PART I

This part carries 33% of the total examination marks.

You should attempt **ALL ELEVEN** *questions in this Part.*

Pencil your answers on the CME form provided. Detailed instructions for completing it are printed opposite. Note that each question requires only **ONE** *answer. No marks will be given for questions where more than one answer has been selected from the key. There are no penalty marks for incorrect answers.*

Q1 The key contains five statements about a moving particle, only one of which is correct. Select the CORRECT statement from the key for Q1, and pencil across *one* cell in row 1.

KEY for Q1

A A particle moving in a straight line at a constant speed experiences a net force of constant (non-zero) magnitude.

B If the total force acting on a particle is doubled, its speed will also double.

C When the magnitude of the total force, acting on a particle moving in a straight line, is reduced to zero, the particle will slow down.

D A particle in uniform circular motion experiences a net force of constant magnitude.

E The velocity of a particle must have the same direction as its acceleration.

Q2 On a frictionless, horizontal surface, a coin A of mass m approaches a stationary coin B, also of mass m, along the straight line connecting the centres of mass of the two coins. Assuming that $\boldsymbol{v}$ is the constant velocity of A *before* it collides **elastically** with B, select from the key for Q2 the one CORRECT option for the velocities of the two coins *after* the collision. Pencil across *one* cell in row 2.

KEY for Q2

A $\boldsymbol{v}_A = 0$; $\boldsymbol{v}_B = 0$

B $\boldsymbol{v}_A = 0$; $\boldsymbol{v}_B = \boldsymbol{v}$

C $\boldsymbol{v}_A = -\boldsymbol{v}$; $\boldsymbol{v}_B = 0$

D $\boldsymbol{v}_A = \frac{1}{2}\boldsymbol{v}$; $\boldsymbol{v}_B = \frac{1}{2}\boldsymbol{v}$

E $\boldsymbol{v}_A = -\frac{1}{2}\boldsymbol{v}$; $\boldsymbol{v}_B = \frac{1}{2}\boldsymbol{v}$

Q3 The five statements in the key below concern relationships between force, torque and angular momentum; four of them are true. Select the *one* statement that is WRONG in the key for Q3, and pencil across *one* cell in row 3.

KEY for Q3

A The total torque acting on a body is equal to the rate of change of its angular momentum.

B If the total force acting on a body is zero, its angular momentum remains constant at all times.

C A force acting at the centre of mass of a stationary object does not change the angular momentum of the object about its centre of mass.

D The internal torques acting within a system of objects do not change its total angular momentum.

E If the total external torque acting on a system is zero, the total angular momentum of the system is a constant vector.

Q4 For an ideal gas, consisting of a fixed number of molecules, the ratio PV/T is a constant. Select from the key for Q4 the CORRECT SI units for this constant. Pencil across *one* cell in row 4.

KEY for Q4

A $\mathrm{N\,m\,K}$

B $\mathrm{N\,m^{-1}\,K}$

C $\mathrm{N\,m^{-1}\,K^{-1}}$

D $\mathrm{N\,m\,K^{-1}}$

E Since it is a constant, the ratio PV/T has no units.

Q5 Figure 1 shows a standing wave on a string fixed between two points 10 m apart. Choose from the key for Q5 the CORRECT value for the wavelength, and pencil across *one* cell in row 5.

Figure 1

KEY for Q5

A 2 m

B 3 m

C 4 m

D 5 m

E 6 m

F 10 m

Q6 Calculate (to one significant figure) the separation of two 3 nC (i.e. 3×10^{-9} C) point charges in free space that repel each other with a force of magnitude 2×10^{-7} N. Choose *one* answer from the key for Q6, and pencil across *one* cell in row 6.

KEY for Q6

A 0.1 m

B 0.2 m

C 0.4 m

D 0.6 m

E 0.8 m

Q7 The magnetic energy stored by a solenoid is 200 mJ when a current of 4.0 A is flowing. What is the inductance of the solenoid? Choose *one* item from the key for Q7, and pencil across *one* cell in row 7.

KEY for Q7

A 50 mH

B 25 mH

C 13 mH

D 6 mH

E The question cannot be answered because the number of turns in the solenoid is not given.