Question 4.1

A traffic surveyor makes 2 observations of a traffic stream using the moving observer method along a route 0.5 km long. In the first observation, he is met by 113 vehicles when against the stream and passes a net 16 vehicles when with the stream. On the second pass, he is met by 79 vehicles when against the stream and is passed by a net 9 vehicles when with the stream.
It takes the observer 90 seconds to complete the 0.5 km stretch of road when travelling in both directions.

For each pass, calculate the flow, the average speed of the stream and hence the density of the stream

Derive the linear relationship between speed and density, and derive values for free-flow speed and jam density

Solution 4.1
Q=(113-16)/(2*(1,5/60))=1940 veh/hr
T(avg)=1.5/60+16/1940=0.025+0.008=0.033
V(avg)=0.5/0.033=15 kph
Density = 129 vehicles per km

Q=(79+9)/(2*(1,5/60))=1760 veh/hr
T(avg)=1.5/60-9/1760=0.025-0.005=0.0199
V(avg)=0.5/0.0199=25 kph
Density = 70 vehicles per km

U = 40 – 0.2k

Free flow speed is at 40 kph, jam density is at 200 vehicles per km

Question 4.2

In a stream of vehicles, 20% of the vehicles travel at a constant 50 kph, 30% at a constant speed of 80 kph and the remaining vehicles travel at a constant speed of 110 kph. An observer travelling at a constant speed of 60 kph over a length of 6 km with the stream is passed by 10 more vehicles than he passes. When the observer travels against the stream at the same speed and over the same length of highway, the number of vehicles met is 390.

What is the mean speed and flow of the traffic stream being observed?

How many vehicles travelling at 100 kph are met by the observer while he travels against the stream?

Solution 4.2

Q=(390+10)/(2*(6/60))=2000 veh/hr
T(avg)=6/60-10/2000=0.1-0.005=0.095
V(avg)=6/0.095=63 kph

1000 vehicles travelling at 100 kph (0.5*2000)
$x_1 = Q_1 (t_a + t_1)$
Q_1=1000
t_a = travel time of observer against stream = 0.1 hours
t_1= travel time of vehicle travelling at 100 kph = 6/100 = 0.06
1000(0.1+0.06)=160 vehicles

Question 4.3

Two platoons of cars are timed over a distance of 1.0 kilometres. Their flows are recorded. The first group is timed at 60 seconds, with the flow at 1200 vehicles per hour. The second group take 75 seconds with a flow of 1800 vehicles per hour.

Determine the maximum flow of the traffic stream.

Solution 4.3

Group 1 has an average speed of 60 km/h
Group 2 has an average speed of 48 km/h
Group 1 k value = 1200/60 = 20 veh/km
Group 2 k value = 1800/48 = 37.5 veh/km

The slope, *m*, of the line joining the above two results= -12/17.5 = -0.6857

$y - 60 = -0.6857(x-20)$

$y + 0.6857x = 60 - 13.714$

$y + 0.6857x = 73.714$

Examining the boundary conditions,

free flow speed = 73 km/h
jam density = 107.5 v/km
Max flow = 73*107.5/4 = 1961 v/h

Question 4.4

The following two sets of data were derived for a single lane carriageway link:
Set 1
Speed = 50 kilometres per hour
Volume = 2950 vehicles per hour

Set 2
Speed = 80 kilometres per hour
Volume = 2160 vehicles per hour

Using Greenshields traffic model, estimate the capacity of the link in question

Solution 4.4
Speed=50
Density=59
Speed=80
Density=27

Density=-0.9375
U + 0.9375K = 105.3125
Free flow speed=105.3125kph
Jam density=112.33vehicles per km
Capacity=2957 vehicles per hour

Question 4.5

An observer travelling at a constant speed of 60 Km/hr with a stream over a length of 4 Km is passed by 20 vehicles more than he passes. When the observer travels with the stream, over the same length of highway, the number of vehicles met is 280.

What is the mean speed and flow of the traffic stream?

Solution 4.5

t = 4/60
= 0.0667 hrs = ta = tw
q = (20 + 280)/2(0.0667)
= 2250 veh/hr
= 37.5 vehicles / minute
t(bar) = tw - y/q
= 0.0667 x 60 - (20/37.5)
= 3.47 minutes
V_{mean} = (4/3.47) x 60
= 69.23 Km/hr