

Section A (36 marks)

1 (i) Calculate $\sum_{r=1}^5 (3r+2)$. [2]

(ii) An arithmetic progression (AP) has first term 4.2 and sixth term 1.8. Find the common difference of this AP. [2]

2 (i) Find $\int_1^5 4x \, dx$. [3]

(ii) Find $\int 6x^{\frac{1}{2}} \, dx$. [2]

3

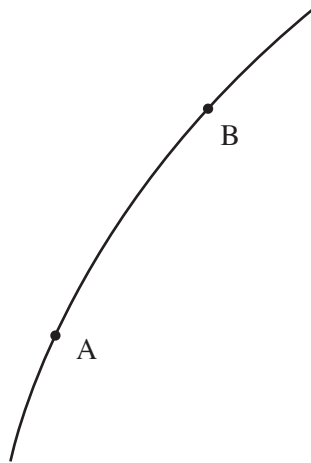


Fig. 3

Fig. 3 shows two points A and B on the curve $y = \log_{10}x$. At A, $x = 0.1$ and at B, $x = 0.2$.

(i) Calculate the gradient of the chord AB. [2]

(ii) The gradient of the chord AB gives an estimate for the gradient of the curve at A. On Fig. 3 in the answer book, mark a point C on the curve such that the gradient of the chord AC would give a better estimate. [1]

- 4 Find the equation of the normal to the curve $y = 2x^3$ at the point on the curve where $x = 2$. Give your answer in the form $ax + by = c$. [5]
- 5 (i) Describe fully the single transformation that maps the curve $y = x^2 + 3$ onto the curve $y = 2x^2 + 6$. [2]
- (ii) Describe fully the single transformation that maps the curve $y = 2x^2$ onto the curve $y = 2(x - 3)^2$. [2]
- 6 A curve passes through the point $(2, 10)$ and has gradient $\frac{dy}{dx} = 12x^3 - 7$. Find the equation of the curve. [5]
- 7 (i) Sketch the curve $y = 2^x$. [2]
- (ii) You are given that $\log_a w = 3 + \log_a x^5 - \log_a 2x + \log_a 6$. Find an expression for w in terms of x and a , giving your answer as simply as possible. [3]
- 8 You are given that $6 \cos^2 x = 5 - \sin x$, where x is in radians. Show that $6 \sin^2 x - \sin x - 1 = 0$. Solve this equation for $0 \leq x \leq 2\pi$. [5]

Section B (36 marks)

- 9 The standard formulae for the volume V and total surface area A of a solid cylinder of radius r and height h are

$$V = \pi r^2 h \text{ and } A = 2\pi r^2 + 2\pi r h.$$

You are given that $V = 400$.

(i) Show that $A = 2\pi r^2 + \frac{800}{r}$. [2]

(ii) Find $\frac{dA}{dr}$ and $\frac{d^2A}{dr^2}$. [4]

- (iii) Hence find the value of r which gives the minimum surface area. Find also the value of the surface area in this case. [4]

- 10 A field is to be turned into a car park, a pond and a meadow. Fig. 10 shows one possible design.

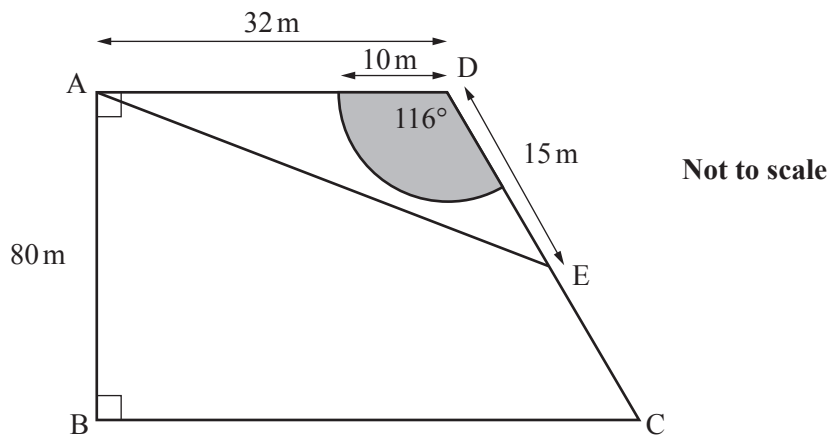


Fig. 10

The field ABCD is a trapezium, with sides AD and BC parallel. $AD = 32$ m, $AB = 80$ m, angle $B = 90^\circ$ and angle $D = 116^\circ$. The pond, shown shaded, is a sector of a circle, centre D and radius 10 m. The point E is on DC, with $DE = 15$ m.

(i) Calculate the length of AE. [2]

(ii) Calculate the perpendicular distance of AE from D. Hence verify that the pond lies entirely within triangle ADE. [3]

The meadow is the triangle ADE except for the pond.

(iii) Calculate the area of the pond and the area of the meadow. [4]

(iv) Show that the car park, AECEB, uses over 90% of the area of the field. [4]

11 A firm takes on two new employees, Arif and Bettina.

- Arif starts on an annual salary of £30 000, and his salary increases by £1000 each year after that.
- Bettina starts on an annual salary of £25 000, and her salary then increases by 5% each year after that. (So, for example, Bettina's salary in year 3 is 5% greater than her salary in year 2.)

(i) Show that Arif earns more than Bettina in year 10 of their employment, but Arif earns less than Bettina in year 11. **[4]**

(ii) Show that the total amounts earned by each of Arif and Bettina during their employment up to the end of year 17, correct to the nearest £100, are equal. **[4]**

(iii) At the end of year n , the total that Bettina has earned during this employment is greater than £ M .

Show that $n > \frac{\log_{10}(M + 500\,000) - \log_{10} 500\,000}{\log_{10} 1.05}$.

Hence find in which year the total that Bettina has earned during this employment is first greater than £1.2 million. **[5]**

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