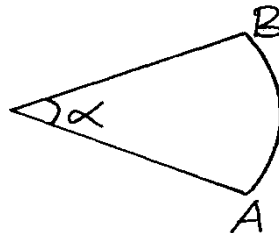


## 1. Longitudes and latitudes

- A globe representing the earth has a radius of 0.2m. Points P ( $60^{\circ}\text{N}$ ,  $140^{\circ}\text{E}$ ) and Q ( $60^{\circ}\text{N}$ ,  $120^{\circ}\text{W}$ ) are marked on the globe. If O is the centre of the latitude  $60^{\circ}\text{N}$ , find the area of the minor sector OPQ (3 mks)
- An aircraft flies from a point A ( $1^{\circ}15'\text{S}$ ,  $37^{\circ}\text{E}$ ) to a point B directly North of A. The arc AB subtends an angle of  $489^{\circ}$  at the centre of the earth. From B the aero plane flies due west to a point C on longitude  $23^{\circ}\text{W}$ . Take radius of the earth as 6370km.
  - (i) State the location of B (2 mks)
    - Find the distance in km traveled by the aero plane between B and C (3 mks)
  - (i) The aeroplane left B at 1.00am local time. What was the local time at C? (2 mks)
    - If it maintained an average speed of 840km/h between B and C, at what local time did it arrive at C? (3 mks)
- Points A and B lies on the same circle of latitude  $P^{\circ}\text{N}$  if A and B are on longitude  $41^{\circ}\text{W}$  and  $3^{\circ}\text{E}$  respectively and the distance between them is 1370nm. Calculate the latitude P. (2mks)
- Points P( $30^{\circ}\text{N}$ ,  $20^{\circ}\text{W}$ ), Q( $30^{\circ}\text{N}$ ,  $40^{\circ}\text{E}$ ), R( $60^{\circ}\text{N}$ ,  $a^{\circ}\text{E}$ ) and S( $b^{\circ}\text{N}$ ,  $c^{\circ}\text{W}$ ) are four points on the surface of the earth. R is due North of Q and S is due West of R and due North of P.
  - State the values of a, b and c. (3mks)
  - Given that all distances are measured along parallels of latitudes or along meridians, and in nautical miles, find the distance of R from P using two alternative routes via Q and S. (4mks)
  - Two pilots start flying from P to R one along the route PQR at 400 knots and the other along PSR at 300 knots which one reaches R earlier and by how long? (3mks)
- A plane leaves an airport P at 1030 hrs and flies due north at 800 km/h. After 2 hours of flight it turns and flies due west at the same speed and reached airport Q at 1415hrs
  - Use scale drawing with a scale of 1 cm for 200km to find the shortest distance between the two airports (3mks)
  - Measure and state the bearing of Q from P (1mk)
  - If the local time at P is 1300hrs when it reached Q, find the local time at Q when it landed at Q. (2mks)
  - If the plane started the return journey at 1700hrs and flew directly to P, if the arrival time at P was 1940hrs, determine the plane's average speed to the nearest kilometer. (3mks)
- Calculate the shortest distance between X( $40^{\circ}\text{N}$ ,  $80^{\circ}\text{W}$ ) and Y ( $40^{\circ}\text{N}$ ,  $100^{\circ}\text{E}$ ) in kilometers taking  $\pi = \frac{22}{7}$  and Radius = 6371km. (Give your answer to the nearest whole number) (3mks)

7. The latitude and longitude of two stations **P** and **Q** are  $(47^\circ\text{N}, 25^\circ\text{W})$  and  $(47^\circ\text{N}, 70^\circ\text{W})$  respectively. Calculate the distance in nautical miles between **P** and **Q** along the latitude  $47^\circ\text{N}$
8. A plane leaves an airport **P** ( $10^\circ\text{S}, 60^\circ\text{E}$ ) and flies due north at  $800\text{km/hr}$ . By taking radius of the earth to be  $6370\text{-km}$  and 1 nautical mile to be  $1.853\text{km}$ ,
- Find its position after 2hrs
  - The plane turns and flies at the same speed due West to reach **Q** longitude  $12^\circ\text{W}$ . Find the distance it has traveled due in West nautical miles
  - Find the time it has taken
  - If the local time at **P** was 1300hrs when it reached **Q**. Find the local time at **Q** when it landed at **Q**
9. Bot juice company has two types of machines, A and B, for juice production  
Type A machine can produce 800 litres per day while type B machine produces 1600 litres per day.  
Type A machine needs 4 operators and type B machine needs 7 operators  
At least 8000 litres must be produced daily and the total number of operators should not exceed 41. There should be 2 or more machines of each type. Let  $x$  be the number of machines of type A and  $y$  the number of machines for type B,
- Form all inequalities in  $x$  and  $y$  to represent the above information
  - On the grid provided below, draw the inequalities and shade the wanted regions
  - Use the grid in (b) to determine the least number of operators required for the maximum possible production
10. Points **R** and **S** are two points on the surface on a latitude  $48^\circ\text{S}$ . The two points lie on longitudes  $30^\circ\text{W}$  and  $150^\circ\text{E}$  respectively. By taking the earth's radius to be  $6370\text{km}$ , calculate:
- The distance from **R** to **S** along a parallel of latitude.
  - An aeroplane flies at an average speed of  $280\text{km/h}$  from **R** to **S** along a great circle through the South Pole. Calculate the total time taken.
  - The local time of **R** when the local time of **S** is 2.15m.
  - Another point **Q** is  $600\text{Nm}$  North of **R**. Find the location of **Q**
11. A jet flies from  $34^\circ\text{N}, 12^\circ\text{E}$  to  $(34^\circ\text{E}, 24^\circ\text{E})$  in  $1\frac{1}{2}$  hrs. Find its average speed in knots  
**P** and **Q** are two points on a geographical globe of diameter  $50\text{ cm}$ . They both lie on a parallel latitude  $50^\circ\text{ North}$ . **P** has longitude  $90^\circ\text{ West}$  and **Q** has longitude  $90^\circ\text{ East}$ . A string **AB** has one end at point **P** and another at point **Q** when it is stretched over the North pole. Taking  $\pi = 3.142$ ;
- Calculate the length of the string.
  - If instead the string is laid along the parallel of latitude  $50^\circ\text{N}$  with **A** at point **P**, calculate the longitude of point **B**
  - State the position of **B** if the string is stretched along a great circle of **P** towards the South pole if point **A** is static at **P**.
12. Two points **A**( $70^\circ, 15^\circ\text{E}$ ) and **B** lie on the same circle of latitude on the earth's surface. Given that the shortest distance between the two points along the circle of latitude is  $2133.6\text{km}$ . Giving coordinates to the nearest degree, find the location of **B**.  
(Take  $\pi = \frac{22}{7}$  and radius of earth =  $6380\text{km}$ )



13. The position of two towns **A** and **B** on the earth's surface are  $(36^\circ\text{N}, 49^\circ\text{E})$  and  $(36^\circ\text{N}, 131^\circ\text{W})$  respectively (Earth's radius = 6370km and  $\pi = \frac{22}{7}$ ):-
- Find the longitudinal difference between the two towns
  - Calculate the distance between the towns:-
    - Along a circle of latitude (in km)
    - Along the great circle in km and nautical miles
  - Another town **C**, is 840km due East to town **B**. Locate the position of town **C**
14. **P**, **Q** and **R** are points on the surface of the earth such that **P**  $(60^\circ\text{N}, 20^\circ\text{W})$ , **Q**  $(60^\circ\text{S}, 20^\circ\text{W})$  and **R**  $(60^\circ\text{N}, 80^\circ\text{E})$  find:
- The shortest distance between **P** and **Q** on the surface of the earth in kilometres and nautical miles(**nm**)
  - The length of latitude  $60^\circ\text{N}$  and hence the length of the minor arc **PR** in kilometres
  - The distance from **P** to the North Pole
15. A jet flies from town **X**  $(50^\circ\text{S}, 20^\circ\text{E})$  directly to **Y**  $(50^\circ\text{S}, 28^\circ\text{W})$  and then due South for 1200m to **Z**
- (i) Find the latitude of **Z**
  - (ii) Calculate the distance XY along a parallel of latitude  $50^\circ\text{S}$  in km
  - (b) (i) Given that the average speed of the jet is 400 knots, calculate the time taken to reach **Z** from **X** to the nearest 0.1hour
  - (ii) Find the time of arrival at **Z** given that the plane left **X** at 7.40a.m. Take  $\pi = \frac{22}{7}$  and radius of the earth to be 6370km
16. A jet on a rescue mission left town A  $(35^\circ\text{S}, 15^\circ\text{E})$  to town B  $(45^\circ\text{N}, 15^\circ\text{E})$  and then to town C  $(45^\circ\text{N}, 45^\circ\text{W})$ . If  $\theta$  subtends 60nm and the radius of the earth is 6370km. Find;
- the distance in nautical miles from A to C via B correct to 4 s.f
  - the distance in kilometers from A to B to the nearest km
  - the jet flew at 840km/h from A to C. If the jet left town A at 8.15a.m, what time will it arrive at town C in local time