

LATITUDES AND LONGITUDES

1. The positions 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.

a) Find the difference in longitude between towns A and B.
(2MKS)

b) Given that the radius of Earth is 6370km, calculate the distance between towns A and B.

(3MKS)

c) Another town C is 840 km due east of town B and on the same latitude as towns A and B. Find the longitude of town C.
(3MKS)

d) What is the time difference between towns A and B and towns A and C to the nearest minute?

(2MKS)

2. Two towns A and B lie on the same parallel of latitude 60°N if the longitudes of A and B are 42°W and 29°E respectively.

(a) **Find** the distance between A and B in nautical miles along the parallel of latitude.

(2mks)

(b) **Find** the local time at A if at B is 1.00pm.
(2mks).

(c) **Find** the shortest distance between A and B along the earth's surface in

km. (2mks) (Take $\pi = \frac{22}{7}$ and $R = 6370 \text{ km}$)

(d) If C is another town due south of A and 10010km away from A, **find** the coordinate C.

(3mks)

3. A plane leaves an airport x (41.5°N , 36.4°W) at 9.00a.m. and flies due North to airport y on latitude 53.2°N .

(a) Calculate the distance covered by the plane in kilometers.
(3mks)

(b) After stopping for 30 minutes to refuel at Y, the plane then flies due east to airport Z, 2500km from Y. Find:-

- (i) The position of Z.
- (ii) The time the plane lands at Z, if its speed is 500km/h.
(Take the value of π as $\frac{22}{7}$ and radius of the earth as 6370km)
(7mks)

4. The positions of two towns on the surface of the earth are given as A(30°S , 20°W) and B(30°S , 80°E)

Find

- a) the difference in longitude
2mk

the distance between the two towns along a parallel of latitude in

- (i) km (take the radius of the earth as 6370km and $\pi = \frac{22}{7}$)
3mks

- (ii) nm 2mks

- c) Find the local time in town B when it is 1:45pm in town A. 3mks

5. A jet flies from town **Q** (60°S , 24°E) to town **R** (60°S , 10°W) and then due north for 1200 nautical miles to town **S**

- (a) Obtain the latitude of **S** (3mks)

- (b) Calculate the distance between **Q** and **R** in

- (i) Nautical miles (3mks)

- (ii) Km (2mks)

- (c) Find the total flight time if the jet flies at an average speed of 800 knots (2mks)

6. A plane leaves an airport P(10°S , 62°E) and flies due north at 800km/h.

(a) Find its position after 2 hrs.
(3mks)

(b) The plane turns and flies at the same speed due west. It reaches Q longitude of 12°W .

(i) Find the distance it has travelled in nautical miles
(3mks)

(ii) Find the time it has taken (Take the radius of the earth to be 6370km and 1 nautical mile to be 1.853km)
(2mks)

(c) If the local time at P was 1300 hrs when it reached Q, Find the local time at Q when it
landed at Q . (2mks)

7. Two points P and Q are found on the earth's surface. The position of P is (52°S , 66°W)

and Q (52°S , 114°E). Using earth's radius = 6370km:

(b) Find the difference in longitude between two points P and Q.
(1mk)

(c) Calculate the shortest distance between points P and Q along:-

(i) The Latitude in km (to 1 whole number).
(2mks)

(ii) The Longitude in km (to one whole number).
(3mks)

(d) A plane travelling at 800km/hr leaves point P at 10.00am and sails through South Pole to point Q. Find the local time the plane arrives at point Q to the nearest minutes. (4mks)

8. A jet flies from town **Q** (60°S , 24°E) to town **R** (60°S , 10°W) and then due north for 1200 nautical miles to town **S**

(a) Obtain the latitude of **S** (3mks)

$\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6370 = 10010$	A1	
$\theta = \frac{10010 \times 7 \times 360}{2 \times 22 \times 6370} = 90$	M1	
	M1	
(d) C (30° S, 42° W)	A1	

3.

SCHEME

1. Longitude = 49 + 131 = 180	M1 A1	
Distance = $\frac{2 \times 180 \times 22 \times 6370 \cos 36}{360 \times 7} = \frac{113,373.26}{7} = 16196.18 \text{ km}$		

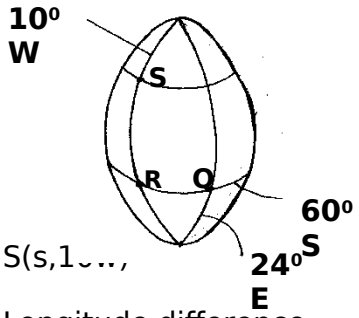
$r = 6370 \cos 26$ $= 6370 \times 0.8090$ $= 5,153.33 \text{ km}$ $\frac{\theta}{360} \times \tau \times 5,153.33 = 840 \text{ km}$ $\theta = 9.34$ Longitude of town C = $131 - 9.34 = 121.66^\circ \text{ W}$ A and B $180 \times 4 \text{ min} = 12 \text{ hrs}$ A and C $(49 + 121.66) \times 4 \text{ min} = 682.64 \approx 683 \text{ min}$ $= 11 \text{ hrs } 23 \text{ min}$	M1,A1	
--	-------	--

4.

(a) $x(41.5^{\circ}\text{N}, 56.4^{\circ}\text{W})$ $y(53.2^{\circ}\text{N}, 36.4^{\circ}\text{W})$ Angle diff = $(53.2 - 41.5)^{\circ}$ $= 11.7^{\circ}$ $l = \frac{(11.7 \times 22 \times 2 \times 6370)}{360 \times 7} \text{km}$ $= 1301.3 \text{km}$	M1	
	M1	
	A1	
(b) (i) $y(53.2^{\circ}\text{N}, 56.4^{\circ}\text{W})$ $z(53.2^{\circ}\text{N}, \underline{\underline{x}})$ $= \left(\frac{x}{360} \times \frac{22}{7} \times 2 \times 6370 \cos 83.2^{\circ} \right)$ $= 2500 \text{km}$ $x(11 \times \frac{91}{9} \cos 3.2) = 2500$ $x = \frac{2500 \times 9}{11 \times 91 \cos 53.4^{\circ}}$ $x = \frac{2500 \times 9}{11 \times 91 \times 0.5996}$ $= 22500$	M1	
	M1	

$ \begin{aligned} &599.599 \\ &= 37.52^\circ \\ &37.52 - 36.40 \\ &= 1.12^\circ\text{E} \\ &Z(53.2^\circ\text{N}, 1.12^\circ\text{E}) \end{aligned} $ (ii) $T = \frac{(1301.3)\text{hrs}}{500}$ $= 2.6026\text{hrs}$ $= 2\text{hrs } 36\text{mins}$ 15mins x to z took 2hrs 36mins Past time - 30 mins 15min z - 4 - 2500km Time taken $\frac{(2500)\text{hrs}}{500}$ $= 5\text{hrs}$ Total time $= 2.36 + 30$ $\quad\quad\quad 5.00$ $= 8.06$ $ \begin{array}{r} 9.00 \\ \underline{8.06} \\ 17.06 \\ \underline{12.00} \\ 5.06\text{pm} \end{array} $	M1	
	M1	
	M1	
	A1	
	10	

4.

 S(S, LOW) S(s, 1, ..., E) Longitude difference a) Longitude difference $(s-60)60 = 1200$ great circle $60s - 3600 = 1200$ <u>$60s = 4800$</u>	M1	
	M1	
	A1	

60 60	
S = 80°N	
b) longitudinal difference = 10+24 = 34°	M1
i) d = 60θ cos x	
= 60 x 34 cos 60°	A1
= 1020nm	
ii) distance = 1nm = 1.853km	
∴ 1020nm = ?	M1
(1020 x 1.853)	
= 1.890.06km	A1
c) Time between QR	
$\frac{1020}{800} + \frac{1200}{800}$	
$1^{11/40} + 1^{1/2} = 2^{31/40}$ hrs	M1
	A1

$$(a) \frac{22}{7} \times 6370 \times 2 \times \frac{\theta}{360} = 1600$$

$$\theta = \frac{7 \times 360 \times 1600}{22 \times 6370 \times 2}$$

$$= \frac{28800}{2002}$$

$$\theta = 14.4^\circ$$

5. 6 Position (4.4°N, 62°E)

$$(b) 74 \times 60 \cos 4.4^\circ$$

$$=4426.9\text{nm}$$

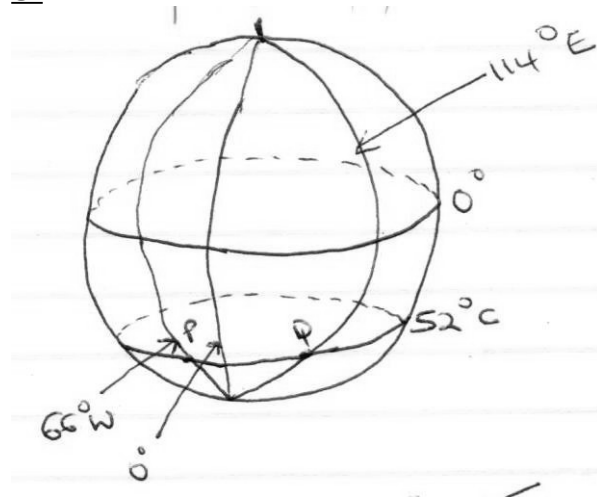
$$T = \frac{D}{S} = \frac{4426.9 \times 1.853}{800}$$

(c)

$$= 10\text{hrs}15\text{min}$$

(e) P(10°S,62°E), Q(4.4°N,2°W)

8.



(a) $114^\circ + 66^\circ = 180^\circ \checkmark \text{B1}$

(b) (i) $\frac{180}{360} \times 2 \times 3.142 \times 6370 \cos 52^\circ \checkmark \text{B1}$

$$12322\text{km or } 12326\text{km} \checkmark \text{B1 using } \pi = \frac{22}{7} \checkmark \text{A1}$$

(ii) $\frac{76}{360} \checkmark \text{B1} \times 2 \times 3.142 \times 6370 \checkmark \text{M1}$
 $= 8451\text{km or } 8453\text{km using } \pi = \frac{22}{7}$

(c) $t = \frac{s}{v} = \frac{8451}{800} \checkmark \text{M1}$

$= 10.56\text{hrs}/M1$
 $= 10\text{hrs } 34\text{min}/A1$
 Time is 8.34pm/B1

8.

$10^\circ W$ $60^\circ S$ $24^\circ S$ $S(S, LOW)$ $S(s, 1\dots)$ Longitude difference $S = 80^\circ N$ a) Longitude difference $(s-60)60 = 1200$ great circle $60s - 3600 = 1200$ <u>$60s = 4800$</u> 60 60 b) longitudinal difference = $10+24 = 34^\circ$ i) $d = 60\theta \cos x$ $= 60 \times 34 \cos 60^\circ$ $= 1020\text{nm}$ ii) distance = $1\text{nm} = 1.853\text{km}$ $\therefore 1020\text{nm} = ?$ (1020×1.853) $= 1.890.06\text{km}$ c) Time between QR <u>$1020 + 1200$</u>	M1 M1 A1 M1 A1 M1 A1
--	---

800 800 $1\frac{11}{40} + 1\frac{1}{2} = 2\frac{31}{40}$ hrs	M1 A1
--	---------------------