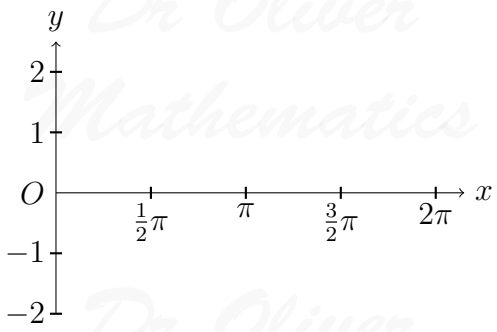
Dr Oliver Mathematics
Cambridge O Level Additional Mathematics
2013 June Paper 1 Variant 1: Calculator
2 hours

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. On the axes below, sketch, for $0 \leqslant x \leqslant 2\pi$, the graph of

   (a) $y = \cos x - 1$, (2)

   (b) $y = \sin 2x$. (2)



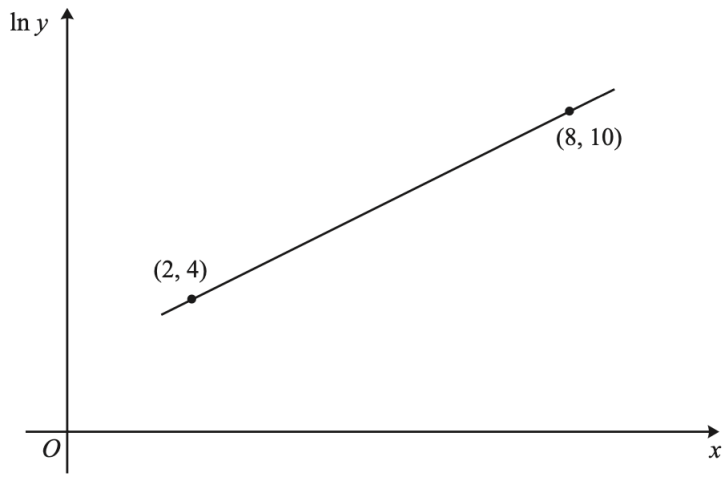
   (c) State the number of solutions of the equation (1)

$$\cos x - \sin 2x = 1 \text{ for } 0 \leqslant x \leqslant 2\pi.$$

2. Variables x and y are such that (5)

$$y = Ab^x,$$

   where A and b are constants.



The diagram shows the graph of $\ln y$ against x, passing through the points $(2, 4)$ and $(8, 10)$.

Find the value of A and of b.

3. A committee of 6 members is to be selected from 5 men and 9 women.

Find the number of different committees that could be selected if

(a) there are no restrictions, (1)

(b) there are exactly 3 men and 3 women on the committee, (2)

(c) there is at least 1 man on the committee. (3)

4. (a) Given that (1)

$$\log_4 x = \tfrac{1}{2},$$

find the value of x.

(b) Solve (4)

$$2\log_4 y - \log_4(5y - 12) = \tfrac{1}{2}.$$

5. (a) Find (2)

$$\int \left(1 - \frac{6}{x^2}\right) \mathrm{d}x.$$

(b) Hence find the value of the positive constant k for which (4)

$$\int_k^{3k} \left(1 - \frac{6}{x^2}\right) \mathrm{d}x = 2.$$

6. (a) Given that (2)

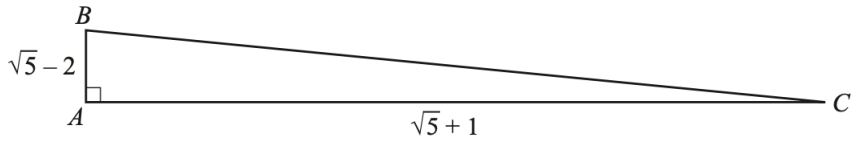
$$\mathbf{A} = \begin{pmatrix} 2 & -1 \\ 3 & 5 \end{pmatrix},$$

find $\mathbf{A}^{-1}$.

(b) Using your answer from part (a), or otherwise, find the values of a, b, c, and d such that (5)

$$\mathbf{A}\begin{pmatrix} a & b \\ c & -1 \end{pmatrix} = \begin{pmatrix} 7 & 5 \\ 17 & d \end{pmatrix}.$$

7. **Calculators must not be used in this question.**



The diagram shows a triangle ABC in which angle $BAC = 90°$.

Sides AB and AC are $(\sqrt{5} - 2)$ and$(\sqrt{5} + 1)$ respectively.

Find

(a) $\tan ABC$ in the form (3)

$$a + b\sqrt{5},$$

where a and b are integers,

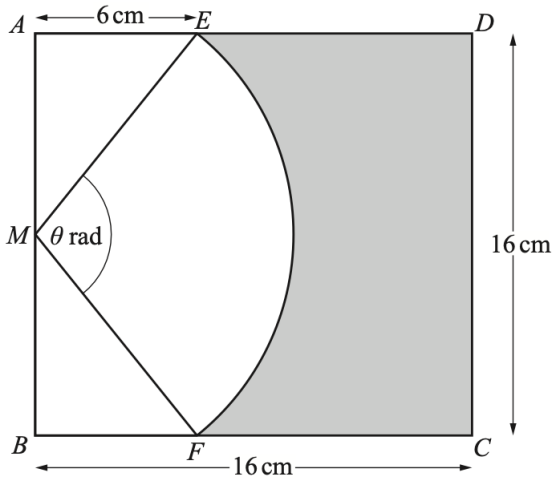
(b) $\sec^2 ABC$ in the form (4)

$$c + d\sqrt{5},$$

where c and d are integers.

8. The diagram shows a square $ABCD$ of side 16 cm.

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- M is the mid-point of AB.
- The points E and F are on AD and BC respectively such that

$$AE = BF = 6 \text{ cm}.$$

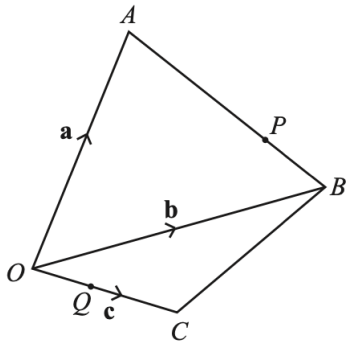
- EF is an arc of the circle centre M, such that angle EMF is θ radians.

(a) Show that $\theta = 1.855$ radians, correct to 3 decimal places. (2)

(b) Calculate the perimeter of the shaded region. (4)

(c) Calculate the area of the shaded region. (3)

9. The figure shows points A, B, and C with position vectors $\mathbf{a}$, $\mathbf{b}$, and $\mathbf{c}$ respectively, relative to an origin O.



- The point P lies on AB such that

$$AP : AB = 3 : 4.$$

- The point Q lies on OC such that

$$OQ : QC = 2 : 3.$$

(a) Express $\overrightarrow{AP}$ in terms of $\mathbf{a}$ and $\mathbf{b}$ and hence show that (3)

$$\overrightarrow{OP} = \tfrac{1}{4}(\mathbf{a} + 3\mathbf{b}).$$

(b) Find $\overrightarrow{PQ}$ in terms of $\mathbf{a}$, $\mathbf{b}$, and $\mathbf{c}$. (3)

(c) Given that (2)

$$5\overrightarrow{PQ} = 6\overrightarrow{BC},$$

find $\mathbf{c}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

10. The point A, whose x-coordinate is 2, lies on the curve with equation

$$y = x^3 - 4x^2 + x + 1.$$

(a) Find the equation of the tangent to the curve at A. (4)

This tangent meets the curve again at the point B.

(b) Find the coordinates of B. (4)

(c) Find the equation of the perpendicular bisector of the line AB. (4)

11. (a) Solve (4)

$$2\sin(x + \tfrac{1}{3}\pi) = -1, \text{ for } 0 \leqslant x \leqslant 2\pi \text{ radians.}$$

(b) Solve (6)

$$\tan y - 2 = \cot y, \text{ for } 0^\circ \leqslant y \leqslant 180^\circ.$$

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