Dr Oliver Mathematics
Cambridge O Level Additional Mathematics
2013 November Paper 2 Variant 3: Calculator
2 hours

The total number of marks available is 80.
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.
You must write down all the stages in your working.

1. Find the coordinates of the stationary points on the curve (5)

$$y = x^3 - 6x^2 - 36x + 16.$$

2. (a) 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. (1)

   Find how many of these 4-digit numbers are

   (b) odd, (1)

   (c) odd and less than 3 000. (3)

3. Find the set of values of k for which the line (6)

$$y = 3x - k$$

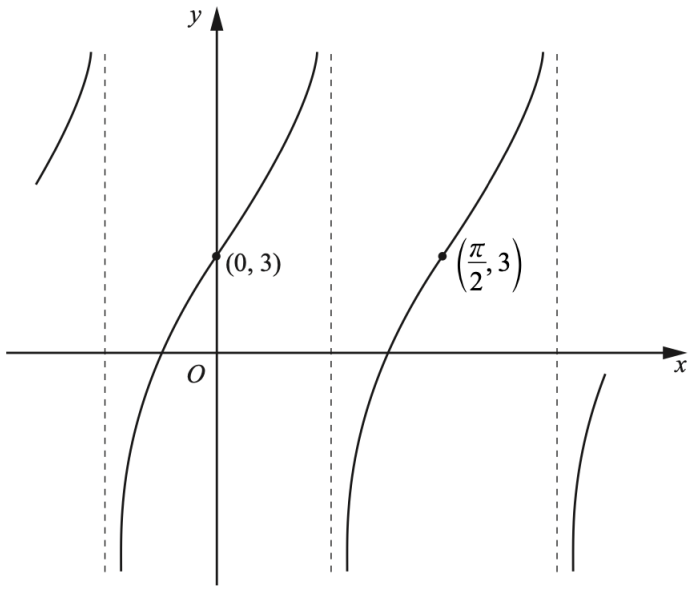
   does not meet the curve

$$y = kx^2 + 11x - 6.$$

4. The diagram shows the graph of

$$y = A + C\tan(Bx)$$

   passing through the points $(0, 3)$ and $(\frac{1}{2}\pi, 3)$.



(a) (i) Find the value of A and of B. (1)

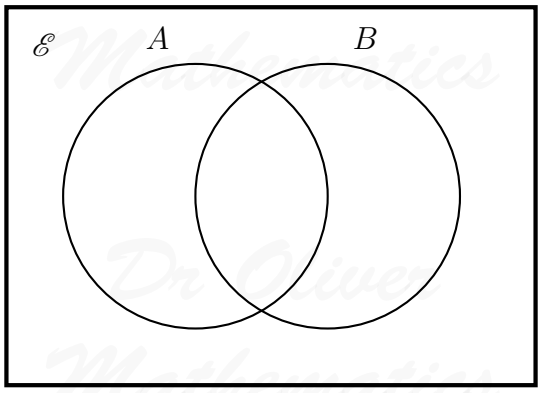
(ii) Given that the point $(\frac{1}{8}\pi, 7)$ also lies on the graph, find the value of C. (2)

(b) Given that (2)

$$\mathrm{f}(x) = 8 - 5\cos 3x,$$

state the period and the amplitude of f.

5. (a) (i) In the Venn diagram below shade the region that represents $(A \cup B)'$. (1)



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

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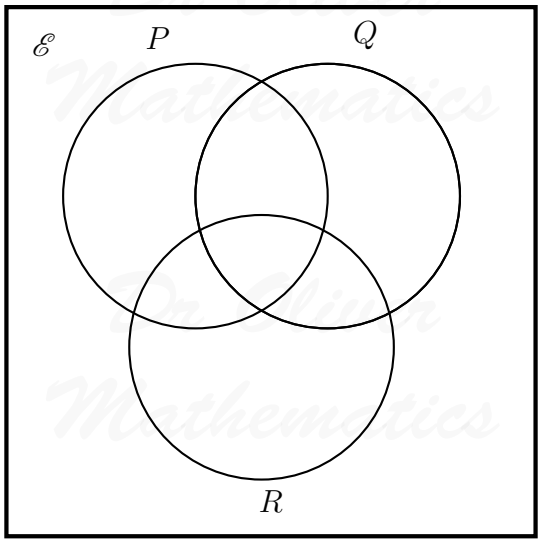
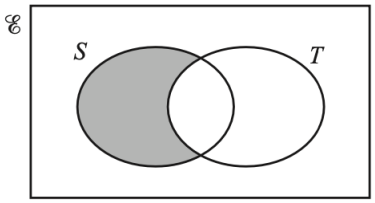


(b) Express, in set notation, the set represented by the shaded region. (1)



(c) The universal set $\mathscr{E}$ and the sets V and W are such that (3)

- $\mathrm{n}(\mathscr{E}) = 40$,
- $\mathrm{n}(V) = 18$, and
- $\mathrm{n}(W) = 14$.

Given that

$$\mathrm{n}(V \cap W) = x \text{ and } \mathrm{n}[(V \cup W)'] = 3x,$$

find the value of x.
You may use the Venn diagram below to help you.

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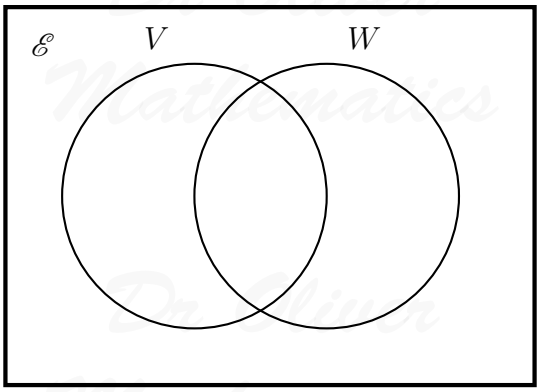

6. The expression

$$2x^3 + ax^2 + bx + 21$$

has a factor $(x + 3)$ and leaves a remainder of 65 when divided by $(x - 2)$.

(a) Find the value of a and of b. (5)

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

7. The line (8)

$$4x + y = 16$$

intersects the curve

$$\frac{4}{x} - \frac{8}{y} = 1$$

at the points A and B.

The x-coordinate of A is less than the x-coordinate of B.

Given that the point C lies on the line AB such that

$$AC : CB = 1 : 2,$$

find the coordinates of C.

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.

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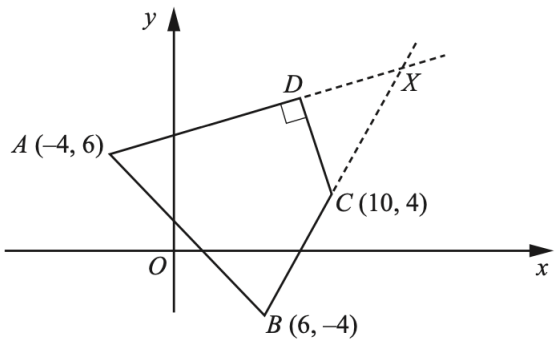


- The angle $ADC = 90°$.
- The lines BC and AD are extended to intersect at the point X.

(a) Given that C is the midpoint of BX, find the coordinates of D. (7)

(b) Hence calculate the area of the quadrilateral $ABCD$. (2)

9. A particle travels in a straight line so that, t s after passing through a fixed point O, its velocity, v ms^{-1}, is given by

$$v = 3 + 6\sin 2t.$$

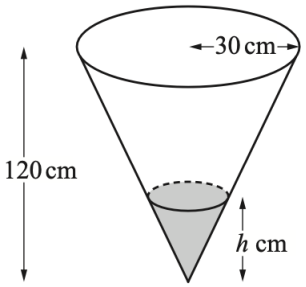
(a) Find the velocity of the particle when $t = \frac{1}{4}\pi$. (1)

(b) Find the acceleration of the particle when $t = 2$. (3)

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

(c) Find the distance OP. (5)

10. The diagram shows a container in the shape of a cone of height 120 cm and radius 30 cm.



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

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

Water is poured into the container at a rate of 20π cm^{3}s^{-1}.

(a) 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. (3)

Show that

$$V = \frac{\pi h^3}{48}.$$

(b) Find the rate at which h is increasing when $h = 50$. (3)

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

11. In this question, $\mathbf{i}$ is a unit vector due east and $\mathbf{j}$ is a unit vector due north.

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

(a) Write down the position vectors of boats A and B after $t$hours. (2)

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

(c) Find the length of time for which A and B are less than 25 km apart. (5)

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