PART II

This part carries 35 per cent of the total examination marks.

You should attempt **ALL** *the questions 12–16 in this part. The marks allocated for each question are shown.*

Write your answer in the thick answer book provided. Do **NOT** *use the same answer book for this part as for either question in Part III.*

Question 12

(7 marks)

(*a*) State the principle of conservation of angular momentum.

(*b*) A rod 2 m long and of negligible mass rotates in the horizontal plane about a frictionless pivot at its centre. Two small 2 kg masses are attached to the ends of the rod (Figure 4a) and the system is observed to rotate at 3 radians per second. The masses are then pushed inwards along the rods until they are both 50 cm from the central pivot (Figure 4b). What is the new angular speed?

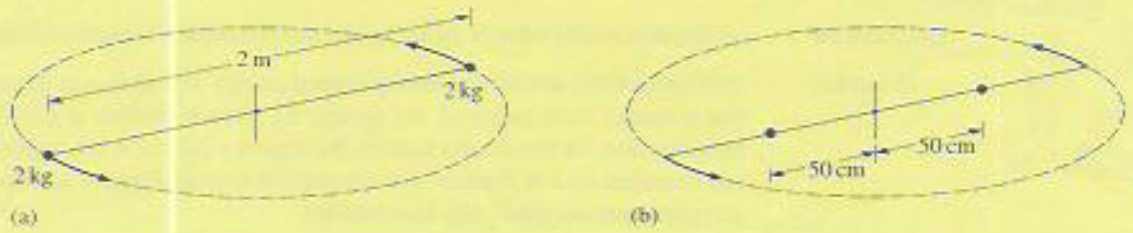

Figure 4

Question 13

(7 marks)

(*a*) State how displacement depends on time in *simple harmonic motion* and describe the relationship between force and displacement that leads to this type of motion.

(*b*) A spring of negligible mass and natural length 50 cm obeys Hooke's law. It is suspended from the ceiling and hangs vertically downwards. When a mass is attached to its free end, the spring stretches to a new equilibrium length of 75 cm. When the mass is displaced slightly from this equilibrium position, it is observed to undergo vertical simple harmonic oscillations. What is the period of these oscillations?

Question 14

(6 marks)

(*a*) Figure 5 shows equipotentials in a region of space. These equipotentials are arcs of circles centred on the point P. *Sketch* a diagram showing electric field lines for this same region, taking care to mark point *P* on your diagram and to put arrows on the field lines.

(*b*) Calculate the energy change ΔE_{el} (in joules) of a *proton* that moves from point A to point B and comment on the sign of your answer.

Figure 5