# National Certificate of Educational Achievement

# 2014 Assessment Report

# Physics Level 1

**90937** **Demonstrate understanding of aspects of electricity and magnetism**

**90938** **Demonstrate understanding of aspects of wave behaviour**

**90939** **Demonstrate understanding of aspects of heat**

# COMMENTARY

In AS 90937 (Demonstrate understanding of aspects of electricity and magnetism), most candidates completed all the questions in the paper and made a good effort to apply their physics understanding to each question. Candidates seemed to be familiar enough with similar contexts to the questions so they had confidence in answering the questions. The level of physics understanding shown seemed to be higher than in previous years though there were some clear exceptions.

In AS 90938 (Demonstrate understanding of aspects of wave behaviour), most candidates attempted all questions and overall showed a good understanding of many concepts in a number of contexts. Many candidates had difficulty describing what a wave is and/or describing the function of a wave. Some candidates struggled with the concept of total internal reflection and diffraction.

In AS 90939 (Demonstrate understanding of aspects of heat), most candidates demonstrated a good understanding of heat transfer methods in Question One. In Question Two candidates showed a good understanding of arrangement of particles in matter, and the effect of heat energy on them was well understood by most candidates. Question Three expected candidates to apply their understanding of heat ideas in a practical context. Most candidates exhibited a reasonable understanding in this question though some candidates struggled to explain this using correct physics terminology.

# STANDARD REPORTS

## 90937 Demonstrate understanding of aspects of electricity and magnetism

### ACHIEVEMENT

**Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They commonly:**

- described transfer of electrons as the reason for objects becoming charged or discharged
- stated that oppositely charged objects attract
- calculated values for electrical circuits using the formulae P=IV and V=IR
- drew a circuit diagram for resistors in series using correct symbols
- applied the right hand grip rule in finding the direction of a magnetic field
- partially calculated the strength of the magnetic field around a wire.

### NOT ACHIEVED

**Candidates who were assessed as Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They commonly:**

- did not understand that friction is the cause of charging for a given situation
- did not identify electron transfer as a cause of static electricity
- applied incorrect formulae, or incorrectly rearranged formulae in calculations
- drew circuit diagrams with incorrect or missing symbols
- wrote descriptions in general terms that did not identify the key physics idea relevant to the question.

## ACHIEVEMENT WITH MERIT

**In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit commonly:**

- linked the charging or discharging objects by electron transfer correctly to the cause of the transfer, by friction, induction, contact or by grounding
- combined formulae in simple two step calculations and remembered to convert units when appropriate
- understood that elements in series increased the total resistance of the circuit and hence the current was reduced
- explained that current in a series was the same because there was only a single pathway
- explained some steps linking the operation of an electromagnet to its function in an electric bell
- calculated the strength of the magnetic field around a wire.

## ACHIEVEMENT WITH EXCELLENCE

**In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence commonly:**

- explained how the process of charging or discharging by electron transfer linked to the behaviour of objects in static electricity
- explained the action of discharging of a charged object to become neutral
- carried out two step calculations to solve problems related to the resistance of a circuit and energy used by a component in a circuit
- explained how power consumption for a given circuit depends on the voltage or the current
- explained the working of the bell circuit in detail giving reasons for what was happening at each step in the operation.

## OTHER COMMENTS

Candidates at all level of achievement often showed clear misunderstanding when explaining the change in power in question 2(c). The vast majority of candidates clearly thought that the current they calculated for a single element in 2(a) was still the current in the series circuit. Very few candidates recognised that adding elements in series increased the total resistance of the circuit and hence the current was reduced. Most candidates tried to explain this situation in term of the voltage splitting in a series circuit.

Significant number of candidates were unfamiliar with the operation of the bell or relay type circuit in question three and so limited the score that they achieved in this question. Most candidates did not try to explain an experimental technique to demonstrate the magnetic field in question 3(d). The vast majority of candidates described use of the right hand grip rule; this is a useful way to help work out the direction but is not an experimental technique.

# 90938 Demonstrate understanding of aspects of wave behaviour

## ACHIEVEMENT

**Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They commonly:**

- stated that waves transport energy
- calculated the wavelength correctly from a diagram
- calculated the speed of a wave using, $v = f\lambda$
- drew the diffracted waves around a barrier with correct bending or unchanged wavelength
- recognised that reflection and refraction did not affect the amplitude of the wave
- recognised that refraction occurred at the air/prism space/atmosphere boundary
- identified some colours formed in a spectrum when white light passes through a prism
- recognised total internal reflection as the phenomenon for a given context.

## NOT ACHIEVED

**Candidates who were assessed as Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They commonly:**

- did not know what a wave is
- could not identify the correct values to use in an appropriate formula
- used formulae and data incorrectly to solve one-step problems
- failed to draw correctly the shape of diffracted waves
- could not calculate the wavelength of a longitudinal wave from a given diagram
- were unable to convert kHz to Hz
- were unable to rearrange simple formulae such as $\mathrm{v} = \frac{\mathrm{d}}{\mathrm{t}}$ to find the value for d
- explained refraction without any reference to light entering or exiting a second medium.

## ACHIEVEMENT WITH MERIT

**In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit commonly:**

- described what a wave is
- described that amplitude of waves decrease as they progress through water
- drew the diffracted waves around a barrier with correct bending and unchanged wavelength
- recognised that longer wavelengths diffract more around a barrier
- explained how reflection and diffraction might affect amplitude of a wave
- describe how reflection and diffraction change the direction of waves
- identified the colours in a spectrum in the correct order
- recognised refraction as the phenomenon in a given situation and explained why it occurred
- explained how different wavelengths or frequencies affected refraction in a medium
- explained the conditions required for total internal reflection to take place in a given situation.

### ACHIEVEMENT WITH EXCELLENCE

**In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence commonly:**

- used $v = f\lambda$ and $v = \frac{d}{t}$ with echolocation idea to calculate the distance of an object
- drew correct shape to indicate loss of amplitude with no change in wavelength for travelling water waves
- knew the link between wavelength and frequency, and that longer wavelengths cause greater diffraction
- explained why total internal reflection takes place in a given context
- compared amplitude and wave direction of diffracted and reflected wave correctly
- explained the change in apparent position of the sun from sunrise to midday by referring to the decreasing angle of incidence.

### OTHER COMMENTS

Significant number of candidates persist in thinking that different colours have different refractive indices – rather than the medium having slightly different refractive indices for the different colours. In the formula $v = f\lambda$, many candidates used frequency in kHz which shows that they were not aware that hertz Hz is the unit of frequency.

## 90939 Demonstrate understanding of aspects of heat

### ACHIEVEMENT

**Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They commonly:**

- understood that vacuum between walls in a thermos flask prevent heat loss by convection
- described that silvered surfaces prevent heat loss by radiation
- calculated the required unknowns using the equations: $Q = mc\Delta t$, $Q = mL$ and $E = P \times t$
- drew diagrams showing particle arrangement in steam and in a metal
- stated one similarity or one difference between the behaviour of particles in liquid and gaseous state
- identified that the rate of heat gain decreases as the temperature difference decreases
- identified the reason for heat loss in a thermos flask
- stated why metal expands when heated
- stated radiation as the method of heat transfer from the Sun
- described two modifications to improve the efficiency of heating for a given set up.

## NOT ACHIEVED

**Candidates who were assessed as Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They commonly:**

- did not know how to calculate the required unknowns using the equations: $Q = mc\Delta t$, $Q = mL$ and $E = P \times t$
- failed to draw correct distribution of particles in a solid or gas
- were unable to describe that vacuum between walls in a thermos flask prevent heat loss by convection
- were unable to describe that silvered surfaces prevent heat loss by radiation
- did not understand that latent heat is needed to bring about a phase change
- were unable to state that metal expands when heated
- did not know that radiation is the method of heat transfer from the Sun to Earth.

## ACHIEVEMENT WITH MERIT

**In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit commonly:**

- explained how the silvered walls, vacuum between the walls in a thermos flask and its cap help to retain heat
- calculated simple two step problems using the equations: $Q = mc\Delta t$, $Q = mL$ and $E = P \times t$
- explained the reason for heat loss of contents in a thermos flask
- explained why metal expands when heated
- stated one similarity and one difference between the behaviour of particles in liquid and gaseous states
- explained the method of heat transfer from the Sun to Earth
- explained why the entire energy incident on the concave mirror is not used to heat the water
- explained one modification to improve the efficiency of heating for a given set up.

## ACHIEVEMENT WITH EXCELLENCE

**In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence commonly:**

- carried out two step calculation to work out rate of heat gain in a given context
- explained the reasons for having a lid on a thermos flask to retain heat
- explained why content in the flask lose heat any way after 24 hours despite having the lid on
- explained why metal expands when heated
- calculated the minimum time required to raise the temperature of the water to a certain level in a given situation
- explained two modifications to the set-up given to raise the efficiency of heating.

## OTHER COMMENTS

Question 2 (c) asked candidates to compare and contrast particles in liquid and gaseous states but many candidates compared states of matter rather than particles, which highlight the need to read the questions carefully before answering them.

Question 3 (c) was a straightforward question, asking candidates to calculate the time taken. However, a large number of candidates gave the unit for time in minutes and not in seconds.