



Computer Marked Assignment

S357 42

Make sure you know how to use the CMA form: detailed instructions are given in your student handbook (or supplement).

You are strongly advised to attempt every question in this assignment.

If you do not wish to answer a question, pencil across the 'don't know' cell ('?').

If you think that a question is unsound in any way, pencil across the 'unsound' cell ('U') in addition to pencilling across either an answer cell or the 'don't know' cell.

Note For each question you must pencil across either the required number of answer cells or the 'don't know' cell.

Covering: Units 7 and 9

Cut-off date:

Friday 4 July 1997

Q1 The time interval between two events is registered by inertial observers, O and O' as 2.5 s and 2.6 s respectively. If O determines the distance apart, in his frame, of the positions at which the events occur to be 2.1×10^5 km, how far apart do they occur in O's frame? Pencil across *one* cell in row 1.

KEY for Q1

- A 2.2×10^5 km
B 2.4×10^5 km
C 2.6×10^5 km
D 2.8×10^5 km

- ☒ E 3.0×10^5 km
F 3.2×10^5 km
G None of A-F

Q2 and Q3 An inertial observer assigns spacetime coordinates, (ct, x) , of (2, 3), (4, 4) and (1, 7) respectively, to three events \mathcal{E}_a , \mathcal{E}_b and \mathcal{E}_c . The coordinates are given in *units* peculiar to this observer.

Q2 The key shows several possible endings for a sentence beginning 'There exists an inertial observer in whose frame ...'. Select the *two* items which complete *true* statements. Pencil across *two* cells in row 2.

KEY for Q2

- A \mathcal{E}_a and \mathcal{E}_b are simultaneous.
B \mathcal{E}_a and \mathcal{E}_b occur at the same position.
C \mathcal{E}_a and \mathcal{E}_c are simultaneous.
D \mathcal{E}_a and \mathcal{E}_c occur at the same position.
E \mathcal{E}_b and \mathcal{E}_c are simultaneous.
F \mathcal{E}_b and \mathcal{E}_c occur at the same position.

Q3 Select from the key the *three* statements which are *false*. Pencil across *three* cells in row 3.

KEY for Q3

- A \mathcal{E}_b could be caused by both \mathcal{E}_a and \mathcal{E}_c .
B \mathcal{E}_c could cause both \mathcal{E}_a and \mathcal{E}_b .
C There exists no inertial reference frame in which \mathcal{E}_a and \mathcal{E}_b are separated by a time interval $\Delta t'$ such that $c \Delta t' = 1$ unit.

D There exists no inertial reference frame in which \mathcal{E}_a and \mathcal{E}_b are separated by a time interval $\Delta t'$ such that $c \Delta t' = 2$ units.

E There exists no inertial reference frame in which \mathcal{E}_a and \mathcal{E}_c occur a distance of 4 units apart.

☒ F There exists no inertial reference frame in which \mathcal{E}_a and \mathcal{E}_c occur a distance of 3 units apart.

Q4 An inertial observer finds that two explosions were separated by a time interval of 10 s and a distance of 2×10^9 m. Six other inertial observers, A, B, C, D, E and F, each claim to have observed the same two explosions. The key gives the coordinates assigned to the observed explosions by each of these six observers. Which of the observers are certainly mistaken in believing they have correctly recorded the coordinates of the original explosions to the given number of significant figures? Pencil across *no more than three* cells in row 4.

KEY for Q4

- A (10 s, 4×10^9 m) and (20 s, 2×10^9 m) *10, 2E9*
B (-5 s, 3×10^9 m) and (5 s, 1×10^9 m)
☒ C (-25 s, 7×10^9 m) and (-35 s, 4×10^9 m)
D (-2 s, -2×10^9 m) and (8 s, 0)
☒ E (8.0 s, 12×10^9 m) and (-0.2 s, 13×10^9 m)
☒ F (-8.0 s, -12×10^9 m) and (2.1 s, -13×10^9 m)

Q5 An observer receives monochromatic radiation at a frequency of 5.88×10^{14} Hz from a source located on his positive 1-axis and moving with velocity $(-0.141c, 0.035c, 0.047c)$ in his frame. Select from the key the item which is closest to the frequency of the radiation emitted by the source. Pencil across *one* cell in row 5.

KEY for Q5

- A 4.97×10^{14} Hz
B 5.09×10^{14} Hz
☒ C 5.11×10^{14} Hz
D 6.61×10^{14} Hz
E 6.76×10^{14} Hz
F 6.79×10^{14} Hz

4 A ✓ B × C ✓