Q6 Calculate the effective resistance between A and B in Figure 3. Choose *one* answer from the key for Q6 closest to your own, and pencil across *one* cell in row 6.

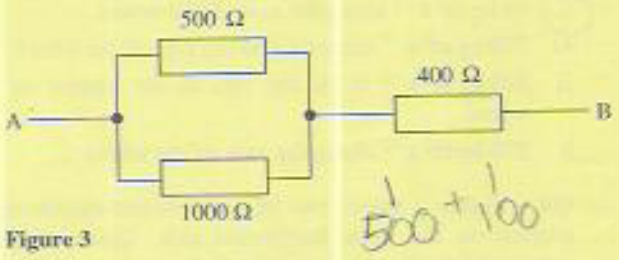

Figure 3

KEY for Q6

A $3 \times 10^{-3}\ \Omega$
B $316\ \Omega$
C $333\ \Omega$
D $400\ \Omega$
E $733\ \Omega$
F $1.9\ \text{k}\Omega$

Q7 Calculate the magnitude of the magnetic flux through a square circuit with sides of lengths 0.2 m, with its plane at an angle of 30° to a uniform magnetic field of strength 1.0×10^{-5} T (as shown in cross-section in Figure 4). Select *one* item from the key for Q7, and pencil across *one* cell in row 7.

Figure 4

KEY for Q7

A $2.0 \times 10^{-7}\ \text{T m}^2$
B $3.4 \times 10^{-7}\ \text{T m}^2$
C $4.0 \times 10^{-7}\ \text{T m}^2$
D $2.0 \times 10^{-5}\ \text{T m}^2$
E $4.0 \times 10^{-5}\ \text{T m}^2$

Q8 An observer in inertial frame A finds that an event E_1 occurs at position x_1 and time t_1 and that an event E_2 occurs at position x_2 and time t_2. A second observer in inertial frame B, finds that E_1 occurs at position x_1' and time t_1' and E_2 occurs at position x_2' and time t_2'. The two frames A and B are in standard configuration, with x-axes pointing in the same direction, and c is the speed of light in a vacuum. Only two of the statements in the key are automatically true according to the special theory of relativity. Select the two true statements from the key for Q8, and pencil across *two* cells in row 8.

KEY for Q8

A If $t_1 = t_2$, it follows that $t_1' = t_2'$.
B If $x_2 = x_1$ and $t_1 = t_2$, it follows that $x_1' = x_2'$ and $t_1' = t_2'$.
C $x_2' - x_1' = x_2 - x_1$.
D $t_2' - t_1' = t_2 - t_1$
E If $\dfrac{x_2 - x_1}{t_2 - t_1} = \dfrac{c}{2}$, it follows that $\dfrac{x_2' - x_1'}{t_2' - t_1'} = \dfrac{c}{2}$.
F If $\dfrac{x_2 - x_1}{t_2 - t_1} = c$, it follows that $\dfrac{x_2' - x_1'}{t_2' - t_1'} = c$.

Q9 The items in the key are important experiments that led to the framework of modern physics. Which one of these experiments led most directly to the conclusion that photons in electromagnetic radiation of wavelength λ scatter as particles of energy hc/λ and momentum magnitude h/λ? Select one item from the key for Q9, and pencil across *one* cell in row 9.

KEY for Q9

A Michelson–Morley experiment
B Experiments showing the Compton effect
C Stern–Gerlach experiment
D Experiments showing the photoelectric effect
E X-ray emission experiments
F Davisson–Germer experiment

Q10 In a region between $x = 0$ and $x = L$, a particle is described by a wavefunction of the form

$$\psi(x) = \frac{1}{\sqrt{L}} e^{-x/L}.$$

Calculate the ratio P_1/P_2, where P_1 is the probability of finding the particle in the small region between $x = 0$ and $x = 0.001L$, and P_2 is the probability of finding the particle in a similar region between $x = 0.999L$ and $x = L$. Select one option from the key for Q10, and pencil across *one* cell in row 10.

KEY for Q10

A 0.13
B 0.36
C 1.0
D 2.7
E 7.4

Q11 In the context of atomic physics, an electron is said to be 'paired' if there is another electron with the same set of n, l and m_l quantum numbers but with the opposite spin magnetic quantum number m_s. The statements in the key all refer to a nitrogen atom (atomic number 7) in its ground state. Only two of these statements are true. Select the two true statements from the key for Q11, and pencil across *two* cells in row 11.

KEY for Q11

A The atom has 5 electrons with $n = 2$.
B The atom has 4 electrons with $l = 2$.
C The atom has 2 electrons with $l = 1$.
D The atom has 1 unpaired electron.
E The atom has 2 unpaired electrons.
F The atom has 3 unpaired electrons.
G The atom has 7 unpaired electrons.