1	(a)	Solve the simultaneous equations	
		2y = x - 8,	[3]
		3x - 4y = 19.	
	(h)	Simplify $\frac{x^2 - 4y^2}{2}$	[3]
	(0)	$x^2 - 5xy + 6y^2$	[9]
	(c)	(i) Express $x^2 - 7x - 3$ in the form $(x + a)^2 + b$.	[2]
		(ii) Hence solve the equation $x^2 - 7x - 3 = 0$, giving your answers	
		correct to two decimal places.	[2]
1(a))	x = 2y + 8	
		3(2y+8) - 4y = 19	
		2y = -5	
		y = -2.5	
		<i>x</i> =3	
1(b))	$2 \dots 2$	
		$\frac{x^2 - 4y^2}{2}$	
		$x^2 - 5xy + 6y^2$	
		$=\frac{(x+2y)(x-2y)}{(x-2y)}$	
		(x-3y)(x-2y)	
		$=\frac{(x+2y)}{(x-3y)}$	
1(ci	i)	$x^{2} - 7x - 3 = x^{2} - 7x + (\frac{7}{2})^{2} - (\frac{7}{2})^{2} - 3$	
		$=\left(r-\frac{7}{2}\right)^{2}-15\frac{1}{2}$	
		$\begin{pmatrix} x \\ 2 \end{pmatrix}$ $\begin{pmatrix} x \\ 4 \end{pmatrix}$	
1(ci	i)	$\left(r-\frac{7}{2}\right)^2 - 15\frac{1}{2} = 0$	
1(01	<i>)</i>	$\begin{pmatrix} x \\ 2 \end{pmatrix}$ 4^{-0}	
		$\left(x - \frac{7}{2}\right)^2 = 15\frac{1}{4}$	
		$\begin{pmatrix} 7 \end{pmatrix}$	
		$\begin{pmatrix} x - \frac{1}{2} \end{pmatrix} = \pm 3.905$	
		x = 7.41 $x = -0.41$	





4. The first four terms in a sequence of numbers, $u_1, u_2, u_3, u_4, \dots$ are given			
below.			
$u_1 = 3^0 + 0 = 1$			
$u_2 = 3^1 + 2 = 5$			
$u_3 = 3^2 + 4 = 13$			
$u_4 = 3^3 + 6 = 33$			
(a) Write down an expression for u_5 and show that $u_5 = 89$.	[1]		
(b) Write down an expression for u_8 and evaluate it.	[1]		
(c) Find an expression, in terms of n , for the <i>n</i> th term, u_n , of the sequence	. [2]		
(d) Explain why the value of u_n must be odd for all values of n .	[2]		
(e) (i) Show that $(3)^{n-1} - (3)^{n-2} = (2)3^{n-2}$	[2]		
(ii) Find , and simplify, an expression, in terms of n , for $u_n - u_{n-1}$.	[2]		
$4(a)$ $u_{r} = 3^{4} + 8 = 89$			
$(a) a_5 = 5 + 6 = 67$			
4(b) $u_8 = 3^7 + 14 = 2201$			
4(c) $u_n = 3^{n-1} + 2(n-1)$			
4(d) 3^{n-1} is an odd number for all values of <i>n</i> ,			
2(n-1) is always an even number for all values of n ,			
The sum of odd no and even no gives odd number			
4e(i) $(3)^{n-1} - (3)^{n-2} = 3^{n-2}(3-1) = 2(3)^{n-2}$			
4e(ii) $u_{n-1} = 3^{n-2} + 2(n-2)$			
$u_n = 3^{n-1} + 2(n-1)$			
$u_n - u_{n-1} = 3^{n-1} + 2n - 2 - 3^{n-2} - 2n + 4$			
$=3^{n-1} - 3^{n-2} + 2$			
$\left(-n-2\right)$			
$=2(3^{n-2})+2$			

5 (a) The diagram shows an open container A, made from a cylinder and a cone. The cylinder has a radius of 8 cm and a height of 16 cm. The cone has a height of 12 cm. The container is completely filled with water.

Find the volume of water in the container.



[3]

(b) The diagram shows a pot which is part of a right circular cone of height *h* cm.

The open end of the pot is a circle of radius 6 cm. The base of the pot is a circle of radius 4 cm. The height of the pot is 10 cm.

Some water from the container *A* is poured into the pot.

The height of the water in the pot is 8 cm.

The top of the water surface is a circle of radius r cm.



5(a) Volume of water = $\pi(8)^2(16) + \frac{1}{3}\pi(8)^2(12)$

 $=4020 \text{ cm}^3 (3 \text{ sf})$

5(bi) $\frac{h-10}{h} = \frac{4}{6}$ 6h - 60 = 4h $h = 30 \ cm$

5(bii)
$$\frac{h-10+8}{h} = \frac{r}{6}$$

 $\frac{r}{6} = \frac{28}{30}$
 $r = 5.6$

5(biii)

Volume of water = $-\frac{1}{3}\pi(5.6)^2(28) - \frac{1}{3}\pi(4)^2(20)$ = 584.42 cm³

Percentage = $\frac{584.42}{4021.2} \times 100\%$ = 14.5 %

In the diagram, $\overrightarrow{PQ} = 2\mathbf{a}$ and $\overrightarrow{PR} = \mathbf{b}$. QS is parallel to PR and $QS = \frac{3}{2}$ PR. 6 T is the point on QR such that QT : TR = 3 : 1. U is the midpoint of PQ. Express, as simply as possible, in terms of **a** and **b**, (a) \rightarrow (i) QR, [1] \rightarrow PT, (ii) [2] \rightarrow (iii) US. [1] Show that *PT* is parallel to *US*. **(b)** [2] The point *X* lies on *QP* produced such that $XP = \frac{1}{2}PQ$. (c) Given that *XTS* is a straight line and XT = TS, area of triangle XPT find [3] area of quadrilateral PQST $\begin{array}{cc} \rightarrow & \rightarrow & \rightarrow \\ 6(ai) & QR = QP + PR \end{array}$ $= -2\mathbf{a} + \mathbf{b}$ b 6(aii) $\overrightarrow{PT} = \overrightarrow{PQ} + \overrightarrow{QT}$ $= \overrightarrow{PQ} + \frac{3}{4} \overrightarrow{QR}$ U $= 2\mathbf{a} + \frac{3}{4}(-2\mathbf{a} + \mathbf{b})$ 2**a** $=\frac{1}{2}\mathbf{a}+\frac{3}{4}\mathbf{b}$ $\begin{array}{cc} \rightarrow & \rightarrow & \rightarrow \\ 6(aiii) & US = UQ + QS \end{array}$ $=\mathbf{a}+\frac{3}{2}\mathbf{b}$

6(b)
$$\overrightarrow{US} = 2\left(\frac{1}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}\right)$$

= 2 \overrightarrow{PT}

Therefore, *PT* is parallel to *US*.

6(c) Using common height. Area of triangle XTQ: Area of triangle STQ= XT: TS= 1 : 1

> Area of triangle *XPT* : Area of triangle *QPT* = *XP* : *QP* = 1 : 2

Area of triangle *XPT* : Area of triangle *QPT* : Area of triangle *STQ* = 1 : 2 : 3

Therefore,
$$\frac{\text{area of triangle } XPT}{\text{area of quadrilateral } PQST}$$

= $\frac{\text{area of triangle } XPT}{\text{area of triangle } QPT + \text{area of triangle } STQ} = \frac{1}{5}$

7 Answer the whole of this question on a sheet of graph paper.

The speed, v m/s, of an object at a time t seconds after it starts from rest is given by the equation $v = 40 + 5t - 2t^2$.

Some values of *t* and the corresponding values of *v* are given in the table below.

<i>t</i> (s)	0	0.5	2	3	4	4.5	5	5.5
v (m/s)	40	42	42	37	28	p	15	7

- (a) Calculate the value of *p*.
- (b) Using a scale of 2 cm to represent 1 second, draw a horizontal *x*-axis for $0 \le t \le 6$. Using a scale of 2 cm to represent 10 m/s, draw a vertical *y*-axis for $0 \le v \le 70$. On your axes, plot the points given in the table and join them with a smooth curve. [3]

[1]

(c)	Use your graph to find					
	(i)	the value of t when the object comes to a stop,	[1]			
	(ii)	the length of time when the object is moving faster than 40 m/s,	[2]			
	(iii) the maximum speed of the object. Hence state the acceleration of t					
		object at this speed.	[2]			
(d)	(i)	Draw the tangent to the curve at the point where				
		the gradient is -7 .	[1]			
	(ii)	Explain what the gradient represents.	[1]			
	(iii)	Write down the equation of the tangent.	[1]			

10



8 (a) In a Mathematics examination, 400 students each took two papers.Both papers were marked out of 100.

The cumulative frequency curves show the distribution of the marks for the two papers.





Two students are selected at random.

- (i) Find the probability that a student from the class has a timing of less than 12 seconds. [1]
- (ii) Find the probability that both students have a timing of at least 11 seconds. [2]

8(a)(i)(a)	53 or 54	
(b)	65-40	
	=25	
(ii)	325	
(iii)	70	
(iv)	Paper 1. The median mark of P1 is 53 while	
	median for P2 is 64. P1 is more difficult.	
(b)(i)	$\frac{3+5+10}{3} = \frac{3}{3}$	
	30 5	
(ii)	P (both at least 11s) = $\frac{10+12}{30} \times \frac{21}{29}$	
	$=\frac{77}{145}$	

9 (a) ABC is a triangle with AB = 5 cm, AC = 8 cm and $\angle ACB = 10^{\circ}$.

(i)	Find the obtuse $\angle ABC$.	[2]		
(ii)	Calculate the area of triangle ABC.	[2]		
A map is drawn to a scale of 1: 20 000.				
Triangle ABC represents the surface area of a reservoir on this map.				
(iii)	Calculate the actual surface area, in m ² , of the reservoir.	[2]		

(b) P, Q and R are three points on the sea. Q is 14 km from P. The bearing of Q from P is 067°. R is due west of Q. A kayak, X, sails from P to R. The bearing of R from P is 030°. Find the distance sailed by kayak X. [2]



(c)	In the diagram, point S is 9 km from P and 11 km from Q ,			
	calculate the bearing of S from Q.	[3]		

```
(d) A sea gull is hovering vertically above S.
The angle of elevation of the sea gull from P is 16°.
Another kayak Y sails along PQ.
Find the greatest possible angle of elevation of the sea gull from Y. [3]
```

9(a)(i)
$$\frac{\sin A\hat{B}C}{8} = \frac{\sin 10^{\circ}}{5}$$

$$A\hat{B}C = 163.8688^{\circ}$$

$$= 163.9^{\circ}$$
9(ii) Area = $\frac{1}{2} \times 5 \times 8 \times \sin(180^{\circ} - 10^{\circ} - 163.8688^{\circ})$

$$= 2.1361$$

$$= 2.14 \text{ cm}^{2}$$
9(iii) 1 cm: 200 m
1 cm²: (200)² m²
2.1361 cm²: 85 444 m²
Actual surface area = 85 400 m² (3 sf)
9(bi) $\frac{PR}{\sin 23^{\circ}} = \frac{14}{\sin(30^{\circ} + 90^{\circ})}$
 $PR = 6.3165 = 6.32 \text{ km (3 sf)}$
9(ii) $Q = \cos^{-1}(\frac{11^{2} + 14^{2} - 9^{2}}{2 \times 11 \times 14})$

$$= 39.9831^{\circ}$$
Bearing = $180^{\circ} + (67^{\circ} - 39.9831^{\circ})$

$$= 207.0^{\circ}$$
9(iii) $\tan 16^{\circ} = \frac{height}{9}$
 $h = 9 \tan 16^{\circ}$
Perpendicular distance = 11 sin 39.9831^{\circ}
 $\tan \theta = \frac{9 \tan 16^{\circ}}{11 \sin 39.9831^{\circ}}$
 $\theta = 20.1^{\circ} (1 \text{ dp})$

15

	Plan A	Plan B	Plan C
Monthly	\$10	\$35	\$60
Subscription			
Free Voice Call	0 minutes	150 minutes	400 minutes
Excess Voice Call	15 cents per minute	10 cents per minute	5 cents per minute
Free SMS	0	500	1000
Excess SMS	2 cents each	1 cents each	1 cents each
Free Data	2 GB	3 GB	5 GB
Excess Data	\$5 / GB	\$10 / GB	\$10 / GB

10 The mobile plans offered by a company are shown below.

- (a) In a particular month, Amy made 240 minutes of voice call, sent 400 SMS and used 4 GB of data.
 Calculate how much she had to pay if she subscribed to Plan B. [3]
- (b) Give two possible reasons why a person would prefer Plan C over Plan A. [2]
- (c) Jack wants to buy a mobile phone.

He visits a roadshow and there is a promotion.

Sign up a 2-Year Contract for Plan B or C.

Option 1: Get a voucher of \$200 offset for any phone Option 2: 10% discount for the monthly subscription

On average, he makes 350 minutes of voice call, sends 300 SMS and uses

3.5 GB of data per month.

Suggest the plan and option for Jack to sign up.

Justify your decision with calculations.

[5]

- END OF PAPER -

10(a)	Monthly Subscription costs \$35
	240 minutes of voice call costs $(240-150) \times 0.1 = 9
	400 SMS costs \$0
	4GB of data cost $1 \times 10 = 10
	Total is \$54.
10(b)	Using a lot of call / excess voice call is cheaper
	Using a lot of SMS / excess SMS is cheaper
	Using a lot of data up to 5 GB
10(c)	Plan B Option 1:
	Each Month: $35 + 0.10 \times 200 + 10 = 65$
	Each Year: $$65 \times 24 = 1560
	After Voucher: $$1560 - $200 = 1360
	Plan B Option 2:
	Each Month After Discount: $35 \times 0.9 + 0.10 \times 200 + 10 = 61.50$
	Each Year After Discount: $61.50 \times 24 = 1476$
	Plan C Option 1:
	Each Month: \$60
	Each Year: $60 \times 24 = 1440$
	After Voucher: $1440 - 200 = 1240$
	Plan C Option 2:
	Each Month After Discount: $60 \times 0.9 = 54$
	Each Year After Discount: $$54 \times 24 = 1296
Ass	uming the phone is more \$200, Jack should choose Plan C Option 1.
1	