + 4n + 1$	
		C1	(dep A1) for a concluding statement eg $4(n^2 + n) + 1$ (is one more than a multiple of 4)	

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4.

13	(a)	Shown	M1	for finding one missing angle eg $BDE = y$ **or** $ODE = 90$ **or** $ODF = 90$ **or** $DBO = x$ **or** $BCD = 180 - y$ **or** (reflex) $BOD = 2y$	Could be shown on the diagram or in working
			A1	for a complete correct method leading to $y - x = 90$	
			C1	(dep on A1) for all correct circle theorems given appropriate for their working eg The tangent to a circle is perpendicular (90°) to the radius (diameter) Alternate segment theorem **OR** Angle at the centre is twice the angle at the circumference Opposite angles in a cyclic quadrilateral sum to 180°	
	(b)	Explanation	C1	for explanation eg No as y must be less than 180 as it is an angle in a triangle	

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5.

19		Proof (supported)	M1	for a method to find coordinates of $M(-1, -1)$ or $N(3, 1)$
			M1	for method to find gradient of MN or PR or for method to find column vector for MN or PR or for differences of x coordinates and differences of y coordinates for MN or PR
			A1	for gradients of MN and PR, ie ½ oe or for column vectors of MN and PR, $\overrightarrow{MN} = \binom{4}{2}$ and $\overrightarrow{PR} = \binom{8}{4}$ or for differences of x coordinates and of y coordinates for MN andPR
			C1	for conclusion from reasoning and correct working

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6.

21			C1	states (angle) ABC = (angle) BCD
			C1	states 2nd link $AB = CD$
			C1	states 3rd link with reason: $BC = BC$ (common)
			C1	concludes proof by stating (triangle) $ABC \equiv$ (triangle) DCB with reason SAS and $AC = BD$

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7.

15		Proof	C1	for identifying one pair of equal angles with a correct reason, e.g. (angle) BAE = (angle) CDE; angles in the same segment are equal or angles at the circumference subtended on the same arc are equal or for identifying two pairs of equal angles with no correct reasons given (angles must be within the appropriate triangles)
			C1	for identifying a second pair of equal angles with a correct reason, e.g. (angle) AEB = (angle) DEC; opposite angles or vertically opposite angles are equal or for identifying the three pairs of equal angles with no correct reasons given
			C1	for stating the three pairs of equal angles of the two triangles e.g. $ABE = DCE$, $BEA = CED$, $EAB = EDC$ with fully correct reasons

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8.

5		Shows polygon is a hexagon	M1	for a complete method to find the interior or exterior angle of the dodecagon eg $180 - \frac{360}{12}$, $\frac{180}{12}(12-2)$ oe (= 150), 360 ÷ 12 (=30)
			M1	for a complete method to find the interior angle of polygon **P** eg at B or C: 360 – "150" – 90 (= 120) or "30" + 90 (= 120) **or** for a complete method to find the interior or exterior angle of the hexagon eg $180 - \frac{360}{6}$, $\frac{180}{6}(6-2)$ oe (= 120), 360 ÷ 6 (= 60)
			A1	for 30 and 120 **or** 30 and 60 **or** 120 and 150 **or** 60 and 150
			C1	complete solution, fully supported by accurate figures

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9.

20	$\angle TSU = 360 \div 5$ (=72) Exterior angles of a polygon add up to 360° $\angle QRO = \angle OTP = 90$ The tangent to a circle is perpendicular (90°)to the radius (diameter) $\angle ROT = 540 - 2 \times 90 - 2 \times 108$ (= 144) $\angle RUT = 144 \div 2$ (= 72) The angle at the centre of a circle is twice the angle at the circumference Base angles of an isosceles triangle are equal	proof	M1 M1 M1 C1 C1	for method to find interior or exterior angle of regular pentagon for using angle between tangent and radius for method to find angle *ROT* for method to find angle *RUT* with reason for deduction that *ST* = *UT* with reasons

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10.

*20			Proof	5	M1for finding one other vector expressed as **a** and/or **b** M1 for method to find one of $\overrightarrow{DM}$, $\overrightarrow{MA}$ or $\overrightarrow{DA}$ eg $\overrightarrow{DM}$ = −**b** + ½(3**b** +**a**) oe, $\overrightarrow{MA}$ = ½(3**b** + **a**) + **a** oe or $\overrightarrow{DA}$ = 2**b**+2**a** oe M1 for method to find two of $\overrightarrow{DM}$, $\overrightarrow{MA}$ or $\overrightarrow{DA}$ A1 for two of $\overrightarrow{DM}$ = ½ (**a** + **b**), $\overrightarrow{MA}$ = 1.5(**a** + **b**), $\overrightarrow{DA}$ =2(**a**+**b**) ie simplified but oe C1 (dep on working shown) for conclusion relating to correct working

Pearson Edexcel - Monday 6 June 2011 - Paper 3 (Non-Calculator) Higher Tier

11.

17		*PBC* = 90 – *PAC* *BCP* = 90 – (90 – *PAC*)	Proof	3	M1 for *PBC* = 90 – *PAC* or *PAC* = 90 – *PBC* or *ACP* = 90 – *PCB* M1 for *BCP* = 90 – (90 – *PAC*) or *PAC* = 90 – (90 – *BCP*) oe A1 for *PAC* = *PCB* and *PCA* = *PBC* and *APC* = *CPB* B1 SC if M0 awarded for *APC* = *BPC* = 90° or statement matching the 3 equal sets of angles *PAC* = *PCB* and *PCA* = *PBC* and *APC* = *CPB*

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12.

16			e.g. When x = 0.1 $(2x)^2$ = 0.04 $2x$ = 0.2 So $(2x)^2 < 2x$ which contradicts Bethany's statement So it is not always true	**3** **2 AO2.4a** **1 AO2.5a**	**M1** for attempting to demonstrate that for some value of x in range $0 < x < \frac{1}{2}$ it is not true **A1** for complete working **A1** for explanation or **M1** for attempt including squaring bracket **A1** for complete solution for either $x < 0$ or $x \geq \frac{1}{2}$ **A1** for explanation or **B1** for a counter example given without working	

AQA GSCE – Sample Paper 2 (Calculator) Higher Tier

13.

18(a)	$(n - 6)^2$ could be zero (so she is wrong) or The sixth term is 1	B1	oe
18(b)	1	B1	