Topic Test: Spherical Geometry

Remember: these are HSC-type questions.

Part A   (Suggested time: 15 minutes)

Choose the correct answer (A, B, C or D) for each question.   One mark each

1 Blackpool is located at (54°N, 3°W) and Mauritius at (21°S, 57°E). Ignoring time zones, if it is 6 pm in Mauritius what time is it in Blackpool?
A 1 pm
B 2 pm
C 10 pm
D 11 pm

2 A ship is travelling at 12 knots. What is the approximate speed in kilometres per hour? (1.852 km = 1 M)
A 6.5 km/h
B 22 km/h
C 37 km/h
D 65 km/h

3 What is the perimeter of the sector, to the nearest metre?
A 9 m
B 27 m
C 30 m
D 36 m
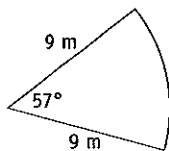
4 P and Q lie on the equator. G represents Greenwich. What is the position of R?
A (50°N, 90°E)
B (50°N, 90°W)
C (90°N, 50°E)
D (90°N, 50°W)
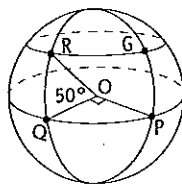
5 When on standard time, the time difference between London (0°) and Sydney (150°E) is ten hours. If it is 9 am standard time in London, what is the time in Sydney if Sydney is on daylight-saving time?
A 6 pm
B 8 pm
C 10 pm
D midnight

6 If it is 3 pm Monday in Dunedin (46°S, 170°E), what is the time and day in Rarotonga (21°S, 160°W)?
A 1 pm Tuesday
B 5 pm Tuesday
C 1 pm Sunday
D 5 pm Sunday

7 Rio de Janeiro is 45° west of Paris. A plane leaves Paris at 10.45 am to fly to Rio. The flight takes 8 hours and 15 minutes. What is the local time when the plane arrives?
A 10 pm
B 4 pm
C 11.30 pm
D 5.30 am

8 Find the approximate distance in kilometres between Jakarta (6°S, 107°E) and Ho Chi Minh City (11°N, 107°E).
(The radius of the earth is approximately 6400 km; 1.852 km = 1 M)
A 1020 km
B 300 km
C 1900 km
D 560 km

9 A plane averaged 300 knots when flying due south a distance of 2361.3 km. If it left at 3.40 pm, when did it arrive? (1.852 km = 1 M).
A 8.05 pm
B 6.15 am
C 7.55 pm
D 6.37 am

10 What is the difference in latitude between Katoomba (34°S, 150°E) and Katmandu (28°N, 85°E)?
A 65°
B 6°
C 62°
D 55°

Show all working.   **15 marks**

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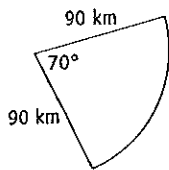
a Find the arc length of the sector to the
   nearest kilometre.   1 mark
b What is that distance in nautical miles?
   (1.852 km = 1 M)   1 mark
c If a boat is able to travel that distance in
   three and a half hours, what is its average
   speed in knots?   1 mark

12 Dallas (97°W) and Nagasaki (130°E) lie on
        the same parallel of latitude. (Ignore time zones.)
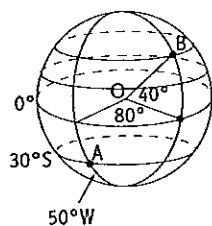   a What is the time difference between
      the two cities?   1 mark
   b If it is 8.25 am in Nagasaki on 4th March,
      what is the time and date in Dallas?   2 marks

13 Cairo (30°N, 31°E) and Durban (30°S, 31°E)
        both lie on the same meridian of longitude.
   a If it is 6.35 pm on July 31st in Cairo,
      what is the time and date in Durban?   1 mark
   b Show that the distance between the
      two cities is approximately 6700 kilometres.
      (The radius of the Earth is approximately
      6400 km; 1.852 km = 1 M)   1 mark
   c If a plane leaves Cairo at 2.48 pm and
      averaged 1000 km/h, when did it arrive ·
      in Durban?   2 marks

14

   a What are the position coordinates of A?   1 mark
   b What are the position coordinates of B?   1 mark
   c What is the time difference between A
      and B? (Ignoring time zones).   1 mark
   d A plane flies from A to B, leaving A at
      10.35 am local time. It arrives at B at 5.25 am
      the next day local time. How long was
      the flight?   2 marks

Solutions

Topic Test p180

1 Angular difference $= 57° + 3°$
$= 60°$
Time difference $= (60 \div 15)$ hours
$= 4$ hours
Blackpool is west of Mauritius so it is 4 hours behind.
It will be 2 pm in Blackpool. **B**

2 12 knots $= 12$ M per hour
$= (12 \times 1.852)$ km per hour
$= 22.224$ km/h
The approximate speed is 22 km/h. **B**

3 $l = \dfrac{\theta}{360} 2\pi r$
$= \dfrac{57}{360} \times 2 \times \pi \times 9$
$= 8.953\,539\,063 \ldots$
$= 9$ (nearest unit)
The arc length is 9 m to the nearest metre.
$P = 9 + 9 + 9$
$= 27$
The perimeter of the sector is 27 m, to the nearest metre. **B**
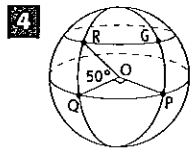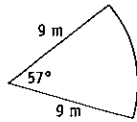
4
R is 50° north of the equator and 90° west of Greenwich.
Location is (50°N, 90°W). **B**

5 9 am in London $=$ 7 pm in Sydney standard time.
It will be 8 pm on daylight saving time. **B**

6 Angular difference $= 170° + 160°$
$= 330°$
Time difference $= (330 \div 15)$ hours
$= 22$ hours
Rarotonga is 22 hours behind Dunedin.
The time is 5 pm Sunday. **D**

7 Angular difference $= 45°$
Time difference $= (45 \div 15)$ hours
$= 3$ hours
Rio is 3 hours behind Paris. It is 7.45 am in Rio when the plane leaves.
After another 8 hours and 15 minutes it will be 4 pm. **B**

8 Angular difference $= 6° + 11°$
$= 17°$
Distance $\approx 17 \times 60$ M
$= 1020$ M
$= 1020 \times 1.852$ km
$= 1889.04$ km
The approximate distance is 1900 km. **C**

9 2361.3 km $= (2361.3 \div 1.852)$ M
$= 1275$ M
Time $= (1275 \div 300)$ hours
$= 4.25$ hours
$= 4$ hours and 15 minutes
It arrived 4 h 15 min after 3.40 pm.
It arrived at 7.55 pm. **C**

10 Difference in latitude $= 34° + 28°$
$= 62°$ **C**

11 **a** $l = \dfrac{\theta}{360} 2\pi r$
$= \dfrac{70}{360} \times 2 \times \pi \times 90$
$= 109.955\,7429 \ldots$
$= 110$ (nearest unit)
The arc length is 110 km to the nearest kilometre. ✓
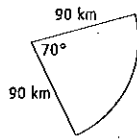
b 110 km $= (110 \div 1.852)$ M
$= 59.395 \ldots$ M
$= 59.4$ M (1 d.p.) ✓

c speed $= (59.4 \div 3.5)$ knots
≈ 17 knots ✓

12 **a** Angular difference $= 97° + 130°$
$= 227°$
Time difference $= (227 \div 15)$ hours
$= 15.133\,33 \ldots$ hours
$= 15$ h 8 min
The time difference between the two cities is 15 hours and 8 minutes. ✓

b Dallas is 15 hours and 8 minutes behind Nagasaki.
It is 5.17 pm on 3rd March. ✓✓

13 **a** Angular difference $= 0°$
There is no time difference.
It is 6.35 pm on July 31st. ✓

b Difference in latitude $= 30° + 30°$
$= 60°$
Distance $\approx 60 \times 60$ M
$= 3600$ M
$= 3600 \times 1.852$ km
$= 6667.2$ km
The distance is approximately 6700 km. ✓
[Or find the arc length.]

c Plane flew 6700 km at 1000 km/h.
Time $= (6700 \div 1000)$ hours
$= 6.7$ hours
$= 6$ hours and 42 minutes ✓
It arrived 6 hours and 42 minutes after 2.48 pm.
It arrived at 9.30 pm. ✓
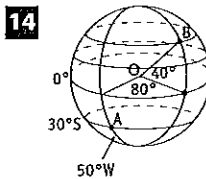
14
a A is at (30°S, 50°W) ✓
b B is at (40°N, 30°E) ✓
c Angular difference $= 80°$
Time difference
$= (80 \div 15)$ hours
$= 5.3333 \ldots$ hours
$= 5$ h 20 min ✓
d 10.35 am at A $=$ 3.55 pm at B
The plane left at 3.55 pm B time. ✓
It arrived at 5.25 am the next day.
Flight took 13.5 hours.
The flight was 13 and a half hours long. ✓