## Answer all the questions.

1 (a) Solve the simultaneous equations

$$2y = x - 8,$$
  
 $3x - 4y = 19.$  [3]

(b) Simplify 
$$\frac{x^2 - 4y^2}{x^2 - 5xy + 6y^2}$$
. [3]

- (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]
- 2 The diagram shows a road junction at *O* with *PO* perpendicular to *OQ* and OP = 60 km. A cyclist, *X*, starts from *P* and travels towards *O* at a constant speed of 10 km/h. At the same time, another cyclist, *Y*, starts from *O* and travels towards *Q* at a constant speed of 15 km/h.



- (a) Cyclist X leaves from P and cyclist Y leaves from O at noon. Given that t is the time in hours, write down, in terms of t,
  - (i) the distance of X from O after t hours, [1]
  - (ii) the distance of Y from O after t hours. [1]
- (b) After *t* hours, the cyclists are 80 km apart. Write down an equation in *t* to represent this information and show that it reduces to  $13t^2 - 48t - 112 = 0$ . [2]

(c) Solve the equation 
$$13t^2 - 48t - 112 = 0.$$
 [3]

(d) Find the distance of cyclist *X* from *O* when the cyclists are 80 km apart. [1]

3 The diagram shows a circle ABCDE, with centre O. AEF is a straight line.

Angle  $BAE = 100^{\circ}$  and angle  $CEF = 120^{\circ}$ . AE = ED. EC is a diameter.



4



The first four terms in a sequence of numbers,  $u_1, u_2, u_3, u_4, \dots$  are given below. 4

> $u_1 = 3^0 + 0 = 1$  $u_2 = 3^1 + 2 = 5$  $u_3 = 3^2 + 4 = 13$  $u_4 = 3^3 + 6 = 33$

Write down an expression for  $u_5$  and show that  $u_5 = 89$ . **(a)** [1] **(b)** Write down an expression for  $u_8$  and evaluate it. [1] Find an expression, in terms of n, for the *n*th term,  $u_n$ , of the sequence. (c) [2] **(d)** Explain why the value of  $u_n$  must be odd for all values of n. [2] (i) Show that  $(3)^{n-1} - (3)^{n-2} = (2)3^{n-2}$ . **(e)** [2] (ii) Find, and simplify, an expression, in terms of n, for  $u_n - u_{n-1}$ . [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.



6 In the diagram, 
$$\overrightarrow{PQ} = 2\mathbf{a}$$
 and  $\overrightarrow{PR} = \mathbf{b}$ . QS is parallel to PR and  $QS = \frac{3}{2}$  PR.

*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)** 

 $\overrightarrow{QR}$ , (i) [1]

(ii) 
$$\stackrel{\rightarrow}{PT}$$
, [2]

(iii) 
$$\stackrel{\rightarrow}{US}$$
. [1]

$$\frac{1}{\text{area of quadrilateral } PQST}.$$
[3]

## 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	р	15	7

(a) Calculate the value of *p*.

(b) Using a scale of 2 cm to represent 1 second, draw a horizontal axis

for  $0 \le t \le 6$ .

Using a scale of 2 cm to represent 10 m/s, draw a vertical 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]

## (c) Use your graph to find

	(i)	the value of t when the object comes to a stop,	[1]		
	( <b>ii</b> )	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 the			
		object at this speed.	[2]		
<b>(J)</b>		Drow the tengent to the sum a st the point where			
( <b>u</b> )	(1)	Draw the tangent to the curve at the point where			
		the gradient is $-7$ .	[1]		
	( <b>ii</b> )	Explain what the gradient represents.	[1]		
	( <b>iii</b> )	Write down the equation of the tangent.	[1]		

[1]

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.



(i) For Paper 1, estimate

	(a)	the median mark.	[1]		
	(b)	the interquartile range.	[2]		
(ii)	Estimate the number of students that gained at least 45 marks for				
	Paper	2.	[1]		
( <b>iii</b> )	One additional student gained 60 marks in Paper 1, but was absent for				
	Paper	2.			

Estimate the mark he would have obtained if he had taken Paper 2. [1]

- (iv) Which was the more difficult paper? Justify your answer. [2]
- (b) The histogram shows the distribution of the timings for Shuttle Run by a class of 30 students.



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]

- 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.[2]Triangle ABC represents the surface area of a reservoir on this map.(iii)Calculate the actual surface area, in m², 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]

	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	10 cents per	5 cents per minute
	minute	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]

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