Vectors – Paper 2 – Mark Scheme

Question 1

19	(a) 2**p** 3**p** + **q** ……….. 5**p** + 3**q** cao	1, 1, 1	
	(b) (i) all 4 plotted correctly ft	2	**B1** 2 or 3 correct
	(ii) a (straight) line	1	Allow linear, collinear

Question 2

15	(a) **g** – **h**	1	
	(b) $\frac{1}{4}$**g** + $\frac{3}{4}$**h**	2	**M1** for $\overrightarrow{OH} + \overrightarrow{HN}$ or **h** + $\frac{1}{4}$ (a) $\overrightarrow{OG} + \overrightarrow{GN}$ or **g** – $\frac{3}{4}$ (a)

Question 3

7	$t = 2\frac{1}{2}$	2	**M1** (b)t = (b)(3t – 5)

Question 4

18	(a) (i) -**r** + **q** or **q** – **r**	1	
	(ii) ½(3**q** – **r**) oe	1	Must be simplified
	(b) correct working	3	**M1** for *MX* = ½ **r** + ¾ their (–**r** + **q**) **M1** using a different route for *XS* or ½ *MS* **E1** dep correct simplification and conclusion

Question 5

16	(a) ½ **a** – ½ **c** oe	2	**M1** correct but unsimplified e.g. ½ **a** + – ½ **c**
	(b) ¾ **a** + ¾ **c** oe	2	**M1** correct but unsimplified

Question 6

13	(a) $\frac{1}{2}$**a** + $\frac{1}{2}$**b** oe	2	**M1** unsimplified or any correct route e.g **a** + $\frac{1}{2}$ (**b** – **a**) or **OA** + **AC**
	(b) $-1\frac{1}{2}$**a** + $1\frac{1}{2}$**b** oe	2	**M1** unsimplified or any correct route e.g. **CD** = $1\frac{1}{2}$**AB** or **b** – **a** + $\frac{1}{2}$ (**b** – **a**)

Question 7

15	(a) (3, 3½)	1	
	(b) $\binom{4}{3}$	1	
	(c) Correct perpendicular bisector with arcs	2	**B1** line through (3, 3½) perp to *AB* **B1** two sets of correct arcs

Question 8

17	(a)	(i)	$3\mathbf{a} + \mathbf{c}$	2	**B1** $AO + OC + CB$ or $-\mathbf{a} + \mathbf{c} + 4\mathbf{a}$
		(ii)	$2\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c}$ oe	2	**M1** $\mathbf{a} + \frac{1}{2}$ their **(a)(i)**
	(b)		D marked ¾ way along CB	2	**B1** D on CB

Question 9

19	(a)	$-\mathbf{p} + \mathbf{t}$	1	
	(b)	$\mathbf{p} + 2\mathbf{t}$	2	**M1** for a correct route from P to R or unsimplified answer
	(c)	$2(\mathbf{p} + \mathbf{t})$ or $2\mathbf{p} + 2\mathbf{t}$	2ft	**M1** for **OR** or a correct route or ft $\mathbf{p}$ + their (b) unsimplified provided their (b) is a vector

Question 10

18	(a)	$\mathbf{p} - \frac{1}{3}\mathbf{q}$ oe	2	**M1** $\overrightarrow{QR} + \overrightarrow{RX}$ oe or $-\mathbf{q} + \mathbf{p} + (\frac{2}{3})\mathbf{q}$ oe
	(b)	$\frac{1}{2}\mathbf{p} + \frac{5}{6}\mathbf{q}$ oe	2 ft	ft $\mathbf{q} + \frac{1}{2}$ their (a) but must be vectors or **M1** for $\overrightarrow{OQ} + \overrightarrow{QM}$ oe

Question 11

20	(a)	⅓$(\mathbf{c} - \mathbf{d})$ oe	2	**M1** for $DC = \mathbf{c} - \mathbf{d}$ oe or correct route Their **(a)** + **d** simplified
	(b)	⅓$\mathbf{c}$ + ⅔$\mathbf{d}$ oe	2ft	**M1** for any correct route from O to E stated

Question 12

20	(a)	(i)	$\mathbf{p} + \frac{1}{2}\mathbf{r}$	1	
		(ii)	$2\mathbf{p} + \mathbf{r}$	1ft	$2 \times$ *their* (i)
	(b)		Midpoint of RQ	1	

Question 13

19	(a)		hexagon	1	
	(b)	(i)	$-\mathbf{b} + \mathbf{c}$	1	
		(ii)	$\mathbf{b} - \frac{1}{2}\mathbf{c}$	2	**B1** for **OB + BA** or any correct route
		(iii)	$-\mathbf{b} + \mathbf{c}$	1FT	= *their* (b)(i)

Question 14

16	(a)	$\begin{pmatrix} 9 \\ 6 \end{pmatrix}$	1	
	(b)	10.8 or 10.81 to 10.82	2FT	**M1** for $\sqrt{(\textit{their } 9)^2 + (\textit{their } 6)^2}$ **A1** for 10.8 or FT correctly evaluated
	(c)	(17, 13)	1FT	FT *their* 9 and 6. (8 + *their* 9, 7 + *their* 6) correctly evaluated

Question 15

19	(a)	$-2\mathbf{a} - 2\mathbf{c}$ oe	2	**M1** for $\mathbf{BO} = -\mathbf{a} - \mathbf{c}$ or for any correct route or correct unsimplified expression
	(b)	$2\mathbf{a} + \mathbf{c}$	2	**M1** for any correct route or correct unsimplified expression
	(c)	$-\mathbf{a} - \mathbf{c}$ oe	2FT	FT *their* (a) or correct answer Or **M1** for a correct non direct route from O to E or for correct unsimplified expression or for correct FT unsimplified

Question 16

14	(a)	$\mathbf{p} + \mathbf{r}$	1	
	(b)	$\frac{3}{2}\,\mathbf{p} + \frac{1}{2}\,\mathbf{r}$	2	**M1** for correct route from O to M or **M1** for $\mathbf{p} + \tfrac{1}{2}\textit{their}(\text{a})$

Question 17

19	(a)	(i)	$\mathbf{c} - \mathbf{a}$	1	
		(ii)	$-\dfrac{1}{3}\,\mathbf{a} + \dfrac{1}{3}\,\mathbf{c}$	3	**M2** for $-\mathbf{a} + \dfrac{1}{3}(\mathbf{c} + 2\mathbf{a})$ oe e.g. $-\mathbf{a} + \mathbf{c} + 2\mathbf{a} - \dfrac{2}{3}(\mathbf{c} + 2\mathbf{a})$ Or **M1** for a correct route from A to X
	(b)		$\overrightarrow{AC}$ is a multiple of $\overrightarrow{AX}$ **and** they share a common point [A]	1 1	oe oe

Question 18

14	(a)	$\dfrac{1}{2}\mathbf{b} - \dfrac{1}{2}\mathbf{a}$ oe	2	**M1** for $\frac{1}{2}(\overrightarrow{AO} + \overrightarrow{OB})$ oe or correct unsimplified route e.g. $\overrightarrow{AO} + \overrightarrow{OB} + \overrightarrow{BP}$ or $-\mathbf{a} + \mathbf{b} + \frac{1}{2}\overrightarrow{BA} = -\mathbf{a} + \mathbf{b} + \frac{1}{2}(\mathbf{a} - \mathbf{b})$
	(b)	$\dfrac{1}{4}\mathbf{a} + \dfrac{3}{4}\mathbf{b}$ oe	2	**M1** for $\overrightarrow{OA} + \overrightarrow{AQ}$ oe or correct unsimplified route

Question 19

14	(a)	$\mathbf{a} + 2\mathbf{b} - \mathbf{a}$ or $\mathbf{a} - (\mathbf{a} - 2\mathbf{b})$ oe	1	
	(b)	Parallelogram	1	
		PM **equal** and parallel to QR **or** PM or PS parallel to QR **and** MR found $= \mathbf{a}$ so 2 pairs of parallel sides	1	**SC1** for answer trapezium with reason PM parallel to QR

Question 20

19	(a)	(i)	$-\mathbf{b} + \mathbf{a}$	1	
		(ii)	$\mathbf{b} + \frac{1}{2}\mathbf{a}$	1	
	(b)		$[\overrightarrow{OX} =]\ \mathbf{b} + \frac{1}{3}(-\mathbf{b} + \mathbf{a})$ oe	M1	
			$\frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$ oe	A1	
			2 statements from: $\overrightarrow{OM} = \mathbf{b} + \frac{1}{2}\mathbf{a}$ oe or $[\overrightarrow{OX} =]\ \frac{2}{3}(\mathbf{b} + \frac{1}{2}\mathbf{a})$ oe or $\overrightarrow{OX} = \frac{2}{3}\overrightarrow{OM}$ oe	B2	B1 for any one of these statements

Question 21

4	5.83 or 5.830 to 5.831	2	M1 for $\sqrt{(-3)^2 + 5^2}$

Question 22

23	(a)	$\frac{1}{3}(-\mathbf{a} + \mathbf{b})$ oe	2	M1 for any correct route eg $AO + OB + \frac{2}{3}BA$ or B1 for $\overrightarrow{AB} = -\mathbf{a} + \mathbf{b}$ oe
	(b)	$\frac{2}{3}\mathbf{a} + \frac{1}{3}\mathbf{b}$ oe simplified	2FT	FT *their* (a) + **a** simplified only if in terms of **a** and **b**. M1 for identifying $\overrightarrow{OC}$ as position vector or correct route in any form or for correct unsimplified answer

Question 23

17	(a)	$\mathbf{b} - \mathbf{a}$	2	M1 if unsimplified or correct route in terms of P,Q,R,S
	(b)	$\frac{5}{8}\mathbf{x} + \frac{3}{8}\mathbf{y}$	2	M1 for a correct route e.g. $OX + XM$ or for $\frac{3}{8}\overrightarrow{XY}$ or $\frac{5}{8}\overrightarrow{YX}$

Question 24

24 (a)	$\mathbf{a} + \mathbf{b} - \mathbf{c}$	1	
(b)	$\dfrac{1}{2}\mathbf{a} + \dfrac{1}{2}\mathbf{b} + \dfrac{1}{2}\mathbf{c}$	2	**M1** for $\mathbf{c} + \frac{1}{2}$ (*their* (a)) or for a correct route e.g. $\overrightarrow{OC} + \dfrac{1}{2}\overrightarrow{CB}$, $\overrightarrow{OQ}$
(c)	$\dfrac{1}{2}\mathbf{c} - \dfrac{1}{2}\mathbf{a} - \dfrac{1}{6}\mathbf{b}$	2	**M1** for $\dfrac{1}{3}\mathbf{b} - \dfrac{1}{2}$ (*their* (a)) or other correct route e.g. $-\dfrac{2}{3}\mathbf{b} - \mathbf{a} + $ *their* (b), $\overrightarrow{PO} + \overrightarrow{OQ}$

Question 25

9	$\dfrac{1}{4}\mathbf{a} - \dfrac{1}{4}\mathbf{b} - \dfrac{1}{4}\mathbf{c}$ oe	2	**B1** for $\overrightarrow{GK} = \mathbf{a} - \mathbf{b} - \mathbf{c}$ oe soi or $\overrightarrow{GL} = \dfrac{1}{4}(\overrightarrow{GK})$ or for any correct route

Question 26

14(a)	$(9, -4)$	1	
14(b)	-5	2	**M1** for $t^2 + 12^2 = 13^2$ oe or **SC1** for answer 5 or ± 5

Question 27

22(a)	$6\mathbf{a} - 2\mathbf{b}$ or $2(3\mathbf{a} - \mathbf{b})$	2	**M1** for $4\mathbf{a} + \mathbf{b} - (-2\mathbf{a} + 3\mathbf{b})$ or better
22(b)	$5\mathbf{a} - \mathbf{b}$	2	**M1** for a correct route e.g. $\overrightarrow{OD} + \overrightarrow{DE}$, $4\mathbf{a} + \mathbf{b} + \mathbf{a} - 2\mathbf{b}$, $\overrightarrow{OE}$