CE 560 Public Mass Transportation Name: _____
Test 1 (6 questions on 1 page) Solutions Fri. 23 February 2007
OPEN BOOK AND NOTES 8:28-9:8 AM, Room 2107 CIVL

$\mu = 55.8$, $\sigma = 24.2$, hi = 75, lo = 23

1. (15 points) **Transit's Heritage.** Describe briefly two connections that existed in the early twentieth century between any pairs among the following items.
   a. Amusement park
   b. Electric power company
   c. Street railway company

The power company and the street railway company were often owned by the same holding company. The street railway often provided Sunday service to an amusement park outside of town. The street railway owned the amusement park.

(2:53)

2. **APC Data.** Use the data in the Excel worksheet excerpt (on the reverse side of this sheet) to compute …
   A. (5 points) The average speed from "Waldron & State" to "University Place on Lindberg".

   18:34:06 → 18:41:16 = 7:10 over 4.3 – 1.44 = 2.86 miles.

   $\frac{2.86}{7\,10/60}$ = 0.399 mi/min * 60 min/hr = 23.9 mph

   B. (10 points) The average value of PMT/VMT from "Waldron & State" to "University Place on Lindberg".

   Shortcut: 51.92 – 11.46 = 40.46 PMT. $\frac{40.46\,\text{PMT}}{2.86\,\text{VMT}} = 14.15$.

(6:29)

3. (15 points) **Performance Measures.** On 31 January 2007, a handout was distributed that showed an excerpt of the scorecard being used by the Port Authority Transit of Pittsburgh to identify routes for possible service cuts or elimination. The scorecard uses three categories – effectiveness, efficiency, and equity. Are any of the performance measures used by the Port Authority placed in categories that do not agree with effectiveness/efficiency definitions implied by Table 1 or Figure 4.1 in Handout 22 of the Course Notes? If you find one, identify it and explain why it belongs in a certain category.

The PA has "Riders/Veh" under Efficiency. Table 1 has Pax/Veh Hr under Service Effectiveness. Fig. 4.1 has Pax/Veh Hr under Service Efficiency. I would choose Efficiency for "Riders/Veh", because the ratio relates service consumed to service provided.

Or: PA has "Cost per Rider" under Efficiency. Table 1 has "pax/op exp" under cost-effectiveness. Figure 4.1 has "pax/op exp" under cost-effectiveness, too. Although "cost-effectiveness" may be considered a form of efficiency, I prefer to use the term "efficiency" directly. It is a ratio of service consumed to resources expended to provide service.

(Others answers are acceptable, if justified.)

(10:32)

4. **Runcutting.** Route 5 is served by two vehicle blocks with a 30-minute headway. Vehicle Block 1 begins with Pullout at 6:08AM. The first round trip on Route 5 begins at Central Plaza at 6:15AM, goes out to Land's End Shopping Center, and returns to Central Plaza at 7:10AM. There is a 5-minute layover until the bus departs again for Land's End at 7:15AM. This vehicle block continues until 11:10PM, when the bus arrives at Central Plaza, before a Pull-in time of 11:17PM. Vehicle Block

2 on the same route begins with Pullout at 6:38AM. It serves Route 5 thirty minutes after the Vehicle Block 1 bus does, reaching Central Plaza for the last time at 11:40PM. Its Pull-in time is 11:47PM.

A. (10 points) Try to staff this route with five drivers. When and where will drivers be relieved?

B. (15 points) Calculate the total time each driver will be paid, using the following work rules:

- Report allowance = 10 minutes
- Turn-in allowance = 5 minutes
- Spread premium of 0.5 minute/minute is paid if the spread exceeds 10 hours
- Overtime premium 0.5 minute/minute is paid if time worked exceeds 8 hours
- If total time worked by any driver is less than 8 hours, the driver is paid for 8 hours.

Including Report and Turn-in Allowances, each Vehicle Block lasts 17:24. Because a fifth driver is available, overtime can be avoided. Try this runcut:

A. Driver A pulls out Veh Block 1 bus at 6:08 and gets relieved by Driver B at Central Plaza at 13:10. Pay for (13:10+0:05) – (6:08-0:10) = 7:17.

B. Driver B on Veh Block 1 works from 13:10 and gets relieved by Driver C at Central Plaza at 16:10. Pay for (16:10+0:05) – (13:10-0:10) = 3:15.

C. Driver C on Veh Block 1 works from 16:10 and pulls bus in at 23:17. Pay for (23:17+0:05) – (16:10-0:10) = 7:22.

D. Driver B pulls out Veh Block 2 bus at 6:38 and gets relieved by Driver D at Central Plaza at 9:40. Pay for (9:40+0:05) – (6:38-0:10) = 3:17.

E. Driver D on Veh Block 2 works from 9:40 and gets relieved by Driver E at Central Plaza at 16:40. Pay for (16:40+0:05) – (9:40-0:10) = 7:15.

F. Driver C on Veh Block 2 works from 16:40 and pulls bus in at 23:47. Pay for (23:47+0:05) – (16:40-0:10) = 7:22.

Note that Driver B has a Split Shift, with total pay hours = 3:15 + 3:17 = 6:32. The spread is (16:10+0:05) - (6:38-0:10) = 9:47, which is less than the 10:00 spread premium minimum. No driver has pay hours > 8:00, so each driver gets 8:00 pay.

(20:48)

5. **Automated People Mover at Detroit Airport.**

A. (8 points) Describe the propulsion technology and its advantages.

Rope/cable system. Vehicles are therefore lighter and quieter.

B. (7 points) How is the train supported on its guideway? What are the advantages?

Air cushion. Ride is smoother and quieter.

(22:15)

6. **Transit travel regimes and route planning.** In HW4, Problem 3, a major employment center is mentioned. A LRT line is proposed to connect downtown with the employment center. The proposed LRT service would stop at six stations outside of downtown, including the employment center.

A. (5 points) If the LRT vehicles can accelerate at 3.4 mph/sec to a desired cruising speed of 53 mph, how much time (to the nearest 0.1 second) will it take to reach the cruising speed? Use the standard equation, not Equation 9.1.

$$t_a = \frac{53\,\text{mph}}{3.4\,\text{mph/sec}} = 15.6 \text{ sec.}$$

B. (10 points) How much distance (to the nearest foot) will the LRT vehicle travel during the acceleration? Is it likely that the desired cruising speed will ever be reached in normal operations? Explain.

(10.2a) in h/o 8 or $s = \frac{1}{2} a t^2 = 0.5 * (3.4*1.47)*(15.6)^2 = 608$ feet.

Distance between stations = $\frac{4.42\,\text{mi}}{6\,\text{stations}}$ = 0.737 mi = 3890 feet.

If braking takes about as much distance as acceleration, there is about 3890 – (2*608) = 2674 feet available for cruising.

(26:39)