

Computer Marked Assignment

S357 51

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 1 and 2

Cut-off date:

Friday 21 March 1997

PART A

Q1 to Q12 mainly concern Unit 1.

Q1 What is the angle between the two displacement vectors

$$\mathbf{u} = (1, -1, \sqrt{6}) \text{ and } \mathbf{v} = (-1, 1, \sqrt{6})$$

where all lengths are measured in metres? Select one option from the key. Pencil across one cell in row 1.

KEY for Q1

A 0°

B 30°

C 45°

D 60°

F 90°

G 120°

H 135°

Q2 to Q7 share the same key and concern a particle of mass m observed at time t from a frame of reference to have position $\mathbf{x} = (x^1, x^2, x^3)$, velocity $\mathbf{v} = (v^1, v^2, v^3)$, and acceleration $\mathbf{a} = (a^1, a^2, a^3)$.

Q2 Select from the key the item that is invariant under a recalibration of the time scale from seconds to milliseconds. Pencil across one cell in row 2.

Q3 Select from the key the item that is invariant under a recalibration of the length scale from metres to kilometres. Pencil across one cell in row 3.

Q4 Select from the key the item that is invariant under an arbitrary translation of the origin of spatial coordinates. Pencil across one cell in row 4.

Q5 Select from the key the item that is invariant under an arbitrary rotation of the coordinate axes. Pencil across one cell in row 5.

Q6 Select from the key the item that is invariant under a rotation about the 2-axis but not invariant under a rotation about the 3-axis. Pencil across one cell in row 6.

Q7 Select from the key the item that is invariant under a reflection of the 1-axis but not invariant under a reflection of the 2-axis. Pencil across one cell in row 7.

KEY for Q2 to Q7

A $\frac{v^2 x^3 - v^3 x^2}{(\mathbf{v} \cdot \mathbf{x})^2}$ 1

B $\frac{v^3 x^1 - v^1 x^3}{(\mathbf{v} \cdot \mathbf{x})^2}$ 2

C $\frac{v^1 x^2 - v^2 x^1}{m|\mathbf{v}|^2}$ 3

D $\frac{|\mathbf{v} \times \mathbf{x}|}{m|\mathbf{a}|}$

E $m(v^1 - a^1 t)$

F $m(x^1 - v^1 t)$

$L = m\mathbf{v} \times \mathbf{r}$

Q8 to Q12 share the same key.

Q8 Select from the key the item that is most specifically related to the conservation of momentum. Pencil across one cell in row 8.

Q9 Select from the key the two items that are most specifically related to the conservation of angular momentum. Pencil across two cells in row 9.

Q10 Select from the key the item that is most specifically related to the conservation of energy. Pencil across one cell in row 10.

Q11 Select from the key the item that is most specifically related to Kepler's third law. Pencil across one cell in row 11.

Q12 Select from the key the item that subsumes three of the other four. Pencil across one cell in row 12.

KEY for Q8 to Q12

A The principle of relativity

B The isotropy of space

C Newton's law of universal gravitation 11, 9, 10,

D The homogeneity of time

E The homogeneity of space

Handwritten answers at the bottom of the page:

1) D 2) F 3) C 4) E 5) D 6) B 7) A
8) E 9) A B 10) D 11) C