AQA Practice GCSE Examination Paper Higher Set 5 Paper 3 Calculator	Solutions

Qu №	Answer	Solutions	Marks		AO	Spec.
1	360°	The sum of the interior angles of any triangle is 180°. All quadrilaterals can be split into two triangles so the sum of the interior angles in any quadrilateral = sum of the angles in both triangles $= 2 \times 180 = 360°$	A1	1	2.1a	G3
2	$3^{n+2} + 3^{n+3}$	$9(3^n + 3^{n+1}) = 3^2(3^n + 3^{n+1}) = (3^2 \times 3^n) + (3^2 \times 3^{n+1})$ $= 3^{n+2} + 3^{n+3}$	A1	1	1.3b	A4
3	$y = (x-3)^2$	A translation of $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$ is a horizontal translation of 3 units to the right. $y = f(x)$ becomes $y = f(x-3)$ so $y = x^2$ becomes $y = (x-3)^2$	A1	1	2.3b 2.4a	G24
4	9,000	81 million = 81,000,000 $\sqrt{81 \text{ million}} = \sqrt{81,000,000} = \sqrt{81 \times 10^6} = \sqrt{81} \times \sqrt{10^6}$ $= \sqrt{81} \times \sqrt{10^3 \times 10^3} = 9 \times 10^3 = 9,000$	A1	1	1.3a	N7
5	2.2 cm^3	Volume increases by 65%. Expanded volume is 3.63 cm^3 which is 100 + 65 = 165% of original volume Original volume is 3.63 ÷ 1.65 = 2.2 cm^3	M1 M1 A1	3	1.3a	R9
6	Yes (Claire is correct) [with suitable explanation]	**e.g.** A geometric progression is a sequence where the next term is found by multiplying the previous term by a constant value. 1 4 16 64 256 × 4 × 4 × 4 × 4 In this sequence, the rule to get to the next term is multiply the previous term by 4 ∴ it is a geometric progression.	A1	1	2.1a	A24
7	(–4, 2)	C is the midpoint of DE Coordinates of D are (0, 0); coordinates of E are (4, 6) The midpoint of DE is at $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right) = \left(\frac{0+4}{2}, \frac{0+6}{2}\right) = \left(\frac{4}{2}, \frac{6}{2}\right) = (2, 3)$ Coordinates of C are (2, 3) C is also the midpoint of AB. Co-ordinates of B are (8, 4) ; let co-ordinates of A be (x, y) The midpoint of AB is at $\left(\frac{x+8}{2}, \frac{y+4}{2}\right) = (2, 3)$ $\therefore \frac{x+8}{2} = 2, \ \frac{y+4}{2} = 3$ $x + 8 = 4, \ y + 4 = 6 \rightarrow x = -4, y = 2$ Coordinates of A are (–4, 2)	M1 finding coordinates of C M1 method to find coordinates of A A1	3	2.1a 3.1b 1.3a	A8
8	$x = 1$ or $x = -2$	Factorise $x^2 + x - 2 = 0$ by finding 2 numbers which add to make 1 and multiply to make –2: (–1 + 2 = 1); (–1 × 2 = –2) $x^2 + x - 2 = (x-1)(x+2) = 0$ $(x-1) = 0$ or $(x+2) = 0$ $x = 0 + 1 = 1$ or $x = 0 - 2 = -2$	M1 $(x \pm 1)(x \pm 2)$ M1 $(x-1)(x+2)$ A1	3	1.3b	A18

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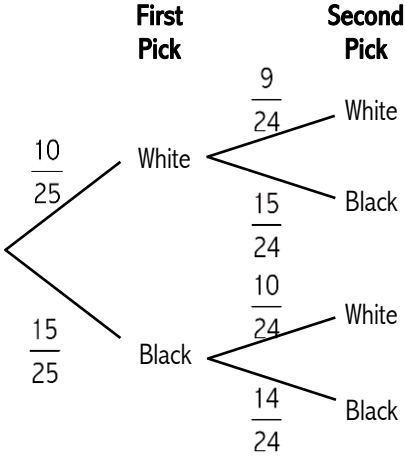
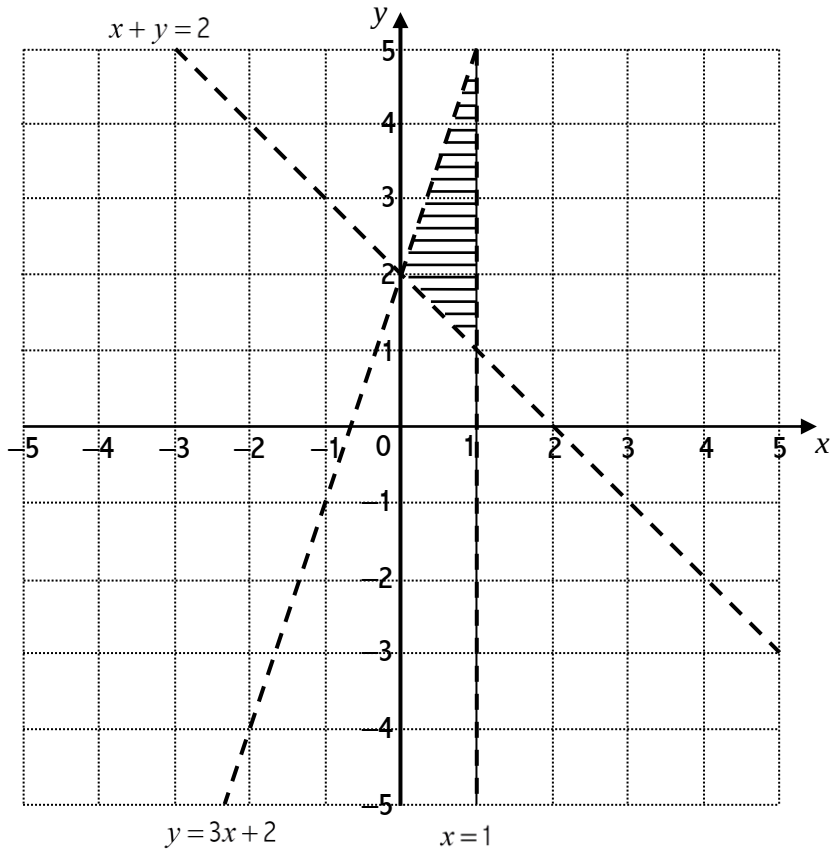
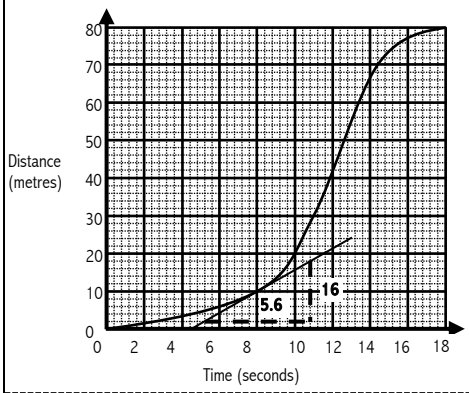
9		The original price has been reduced by $\frac{3}{8}$ $1-\frac{3}{8}=\frac{5}{8}$; £12.50 is $\frac{5}{8}$ of the original price of the DVD	M1		1.3b	R3
		$\frac{1}{8}$ of the original price is 12.50 ÷ 5 = £2.50 The original price of the DVD is 2.50 × 8	M1			
	£20	= £20	A1	**3**		
10a	86–90 cm	The modal class interval is the most common waist size. This is 86–90 cm as it has the highest frequency.	A1		2.3a	S4
b		$\text{mean} = \frac{\text{sum of all waist sizes}}{\text{number of people}}$ The sum of all waist sizes is the sum of (midpoint × frequency). Mid-point between 76 cm & 80 cm is 78 cm Mid-point between 81 cm & 85 cm is 83 cm Mid-point between 86 cm & 90 cm is 88 cm Mid-point between 91 cm & 95 cm is 93 cm Mid-point between 96 cm & 100 cm is 98 cm	M1 finding mid-points of intervals		1.3b	S4
		Sum of all waist sizes is (78 × 4) + (83 × 7) + (88 × 9) + (93 × 5) + (98 × 5) = 2640	M1			
	88 cm	The information is about 30 adults. The mean waist size is 2640 ÷ 30 = 88 cm.	A1	**4**		
11a	$5\boldsymbol{a}$	$\overrightarrow{AB}=3\boldsymbol{a}-\boldsymbol{b}$ $\quad\overrightarrow{BC}=2\boldsymbol{a}+\boldsymbol{b}$ $\overrightarrow{AC}=\overrightarrow{AB}+\overrightarrow{BC}=(3\boldsymbol{a}-\boldsymbol{b})+(2\boldsymbol{a}+\boldsymbol{b})=5\boldsymbol{a}$	A1		1.3b	G25
b	**'Prove That' Qu** *working must be shown*	***Working must be shown*** $\overrightarrow{BC}=2\boldsymbol{a}+\boldsymbol{b}$ $\quad\overrightarrow{PQ}=\frac{5}{4}\boldsymbol{a}$ $\overrightarrow{PC}=\frac{1}{4}\overrightarrow{BC}=\frac{1}{4}(2\boldsymbol{a}+\boldsymbol{b})$	M1		3.1b 1.3b 2.2	G25
		$\overrightarrow{CQ}=\overrightarrow{CP}+\overrightarrow{PQ}=\overrightarrow{PQ}-\overrightarrow{PC}=\frac{5}{4}\boldsymbol{a}-\frac{1}{4}(2\boldsymbol{a}+\boldsymbol{b})=\frac{5}{4}\boldsymbol{a}-\frac{2}{4}\boldsymbol{a}-\frac{1}{4}\boldsymbol{b}$ $=\left(\frac{5}{4}-\frac{2}{4}\right)\boldsymbol{a}-\frac{1}{4}\boldsymbol{b}=\frac{3}{4}\boldsymbol{a}-\frac{1}{4}\boldsymbol{b}=\frac{1}{4}(3\boldsymbol{a}-\boldsymbol{b})$	M1			
		$\overrightarrow{AB}=3\boldsymbol{a}-\boldsymbol{b}$ $\overrightarrow{CQ}=\frac{1}{4}(3\boldsymbol{a}-\boldsymbol{b})=\frac{1}{4}\overrightarrow{AB}$ $\overrightarrow{CQ}$ is a multiple of $\overrightarrow{AB}$ ∴ $\overrightarrow{CQ}$ is parallel to $\overrightarrow{AB}$	A1	**4**		

Qu №	Answer	Solutions	Marks		AO	Spec.
12a	Any correct assumption	**e.g.** the first counter taken out the bag was replaced before the second counter was chosen	A1		3.4	P8
b	$\frac{3}{20}$ (oe fraction, decimal or percentage)	If assumption is not true, the counter taken first will not be replaced  P(Two white counters) $= \frac{10}{25}\times\frac{9}{24}=\frac{5\times2}{5\times5}\times\frac{3\times3}{3\times8}=\frac{2}{5}\times\frac{3}{8}=\frac{2\times3}{5\times8}=\frac{6}{40}$ $=\frac{3}{20}$	M1 A1	**3**	3.1c 1.3a	P8
13	$x = 0.6$	F is directly proportional to x so $F = kx$ Find the value of k: When $x = 0.2$, $F = 19.2$ $\therefore 19.2 = 0.2k$ [÷0.2] $k = 96$ $\therefore F = 96x$ When $F = 57.6$, $57.6 = 96x$ [÷96] $x = 0.6$	M1 M1 A1	**3**	1.3b	R10 R13
14	$x = 3,\ y = 4$	***Either:*** $3x - y = 5$ [rearrange for y] $y = 3x - 5$ $5x + 2y = 23$ [substitute for y] $5x + 2(3x - 5) = 23$ [expand brackets] $5x + 6x - 10 = 23$ [simplify] $11x = 33$ [÷11] $x = 3$ $y = 3x - 5$ [substitute x value] $y = 3\times3 - 5$ $y = 4$ ***Or:*** $3x - y = 5$ (1) $\therefore 2\times(1)$: $6x - 2y = 10$ $5x + 2y = 23$ (2) $2\times(1) + (2)$: $6x - 2y + 5x + 2y = 10 + 23$ $11x = 33$ [÷11] $x = 3$ $y = 3x - 5$ [substitute x value] $y = 3\times3 - 5$	M1 eliminate one variable A1 M1 substitute into a previous equation A1	**4**	1.3b	A4 A19

Qu №	Answer	Solutions	Marks		AO	Spec.
15		Total number of yellow marbles is $3x$ Total number of marbles is $3x + 4x = 7x$ P(First marble is yellow) $= \frac{\text{Number of yellow marbles}}{\text{Total number of marbles}} = \frac{3x}{7x}$ P(Second marble is yellow, if first marble is yellow) $= \frac{\text{Number of yellow marbles left}}{\text{Total number of marbles left}} = \frac{3x-1}{7x-1}$	M1 correct fractions			
		P(both marbles are yellow) $= \frac{3x}{7x} \times \frac{3x-1}{7x-1} = \frac{15}{91}$ $\frac{3x}{7x} \times \frac{3x-1}{7x-1} = \frac{3x(3x-1)}{7x(7x-1)} = \frac{9x^2-3x}{49x^2-7x} = \frac{9x-3}{49x-7} = \frac{15}{91}$	M1 correct equation			
		$\frac{9x-3}{49x-7} = \frac{15}{91}$ [÷3] $\frac{3x-1}{49x-7} = \frac{5}{91}$ [×91] $\frac{91(3x-1)}{49x-7} = 5$ [×(49x − 7)] $91(3x-1) = 5(49x-7)$ [expand brackets]	M1 method to eliminate fractions		3.1d 1.3b	P8 A17
		$273x - 91 = 245x - 35$ [−245x] $28x - 91 = -35$ [+91] $28x = 56$ [÷28] $x = 2$	M1 finding x			
	6	Total number of yellow marbles is $3x$ If $x = 2$, the number of yellow marbles William put in the bag original is $3 \times 2 = 6$	A1	**5**		
16a	**'Show That' Qu** ***working must be shown***	Height = x cm Length = $2x$ cm Width = $(x-1)$ cm	M1 expressions for dimensions			
		Surface area = 2(height × length) + 2(width × length) + 2(height × width) [substitute in values] $= 2(x \times 2x) + 2((x-1) \times 2x) + 2(x \times (x-1))$ [simplify] $= 2(2x^2) + 2(2x^2 - 2x) + 2(x^2 - x)$	M1 begin process to find surface area		2.2 3.1a	A21 G16
		Surface area = 136 cm^2 $\therefore 2(2x^2) + 2(2x^2 - 2x) + 2(x^2 - x) = 136$ [÷ 2]	M1			
		$2x^2 + 2x^2 - 2x + x^2 - x = 68$ [simplify] $5x^2 - 3x - 68 = 0$	A1			
b		$5x^2 - 3x - 68 = 0$ Using quadratic formula: $x = \frac{3 \pm \sqrt{(-3)^2 - 4 \times 5 \times (-68)}}{2 \times 5}$ [simplify]	M1 quadratic formula (or attempt at factorisation)			
		$x = \frac{3 \pm \sqrt{9 + 1360}}{10} = \frac{3 \pm \sqrt{1369}}{10} = \frac{3 \pm 37}{10}$	M1 simplifying (or successful factorisation into $(5x + 17)(x - 4)$)		1.3b 3.1b 3.2 3.3	A2 A18 G16
		$x = \frac{40}{10} = 4$ *or* $x = -\frac{34}{10} = -3.4$ x is a dimension so must be positive, $\therefore x = 4$	M1			
	96 cm^3	Volume $= x \times 2x \times (x-1)$ [substitute in $x = 4$] $= 4 \times 8 \times 3$ $= 96$ cm^3	A1	**8**		

Qu №	Answer	Solutions	Marks		AO	Spec.
17		Circumference of cone $= 2\pi r = 16\pi$ $[\div 2\pi]$ $r = 8$ cm	M1		1.1 1.3b	G17 G20
		Volume of cone $= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi \times 8^2 \times h = \frac{64}{3}\pi h$ Volume of cone $= 320\pi \therefore \frac{64}{3}\pi h = 320\pi$ $[\div \frac{64}{3}\pi]$	M1			
		$h = 320 \div \frac{64}{3} = 320 \times \frac{3}{64}$ $h = 15$ cm	M1			
		$\tan PQX = \frac{\text{opposite}}{\text{adjacent}} = \frac{15}{8}$ $[\tan^{-1}]$	M1			
	61.9°	Angle PQX $= \tan^{-1}\left(\frac{15}{8}\right) = 61.9275... = 61.9°$ (1 d.p.)	A1	**5**		
18		Perimeter of square = 20 cm One side of square $= \frac{20}{4} = 5$ cm	M1		1.3b 2.1b	R9 G14 G16
		Area of left triangle $= \frac{1}{2} \times (5-1) \times (5-3.5)$ $= \frac{1}{2} \times 4 \times 1.5 = 3$ cm^2	M1			
		Area of right triangle $= \frac{1}{2} \times 5 \times (5-2)$ $= \frac{1}{2} \times 5 \times 3 = 7.5$ cm^2	M1			
		Area of square = 5 × 5 = 25 cm^2 Shaded area = 3 + 7.5 = 10.5 cm^2 Percentage of area that is shaded $= \frac{10.5}{25} \times 100$	M1			
	42%	= 42%	A1	**5**		
19a	**'Show That' Qu** ***working must be shown***	$x^3 + 2x = 2$, so $f(x) = x^3 + 2x - 2$ $f(0) = 0^3 + 2 \times 0 - 2 = -2$ $f(1) = 1^3 + 2 \times 1 - 2 = 1$	M1 values for $x = 0$, $x = 1$		1.3b 2.2 2.3b	A2 A6
		Sign change signifies that the solution lies between 0 and 1	A1			
b	**'Show That' Qu** ***working must be shown***	$x^3 + 2x = 2$ $[-x^3]$ $2x = 2 - x^3$ $[\div 2]$ $x = 1 - \frac{x^3}{2}$	A1	**3**	1.3a 2.2 2.3b	A4 A6
20		$\frac{1}{x} = \frac{1}{y} - \frac{1}{z}$ [isolate $\frac{1}{z}$] $\frac{1}{z} = \frac{1}{y} - \frac{1}{x}$ [find common denominator on RHS] $\frac{1}{z} = \frac{x}{xy} - \frac{y}{xy} = \frac{x-y}{xy}$ [reciprocal]	B1		1.3b	A4 A5
	$z = \frac{xy}{x-y}$	$z = \frac{xy}{x-y}$	B1	**2**		

Qu №	Answer	Solutions		Marks		AO	Spec.
21		**Either:** $E = \frac{8.99\times10^{9}Q}{r^{2}}$ Molecule 1: $E = \frac{8.99\times10^{9}\times6.41\times10^{-19}}{\left(3.98\times10^{-9}\right)^{2}}$ $=3.64\times10^{8}$	**Or:** $E = \frac{8.99\times10^{9}Q}{r^{2}}$ Ratio $E_2 : E_1 = 1 : \frac{E_2}{E_1}$ $\frac{E_2}{E_1} = \frac{8.99\times10^{9}Q_2}{r_2^2} \div \frac{8.99\times10^{9}Q_1}{r_1^2}$	M1		1.3b	A2 R4
		Molecule 2: $E = \frac{8.99\times10^{9}\times1.60\times10^{-19}}{\left(2.65\times10^{-10}\right)^{2}}$ $=2.05\times10^{10}$	$=\frac{Q_2}{r_2^2} \div \frac{Q_1}{r_1^2}$ [invert fraction] $=\frac{Q_2}{r_2^2}\times\frac{r_1^2}{Q_1}=\frac{Q_2 r_1^2}{Q_1 r_2^2}$	M1			
	1 : 56.3	$3.64\times10^{8} : 2.05\times10^{10}$ $=1:\frac{2.05\times10^{10}}{3.64\times10^{8}}$ $=1:56.\dot{3}1868\dot{}=1:56.3$ to 1 d.p.	$=\frac{1.60\times10^{-19}\times\left(3.98\times10^{-9}\right)^{2}}{6.41\times10^{-19}\times\left(2.65\times10^{-10}\right)^{2}}$ $=56.\dot{3}1868\dot{}$ Ratio $=1:56.3$ to 1 d.p.	A1	**3**		
22		Ratio of goldfish : tetras is 5 : 1 Ratio of tetras : swordtails is 3 : 1 Ratio of goldfish : tetras is 5 : 1 = 5 × 3 : 1 × 3 = 15 : 3 [multiply by 3 to make tetras the same in both ratios]		M1		1.3a 3.1c	R4
	15 : 3 : 1	Ratio of goldfish : tetras : swordtails is 15 : 3 : 1		A1	**2**		
23				M1 one line drawn correctly M1 more than one line drawn correctly A1 region shaded correctly between two correct lines A1 all lines and shaded region correct	**4**	2.3b	A9 A22

Qu №	Answer	Solutions	Marks		AO	Spec.
24a		At 11 seconds, the distance travelled is 30 m. At 17 seconds, the distance travelled is 79 m. Average speed $= \frac{\text{distance}}{\text{Time}} = \text{gradient} = \frac{\text{change in } y}{\text{change in } x} = \frac{79-30}{17-11} = \frac{49}{6}$	M1		2.3a 1.3a	A15
	8.1 – 8.2 m/s	$= 8.1\dot{6}$ m/s	A1			
b		Average speed is gradient, m, of tangent at 8 seconds  	M1 drawing tangent at 8 seconds		2.3a 1.3a	A15
		$m = \frac{\text{change in } y}{\text{change in } x} = \frac{16}{5.6} = \frac{20}{7}$	M1 finding gradient of tangent			
	2.5 m/s – 3.5 m/s	= 2.8571…= 2.9 m/s correct to 1 decimal place	A1	**5**		
25	Yes (Jeff is correct) [with reason]	***Reasoning must be given*** $16a \div 4a = 4$ 4 is a whole number ∴ Jeff is correct, $4a$ is always a factor of $16a$	A1	**1**	2.4a	N4
26a	5.72×10^{-5}	In standard form a number between 1 & 10 is multiplied by 10^n 5.72 is between 1 and 10; the decimal moves 5 places to the left. $0.0000572 = 5.72 \div 100{,}000 = 5.72 \times \frac{1}{100000} = 5.72 \times 10^{-5}$	A1		1.3b	N9
b	3,200	$3.2 \times 10^3 = 3.2 \times 1000 = 3{,}200$ The decimal point moves 3 places to the right.	A1	**2**	1.3a	N9
			Total Marks:	**80**		