

Dr Oliver Mathematics
Cambridge O Level Additional Mathematics
2011 June Paper 2 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. Without using a calculator, express (4)

$$\frac{(5 + 2\sqrt{3})^2}{2 + \sqrt{3}}$$

in the form

$$p + q\sqrt{3},$$

where p and q are integers

2. (a) Find the coefficient of x^3 in the expansion of (2)

$$\left(1 - \frac{1}{2}x\right)^{12}.$$

- (b) Find the coefficient of x^3 in the expansion of (3)

$$(1 + 4x)\left(1 - \frac{1}{2}x\right)^{12}.$$

3. Relative to an origin O , the position vectors of the points A and B are $\mathbf{i} - 4\mathbf{j}$ and $7\mathbf{i} + 20\mathbf{j}$ respectively. (5)

The point C lies on AB and is such that

$$\overrightarrow{AC} = \frac{2}{3}\overrightarrow{AB}.$$

Find the position vector of C and the magnitude of this vector.

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

$$y = 2x - 5$$

cuts the curve

$$y = x^2 + kx + 11$$

in two distinct points.

5. The expression

$$x^3 + 8x^2 + px - 25$$

leaves a remainder of R when divided by $(x - 1)$ and a remainder of $-R$ when divided by $(x + 2)$.

(a) Find the value of p . (4)

(b) Hence find the remainder when the expression is divided by $(x + 3)$. (2)

6. (a) A shelf contains 8 different travel books, of which 5 are about Europe and 3 are about Africa.

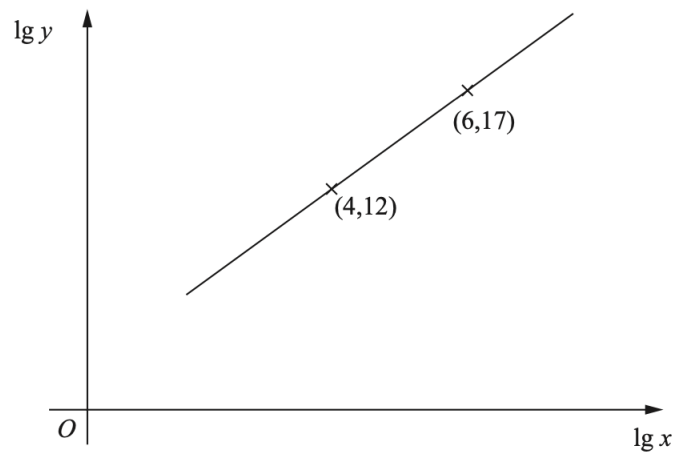
(i) Find the number of different ways the books can be arranged if there are no restrictions. (2)

(ii) Find the number of different ways the books can be arranged if the 5 books about Europe are kept together. (2)

(b) 3 DVDs and 2 videotapes are to be selected from a collection of 7 DVDs and 5 videotapes. (3)

Calculate the number of different selections that could be made.

7. The variables x and y are related so that when $\log_{10} y$ is plotted against $\log_{10} x$ a straight line graph passing through the points $(4, 12)$ and $(6, 17)$ is obtained.



(a) Express y in terms of x , giving your answer in the form $y = ax^b$. (6)

(b) Find the value of x when $y = 300$. (2)

8. The temperature, T° Celsius, of an object, t minutes after it is removed from a heat source, is given by

$$T = 55e^{-0.1t} + 15.$$

(a) Find the temperature of the object at the instant it is removed from the heat source. (1)

(b) Find the temperature of the object when $t = 8$. (1)

(c) Find the value of t when $T = 25$. (3)

(d) Find the rate of change of T when $t = 16$. (3)

9. A coastguard station receives a distress call from a ship which is travelling at 15 kmh^{-1} on a bearing of 150° .

A lifeboat leaves the coastguard station at 15 : 00 hours; at this time the ship is at a distance of 30 km on a bearing of 270° .

The lifeboat travels in a straight line at constant speed and reaches the ship at 15 : 40 hours.

(a) Find the speed of the lifeboat. (5)

(b) Find the bearing on which the lifeboat travelled. (3)

10. (a) Solve the equation (3)

$$3 \sin x + 4 \cos x = 0, \text{ for } 0^\circ < x < 360^\circ.$$

(b) Solve the equation (5)

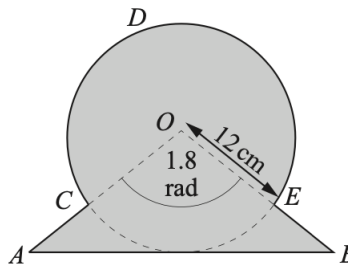
$$6 \cos y + 6 \sec y = 13, \text{ for } 0^\circ < y < 360^\circ.$$

(c) Solve the equation (3)

$$\sin(2z - 3) = 0.7, \text{ for } 0 < z < \pi \text{ radians.}$$

EITHER

11. The diagram shows an isosceles triangle AOB and a sector $OCDEO$ of a circle with centre O .



- The line AB is a tangent to the circle.
- Angle $AOB = 1.8$ radians and the radius of the circle is 12 cm.

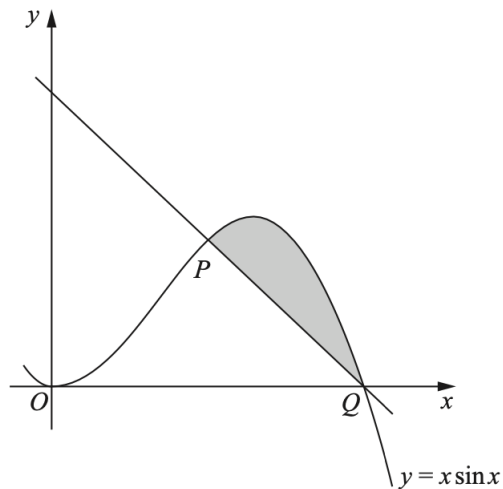
- (a) Show that the distance $AC = 7.3$ cm to 1 decimal place. (2)
- (b) Find the perimeter of the shaded region. (6)
- (c) Find the area of the shaded region. (4)

OR

12. The diagram shows part of the curve

$$y = x \sin x$$

and the normal to the curve at the point $P(\frac{1}{2}\pi, \frac{1}{2}\pi)$.



The curve passes through the point $Q(\pi, 0)$.

- (a) Show that the normal to the curve at P passes through the point Q . (4)
- (b) Given that (3)

$$\frac{d}{dx}(x \cos x) = \cos x - x \sin x,$$

find

$$\int x \sin x \, dx.$$

- (c) Find the area of the shaded region. (5)