Question	Answer	Mark	Comments
1	$(PQ =)\ \mathbf{a} + \mathbf{b} + \mathbf{c}$	M1	oe
	$(XY =)\ \frac{2}{3}\mathbf{a} + \mathbf{b} + \frac{2}{3}\mathbf{c}$ or $(XY =) -\frac{1}{3}\mathbf{a} + \mathbf{a} + \mathbf{b} + \mathbf{c} - \frac{1}{3}\mathbf{c}$	M1	
	$(PQ =)\ \mathbf{a} + \mathbf{b} + \mathbf{c}$ and $(XY =)\ \frac{2}{3}\mathbf{a} + \mathbf{b} + \frac{2}{3}\mathbf{c}$ and No, as XY is not a multiple of PQ	A1	oe
	Additional Guidance		

Q	Answer	Mark	Comments
2(a)	**Alternative method 1: *DH + HX***		
	$HE = \mathbf{a} - \mathbf{b}$	M1	implied by $HX = \frac{1}{4}\mathbf{a} - \frac{1}{4}\mathbf{b}$
	$(\mathbf{b} + \frac{1}{4}(\mathbf{a} - \mathbf{b}) =)\ \mathbf{b} + \frac{1}{4}\mathbf{a} - \frac{1}{4}\mathbf{b}$ $= \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$	A1	
	Alternative method 2: *DE + EX*		
	$EH = \mathbf{b} - \mathbf{a}$	M1	implied by $EX = \frac{3}{4}\mathbf{b} - \frac{3}{4}\mathbf{a}$
	$(\mathbf{a} + \frac{3}{4}(\mathbf{b} - \mathbf{a}) =)\ \mathbf{a} + \frac{3}{4}\mathbf{b} - \frac{3}{4}\mathbf{a}$ $= \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$	A1	

Q	Answer	Mark	Comments
2(b)	**Alternative method 1: *DF* from *DE* + *EF* = *DE* + $\frac{1}{4}$*EG***		
	$(EG =) -\mathbf{a} + 9\mathbf{b}$ or $(EF =) -\frac{1}{4}\mathbf{a} + \frac{9}{4}\mathbf{b}$	M1	oe
	$(EF =) -\frac{1}{4}\mathbf{a} + \frac{9}{4}\mathbf{b}$ and $(DF =) \mathbf{a} -\frac{1}{4}\mathbf{a} + \frac{9}{4}\mathbf{b}$	M1	oe
	$(DF =) \frac{3}{4}\mathbf{a} + \frac{9}{4}\mathbf{b}$	A1	
	$(DF =) 3(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b})$ and Yes	A1	oe using a different correct scalar multiple for *DF* and *DX*

Q	Answer	Mark	Comments
2(b) cont	**Alternative method 2: *DF* from *DG* + *GF* = *DG* + $\frac{3}{4}$*GE***		
	$(GE =) -9\mathbf{b} + \mathbf{a}$ or $(GF =) -\frac{27}{4}\mathbf{b} + \frac{3}{4}\mathbf{a}$	M1	oe
	$(GF =) -\frac{27}{4}\mathbf{b} + \frac{3}{4}\mathbf{a}$ and $(DF =) 9\mathbf{b} -\frac{27}{4}\mathbf{b} + \frac{3}{4}\mathbf{a}$	M1	oe
	$(DF =) \frac{3}{4}\mathbf{a} + \frac{9}{4}\mathbf{b}$	A1	
	$(DF =) 3(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b})$ and Yes	A1	oe using a different correct scalar multiple for *DF* and *DX*

Q	Answer	Mark	Comments
2(b) cont	**Alternative method 3: *XF* from *XE* + *EF* = $\frac{3}{4}$ *HE* + $\frac{1}{4}$ *EG***		
	$(XE =) \frac{3}{4}\mathbf{a} - \frac{3}{4}\mathbf{b}$ or $(EF =) -\frac{1}{4}\mathbf{a} + \frac{9}{4}\mathbf{b}$	M1	oe
	$(XF =) \frac{3}{4}\mathbf{a} - \frac{3}{4}\mathbf{b} - \frac{1}{4}\mathbf{a} + \frac{9}{4}\mathbf{b}$	M1	oe
	$(XF =) \frac{2}{4}\mathbf{a} + \frac{6}{4}\mathbf{b}$ or $(XF =) \frac{1}{2}\mathbf{a} + \frac{3}{2}\mathbf{b}$	A1	
	$(XF =) 2(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b})$ and Yes	A1	oe using a different correct scalar multiple for *XF* and *DX*

Q	Answer	Mark	Comments
2(b) cont	**Alternative method 4: *XF* from *XH* + *HG* + *GF* = $\frac{1}{4}$*EH* + *HG* + $\frac{3}{4}$*GE***		
	$(XH =) = -\frac{1}{4}\mathbf{a} + \frac{1}{4}\mathbf{b}$ or $(GF =) -\frac{27}{4}\mathbf{b} + \frac{3}{4}\mathbf{a}$	M1	oe
	$(XF =) -\frac{1}{4}\mathbf{a} + \frac{1}{4}\mathbf{b} + 8\mathbf{b} - \frac{27}{4}\mathbf{b} + \frac{3}{4}\mathbf{a}$	M1	oe
	$(XF =) \frac{2}{4}\mathbf{a} + \frac{6}{4}\mathbf{b}$ or $(XF =) \frac{1}{2}\mathbf{a} + \frac{3}{2}\mathbf{b}$	A1	
	$(XF =) 2(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b})$ and Yes	A1	oe using a different correct scalar multiple for *XF* and *DX*
	Additional Guidance		
	Method marks may be awarded for correct work seen on diagram or in working, with no or incorrect answer, even if this is seen amongst multiple attempts		

Q	Answer	Mark	Comment
3	Any one of $(\overrightarrow{QW} =) \mathbf{a} + \mathbf{b} - \frac{1}{3}\mathbf{a}$ $(\overrightarrow{WX} =) \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$ $(\overrightarrow{QX} =) \mathbf{a} + \mathbf{b} + \frac{1}{2}\mathbf{b}$	M1	oe eg $(\overrightarrow{QW} =) \frac{2}{3}\mathbf{a} + \mathbf{b}$ or $(\overrightarrow{WX} =) -\frac{2}{3}\mathbf{a} + \mathbf{b} + \mathbf{a} - \frac{1}{2}\mathbf{b}$ or $(\overrightarrow{QX} =) \mathbf{a} + \frac{3}{2}\mathbf{b}$ allow use of $\overrightarrow{WQ}$ and/or $\overrightarrow{XW}$ and/or $\overrightarrow{XQ}$
	Any two of $(\overrightarrow{QW} =) \mathbf{a} + \mathbf{b} - \frac{1}{3}\mathbf{a}$ $(\overrightarrow{WX} =) \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$ $(\overrightarrow{QX} =) \mathbf{a} + \mathbf{b} + \frac{1}{2}\mathbf{b}$	M1dep	oe allow use of $\overrightarrow{WQ}$ and/or $\overrightarrow{XW}$ and/or $\overrightarrow{XQ}$
	Any valid pair of vectors and indication that one vector is a multiple of the other eg $\overrightarrow{QW} = \frac{2}{3}\mathbf{a} + \mathbf{b}$ and $\overrightarrow{WX} = \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$ and $\frac{2}{3}\mathbf{a} + \mathbf{b} = 2\left(\frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}\right)$	A1	eg $\overrightarrow{QW} = \frac{2}{3}\mathbf{a} + \mathbf{b}$ and $\overrightarrow{XQ} = -\mathbf{a} - \frac{3}{2}\mathbf{b}$ and $3\overrightarrow{QW} = -2\overrightarrow{XQ}$ **or** $\overrightarrow{QX} = \mathbf{a} + \frac{3}{2}\mathbf{b}$ and $\overrightarrow{WX} = \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$ and WX is $\frac{1}{3}$ of QX and WX is parallel to QX
	Additional Guidance		
	Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts		

Q	Answer	Mark	Comments
4	One correct expression eg $(\overrightarrow{DE} =) 6\mathbf{a} + \mathbf{b} + 2\mathbf{a} - 5\mathbf{b}$ or $(\overrightarrow{DF} =) 6\mathbf{a} + \mathbf{b} + 4\mathbf{a} - 6\mathbf{b}$ or $(\overrightarrow{EF} =) -2\mathbf{a} + 5\mathbf{b} + 4\mathbf{a} - 6\mathbf{b}$	M1	oe eg $(\overrightarrow{ED} =) -6\mathbf{a} - \mathbf{b} - 2\mathbf{a} + 5\mathbf{b}$ or $(\overrightarrow{FD} =) -6\mathbf{a} - \mathbf{b} - 4\mathbf{a} + 6\mathbf{b}$ or $(\overrightarrow{FE} =) 2\mathbf{a} - 5\mathbf{b} - 4\mathbf{a} + 6\mathbf{b}$ accept unprocessed brackets eg $(\overrightarrow{EF} =) -(2\mathbf{a} - 5\mathbf{b}) + 4\mathbf{a} - 6\mathbf{b}$
	Two correct expressions from $\overrightarrow{DE}$ $\overrightarrow{DF}$ $\overrightarrow{EF}$	M1dep	oe eg $\overrightarrow{DE}$ and $\overrightarrow{FD}$ accept unprocessed brackets
	Two fully simplified expressions from $(\overrightarrow{DE} =) 8\mathbf{a} - 4\mathbf{b}$ $(\overrightarrow{DF} =) 10\mathbf{a} - 5\mathbf{b}$ $(\overrightarrow{EF} =) 2\mathbf{a} - \mathbf{b}$	A1	oe eg $(\overrightarrow{DE} =) 8\mathbf{a} - 4\mathbf{b}$ and $(\overrightarrow{FD} =) -10\mathbf{a} + 5\mathbf{b}$
	Two fully simplified expressions from $(\overrightarrow{DE} =) 8\mathbf{a} - 4\mathbf{b}$ $(\overrightarrow{DF} =) 10\mathbf{a} - 5\mathbf{b}$ $(\overrightarrow{EF} =) 2\mathbf{a} - \mathbf{b}$ and valid indication that the vectors are parallel	A1	eg $(\overrightarrow{DE} =) 8\mathbf{a} - 4\mathbf{b}$ and $(\overrightarrow{FE} =) -2\mathbf{a} + \mathbf{b}$ and $8\mathbf{a} - 4\mathbf{b} = -4(-2\mathbf{a} + \mathbf{b})$ or $(\overrightarrow{DF} =) 10\mathbf{a} - 5\mathbf{b}$ and $(\overrightarrow{EF} =) 2\mathbf{a} - \mathbf{b}$ and $\overrightarrow{DF} = 5\overrightarrow{EF}$
	Additional Guidance		
	Condone absence of vector notation		
	Condone eg $\overrightarrow{DCE}$ or D to E for $\overrightarrow{DE}$		
	If the only two correct expressions are eg $\overrightarrow{DE}$ and $\overrightarrow{ED}$ the maximum possible mark is M1		
	Only combining the three given vectors		Zero
	$\overrightarrow{DF} = \overrightarrow{DE} + \overrightarrow{EF}$ is not a valid indication		
	Stating eg $\overrightarrow{DF}$ is a (scalar) multiple of $\overrightarrow{EF}$ is not enough for the final A1		