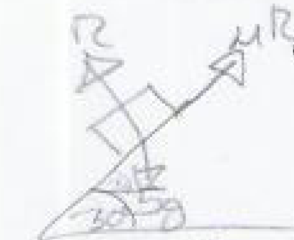
PART II

This part carries 35% of the total examination marks.

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

Write your answers 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

(6 marks)

An object of mass 5 kg is sliding at a constant speed down a plane surface, inclined at 30° to the horizontal. Consider air resistance to be negligible compared to the force of friction.

(*a*) Draw a diagram showing the forces acting on the object.

(*b*) Determine the magnitude and the direction of the force of friction on the object.

$\mu R - mg = 0$ 49N

$\mu R = mg = 5g$

Question 13

(8 marks)

$T = 2\pi$

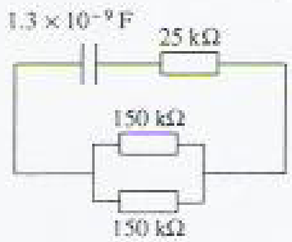
A mass of 2.5 kg undergoes undamped simple harmonic motion with an amplitude of 6.0 cm and a force constant of $1.0 \times 10^3\ \mathrm{N\,m^{-1}}$. If the displacement from the equilibrium position is zero at $t = 0$ s, calculate the period of simple harmonic motion, and sketch three graphs showing how the potential energy, the kinetic energy and the total energy change during one period. Label each graph clearly, and indicate the numerical scales on both axes in each case.

Question 14

(7 marks)

(*a*) Define the terms *capacitance* and *resistance* as applied to components of electrical circuits, explaining the meaning of any symbols used.

(*b*) Calculate the time constant of the circuit shown in Figure 2.



$\frac{1}{150e3} + \frac{1}{150e3}$

$R = 100\,k$

$t = RC$

$= 1.3e{-9} \times 1e5$

$= 1.3e{-4}$

Figure 2

Question 15

(6 marks)

A wire formed into a single circular loop of area $2.0\ \mathrm{m^2}$ is at an angle to a uniform magnetic field as shown in Figure 3. The strength of the magnetic field increases linearly with time, from zero to 3.0 T in 6.0 seconds.

(*a*) Write down an expression for the magnitude of the rate of change of magnetic flux through the coil.

(*b*) If the resistance of the wire is 10 Ω, calculate the magnitude of the induced current.

$\Phi = NAB\sin\theta$

$\frac{d\Phi}{dt} = NAB\frac{d\sin\omega t}{dt}$

$= AB\omega\cos\omega t$

$I = \frac{1}{R}\frac{d\Phi}{dt}$

$= \frac{1}{10} \times 2 \times 0.5 \times \cos 60$

$= 0.05A$

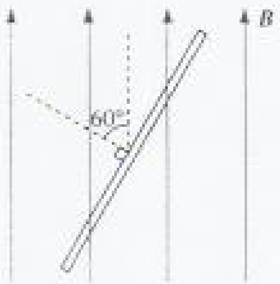


Figure 3

TURN OVER