

1. (cont.)

(c) Answer **all** parts (i) to (iii).

A particle confined to a one-dimensional box of length  $L$  has the following wavefunction:

$$\Psi(x) = \psi_2(x) + 2\psi_3(x),$$

where  $\psi_2(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{2\pi}{L}x\right)$  and  $\psi_3(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{3\pi}{L}x\right)$  are normalised

eigenfunctions of the Hamiltonian for a particle in a one-dimensional box

corresponding to eigenvalues:  $\frac{4h^2}{8mL^2}$  and  $\frac{9h^2}{8mL^2}$  respectively.

(i) Normalise  $\Psi(x)$ .

(4 marks)

(ii) Work out the result of operating with the Hamiltonian operator on the wavefunction, *i.e.*  $\hat{H}\Psi(x)$ .

(3 marks)

(iii) Evaluate the expectation value of the energy for the given wavefunction.

(5 marks)