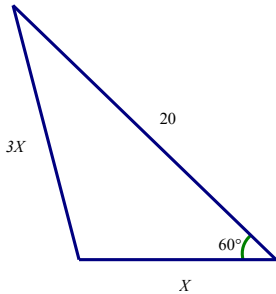


A level Mathematics Practice Paper – Vectors in mechanics – Mark scheme

Question	Scheme	Marks
1(a)	$\tan \theta = \frac{5}{20}$	M1
	$\theta = 14.036..^{\circ}$ $\theta = 104^{\circ}$ nearest degree	A1 A1
		(3)
1(b)	$\mathbf{p} = 400\mathbf{i} + t(15\mathbf{i} + 20\mathbf{j})$	M1 A1
	$\mathbf{q} = 800\mathbf{j} + t(20\mathbf{i} - 5\mathbf{j})$	A1
		(3)
1(c)	Equate their j components: $20t(\mathbf{j}) = (800 - 5t)(\mathbf{j})$	M1
	$t = 32$	A1
	$\mathbf{s} = 800\mathbf{j} + 32(20\mathbf{i} - 5\mathbf{j})$	M1
	$= 640\mathbf{i} + 640\mathbf{j}$	A1
		(4)
		(11 marks)
2(a)	$(4\mathbf{i} - 2\mathbf{j}) + (2\mathbf{i} + q\mathbf{j}) = (6\mathbf{i} + (q - 2)\mathbf{j})$	M1A1
	$6 = 2(q - 2)$ ratio 2:1	DM1
	$q = 5$	A1
		(4)
2(b)	$6\mathbf{i} + 3\mathbf{j} = 1.5\mathbf{a}$	M1
	$\mathbf{a} = (4\mathbf{i} + 2\mathbf{j}) \text{ m s}^{-2}$	A1
	$\mathbf{v} = \mathbf{u} + \mathbf{at} = (-2\mathbf{i} + 4\mathbf{j}) + 2(4\mathbf{i} + 2\mathbf{j})$	M1
	$= 6\mathbf{i} + 8\mathbf{j}$	A1ft
	speed = $\sqrt{6^2 + 8^2}$ $= 10 \text{ m s}^{-1}$	M1 A1
		(6)
		(10 marks)

A level Mathematics Practice Paper – Vectors in mechanics – Mark scheme

Question	Scheme	Marks
3(a)	$\mathbf{F} = m\mathbf{a}: 3\mathbf{i} - 2\mathbf{j} = 0.5\mathbf{a}$	M1
	$\mathbf{a} = 6\mathbf{i} - 4\mathbf{j}$	A1
	$ \mathbf{a} = \sqrt{6^2 + (-4)^2} = 2\sqrt{13} \text{ (m s}^{-2}\text{) **}$	M1A1
		(4)
3(b)	$\mathbf{v} = \mathbf{u} + \mathbf{at}: \mathbf{v} = (\mathbf{i} + 3\mathbf{j}) + 2(6\mathbf{i} - 4\mathbf{j})$	M1A1 ft
	$= 13\mathbf{i} - 5\mathbf{j} \text{ m s}^{-1}$	A1
		(3)
3(c)	Distance = $2 \mathbf{v} = 2\sqrt{4+1} = 2\sqrt{5} = 4.47 \text{ (m)}$	M1A1
		(2)
3(d)	When $t = 3.5$, velocity of P is $(\mathbf{i} + 3\mathbf{j}) + 3.5(6\mathbf{i} - 4\mathbf{j}) = 22\mathbf{i} - 11\mathbf{j}$	M1A1 ft
	Given conclusion reached correctly. E.g. $22\mathbf{i} - 11\mathbf{j} = 11(2\mathbf{i} - \mathbf{j})$	A1
		(3)
		(12 marks)
4(a)		
	Resolve and use Pythagoras	
	$(X - 20\cos 60^\circ)^2 + (20\sin 60^\circ)^2 = (3X)^2$	M1 A1
	$8X^2 + 20X - 400 = 0$	A1
	$X = \frac{-5 \pm \sqrt{25 + 800}}{4} = 5.93 \text{ (3 SF)}$	M1A1
		(5)
4(b)	$ \mathbf{P} - \mathbf{Q} ^2 = 20^2 + X^2 - 2X \times 20 \times \cos 120^\circ$	M1A1
	$ \mathbf{P} - \mathbf{Q} = 23.5 \text{ (N) (3SF)}$	DM1 A1
		(4)
		(9 marks)

A level Mathematics Practice Paper – Vectors in mechanics – Mark scheme

Question	Scheme	Marks
5(a)	$\mathbf{F}_2 = k\mathbf{i} + k\mathbf{j}$ $(-1+a)\mathbf{i} + (2+b)\mathbf{j}$ $\frac{-1+a}{2+b} = \frac{1}{3}$ $a = b = k = 2.5; \mathbf{F}_2 = 2.5\mathbf{i} + 2.5\mathbf{j}$	<p align="center">B1 M1 DM1 A1 DM1 A1 A1</p>
		(7)
5(b)	$\mathbf{v} = 3\mathbf{i} - 22\mathbf{j} + 3(3\mathbf{i} + 9\mathbf{j})$ $= 12\mathbf{i} + 5\mathbf{j}$ $ \mathbf{v} = \sqrt{12^2 + 5^2} = 13 \text{ ms}^{-1}$	<p align="center">M1 A1 M1 A1 cso</p>
		(4)
		(11 marks)
6(a)	$\tan\theta = \frac{2}{9} \quad \theta = 12.5^\circ \quad \text{bearing } 103^\circ$	<p align="center">M1 A1 A1</p>
		(3)
6(b)	$\mathbf{p} = (9\mathbf{i} + 10\mathbf{j}) + t(9\mathbf{i} - 2\mathbf{j})$ $\mathbf{q} = (\mathbf{i} + 4\mathbf{j}) + t(4\mathbf{i} + 8\mathbf{j})$	<p align="center">M1 A1 A1</p>
		(3)
6(c)	$\overrightarrow{QP} = (8 + 5t)\mathbf{i} + (6 - 10t)\mathbf{j}$	<p align="center">M1 A1</p>
		(2)
6(d)	$D^2 = (8 + 5t)^2 + (6 - 10t)^2$ $= 125t^2 - 40t + 100$ $100 = 125t^2 - 40t + 100$ $0 = 5t(25t - 8)$ $t = 0 \text{ or } 0.32$	<p align="center">M1 A1 M1 M1 A1 A1</p>
		(6)
		(14 marks)

A level Mathematics Practice Paper – Vectors in mechanics – Mark scheme

	Source paper	Question number	New spec references	Question description	New AOs
1	M1 2016	1		Vectors in mechanics	1.1b, 2.2a, 3.1b
2	M1 2014R	2		Vectors in mechanics	1.1b, 3.1a, 3.1b
3	M1 2014	5		Vectors in mechanics	1.1b, 2.1, 3.1b
4	M1 2014	6		Vectors in mechanics	1.1b, 3.1a
5	M1 2016	7		Vectors in mechanics	1.1b, 3.1a
6	M1 2017	7		Vectors in mechanics	1.1b, 2.1, 3.1b