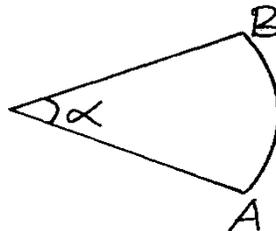


1. Longitudes and latitudes

- A globe representing the earth has a radius of 0.2m. Points P (60°N , 140°E) and Q (60°N , 120°W) are marked on the globe. If O is the centre of the latitude 60°N , find the area of the minor sector OPQ (3 mks)
- An aircraft flies from a point A ($1^{\circ}15'\text{S}$, 37°E) to a point B directly North of A. The arc AB subtends an angle of 489° at the centre of the earth. From B the aero plane flies due west to a point C on longitude 23°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°W and 3°E respectively and the distance between them is 1370nm. Calculate the latitude P. (2mks)
- Points P(30°N , 20°W), Q(30°N , 40°E), R(60°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°N , 80°W) and Y (40°N , 100°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°N
8. A plane leaves an airport **P** ($10^\circ\text{S}, 60^\circ\text{E}$) and flies due north at 800km/hr . By taking radius of the earth to be 6370-km and 1 nautical mile to be 1.853km ,
- Find its position after 2hrs
 - The plane turns and flies at the same speed due West to reach **Q** longitude 12°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°S . The two points lie on longitudes 30°W and 150°E respectively. By taking the earth's radius to be 6370km , calculate:
- The distance from **R** to **S** along a parallel of latitude.
 - An aeroplane flies at an average speed of 280km/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 600Nm 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 cm . They both lie on a parallel latitude 50° North . **P** has longitude 90° West and **Q** has longitude 90° 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°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 2133.6km . Giving coordinates to the nearest degree, find the location of **B**.
(Take $\pi = \frac{22}{7}$ and radius of earth = 6380km)



13. The position of two towns **A** and **B** on the earth's surface are (36°N , 49°E) and (36°N , 131°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°N , 20°W), **Q** (60°S , 20°W) and **R**(60°N , 80°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°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°S , 20°E) directly to **Y**(50°S , 28°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°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 0.1 hour
 - (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°S , 15°E) to town **B**(45°N , 15°E) and then to town **C**(45°N , 45°W). If 1° 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