9. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

(i) A car has five gears. Given that

- the maximum speed of the car in first gear is $22\,\text{km}\,\text{h}^{-1}$
- the maximum speed in each successive gear forms a geometric sequence
- the maximum speed of the car in fifth gear is $130\,\text{km}\,\text{h}^{-1}$

find the maximum speed of the car in second gear, giving your answer, in $\text{km}\,\text{h}^{-1}$, to one decimal place.

(4)

(ii) The first two terms of an arithmetic sequence are 208 and 207.2

Given that S_n is the sum to n terms,

(a) find the maximum value of S_n

(4)

(b) Hence or otherwise state the smallest value of N such that $S_N < 0$

(1)

(Total for Question 9 is 9 marks)



10. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

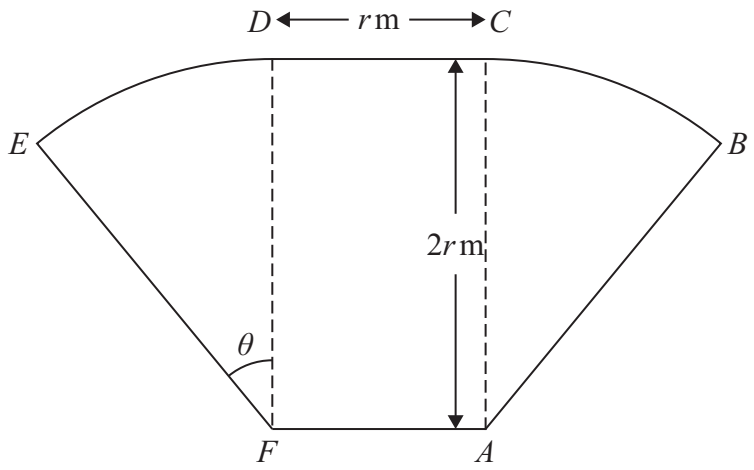


Figure 2

Figure 2 shows the plan view of the design for a stage at a trade fair.

The shape of the stage *ABCDEFA*, consists of a rectangle *ACDF* joined to two congruent sectors of circles. *ABC* is a sector of a circle centre *A* and *FDE* is a sector of a circle centre *F*.

Given that $AC = 2r$ metres, $CD = r$ metres, angle $DFE = \theta$ radians and the area of the stage is $30\,\text{m}^2$,

(a) show that the perimeter, *P* metres, of the stage, is given by

$$P = 4r + \frac{30}{r}$$

(4)

(b) Use calculus to find the minimum value for *P*, giving your answer in the form $a\sqrt{b}$, where *a* and *b* are integers to be found.

(4)

(c) Justify that the value of *P* found in part (b) is the minimum.

(2)

(Total for Question 10 is 10 marks)

TOTAL FOR PAPER IS 75 MARKS