UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7132398222

ADDITIONAL MATHEMATICS

0606/23

Paper 2

October/November 2013

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **19** printed pages and **1** blank page.

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UNIVERSITY *of* CAMBRIDGE
International Examinations

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Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} bc \sin A$$

1 Find the coordinates of the stationary points on the curve $y = x^3 - 6x^2 - 36x + 16$.

2 **(i)** Find how many different numbers can be formed using 4 of the digits 1, 2, 3, 4, 5, 6 and 7 if no digit is repeated.

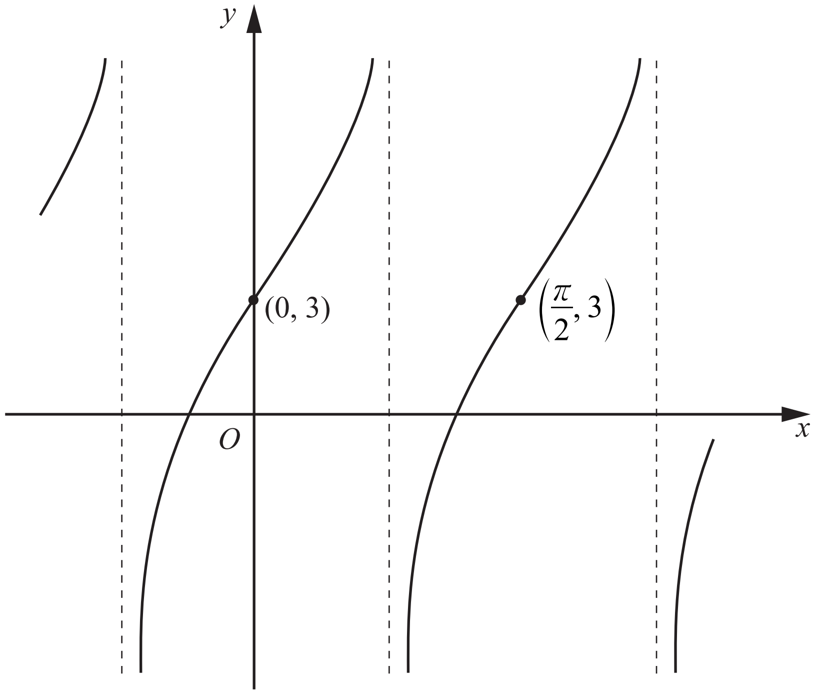
Find how many of these 4-digit numbers are

(ii) odd, [1]

(iii) odd and less than 3000. [3]

3 Find the set of values of k for which the line $y = 3x - k$ does not meet the curve $y = kx^2 + 11$

4



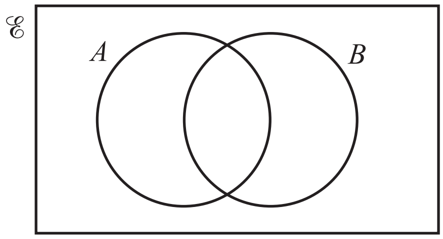
(a) **(i)** The diagram shows the graph of $y = A + C\tan(Bx)$ passing through the points $(0, 3)$ and $\left(\frac{\pi}{2}, 3\right)$. Find the value of A and of B. [2]

(ii) Given that the point $\left(\frac{\pi}{8}, 7\right)$ also lies on the graph, find the value of C. [1]

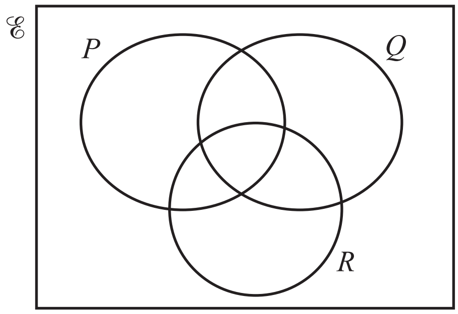
(b) Given that $f(x) = 8 - 5\cos 3x$, state the period and the amplitude of f.

period .... amplitude ....

5 **(a)** **(i)** In the Venn diagram below shade the region that represents $(A \cup B)'$.

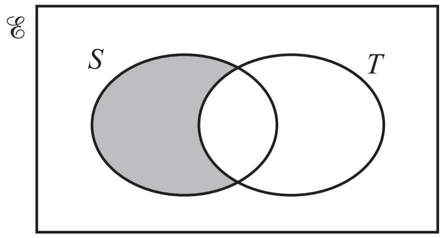


(ii) In the Venn diagram below shade the region that represents $P \cap Q \cap R'$. [1]



[1]

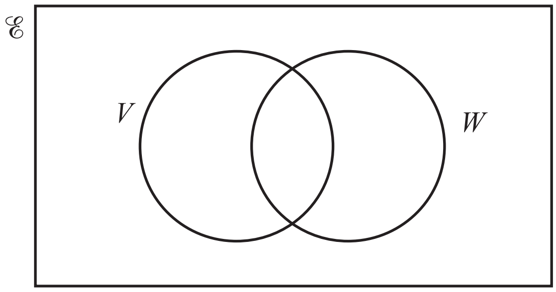
(b) Express, in set notation, the set represented by the shaded region.



Answer .... [1]

(c) The universal set $\mathscr{E}$ and the sets V and W are such that $n(\mathscr{E}) = 40$, $n(V) = 18$ and $n(W)$
Given that $n(V \cap W) = x$ and $n((V \cup W)') = 3x$ find the value of x.

You may use the Venn diagram below to help you. [3]



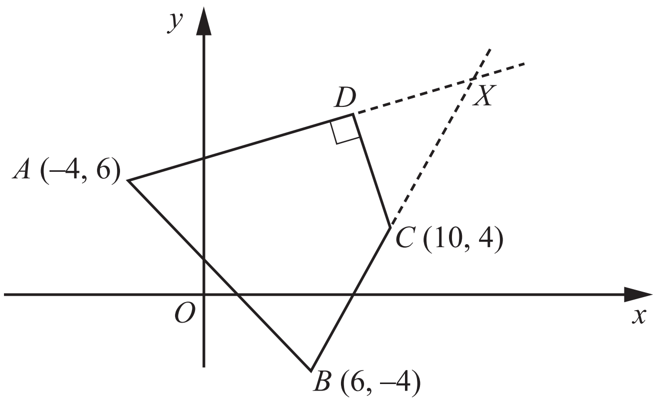
6 The expression $2x^3 + ax^2 + bx + 21$ has a factor $x + 3$ and leaves a remainder of 6
divided by $x - 2$.

(i) Find the value of a and of b. [5]

(ii) Hence find the value of the remainder when the expression is divided by $2x + 1$. [2]

7 The line $4x + y = 16$ intersects the curve $\frac{4}{x} - \frac{8}{y} = 1$ at the points A and B. The x-coordin
A is less than the x-coordinate of B. Given that the point C lies on the line AB such th
$AC : CB = 1 : 2$, find the coordinates of C. [8]

8 **Solutions to this question by accurate drawing will not be accepted.**



The diagram shows a quadrilateral *ABCD*, with vertices $A(-4, 6)$, $B(6, -4)$, $C(10, 4)$ and *D*. The angle $ADC = 90°$. The lines *BC* and *AD* are extended to intersect at the point *X*.

(i) Given that *C* is the midpoint of *BX*, find the coordinates of *D*. [7]

(ii) Hence calculate the area of the quadrilateral *ABCD*.

9 A particle travels in a straight line so that, t s after passing through a fixed point O, its velo[city,] $v\,\text{ms}^{-1}$, is given by $v = 3 + 6\sin 2t$.

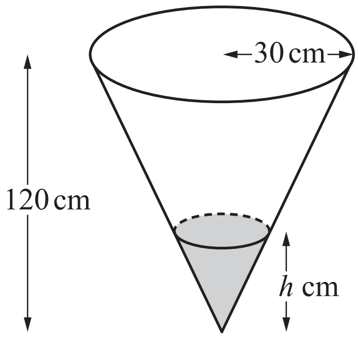
(i) Find the velocity of the particle when $t = \frac{\pi}{4}$. [1]

(ii) Find the acceleration of the particle when $t = 2$. [3]

The particle first comes to instantaneous rest at the point P.

(iii) Find the distance OP. [3]

10



The volume of a cone of height H and radius R is

$$\frac{1}{3}\pi R^2 H$$

The diagram shows a container in the shape of a cone of height 120 cm and radius 30 cm. Water is poured into the container at a rate of $20\pi \text{ cm}^3 \text{ s}^{-1}$.

(i) At the instant when the depth of water in the cone is h cm the volume of water in the cone is V cm^3. Show that $V = \frac{\pi h^3}{48}$. [3]

(ii) Find the rate at which h is increasing when $h = 50$.

(iii) Find the rate at which the circular area of the water's surface is increasing when $h = 50$. [4]

11 In this question **i** is a unit vector due east and **j** is a unit vector due north.

At time $t = 0$ boat A leaves the origin O and travels with velocity $(2\mathbf{i} + 4\mathbf{j})\,\text{km h}^{-1}$. Also at time $t = 0$ boat B leaves the point with position vector $(-21\mathbf{i} + 22\mathbf{j})\,\text{km}$ and travels with velocity $(5\mathbf{i} + 3\mathbf{j})\,\text{km h}^{-1}$.

(i) Write down the position vectors of boats A and B after t hours. [2]

(ii) Show that A and B are 25 km apart when $t = 2$. [3]

(iii) Find the length of time for which *A* and *B* are less than 25 km apart.

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