National Certificate of Educational Achievement

2012 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 achievement standard 90937 *Demonstrate understanding of aspects of electricity and magnetism*, candidates generally showed a much better understanding of the ideas in static electricity and electrical circuits than they did with magnetism and electro-magnetism. In particular the concept of a magnetic field was poorly understood and/or communicated both in written explanations and in diagrams.

In achievement standard 90938 *Demonstrate understanding of aspects of wave behaviour*, most candidates attempted all questions and showed a good understanding of many concepts in a number of contexts. The concepts of reflection and refraction were well understood, however, some candidates struggled with the concept of total internal reflection. Many candidates had difficulty in expressing their understanding of diffraction and explaining why the prisms in a periscope do not cause dispersion of light.

In achievement standard 90939 *Demonstrate understanding of aspects of heat*, most candidates demonstrated a good understanding of the basic equations involved in heat transfer and had a reasonable understanding of the methods to reduce heat loss in homes but struggled to explain this using correct physics terminology. Many candidates displayed a lack of understanding of latent heat. A large number of candidates incorrectly suggested that “heat” rises and that individual particles become less dense upon heating.

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 basic physics ideas such as opposites attract in relation to electrically charged objects or magnets
- were able to draw the magnetic field diagram for a given set-up
- illustrated physics ideas using diagrams in applied context, for example, finding the poles of an electromagnet in an electromagnetic toy
- described that aluminium is not a magnetic material
- used formulae and data correctly to solve one step problems or partially solved multiple step problems
- identified the important physics concepts in a given context, for example related brightness of a lamp to voltage
- identified a parallel circuit from a series circuit in a given context.

NOT ACHIEVED

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

- could not differentiate ideas in static electricity from those in magnetism, for example, used the ideas in static electricity to explain magnetic effects

- used formulae and data incorrectly to solve one step problems
- were unable to describe basic concepts in physics correctly
- were unable to describe or partially explain physics terms in the required situations.

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 an effect with the correct cause, for example, a positively charged object is created by removing electrons from it
- explained how an electrically charged object discharges in a given situation
- carried out simple two step calculations involving electric circuits
- were able to draw diagrams accurately to illustrate understanding of magnetic fields
- quantified answers where specific values were given in questions, for example one less bulb out of five reduces brightness by one fifth
- explained the application of physics ideas in an electromagnetic toy
- were able to explain how the number of turns on a solenoid affects the magnetic field strength.

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 the action of discharging of a charged object to become neutral
- carried out two step calculations involving electric circuits
- made explicit statements linking the physics concepts to the given context, for example, linked brightness to voltage or current
- completed an extended series of linked ideas to provide a full explanation, for example, logically reasoned why the strength of the magnetic field is related to the number of turns in an electromagnet
- explained the underlying physics concepts in a practical application, for example, clarified the workings of an electromagnetic toy, using physics ideas
- explained the effect of induced magnetism in soft iron.

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:

- correctly drew the path of a reflected ray by constructing a normal to the reflecting surface or were able to complete a partial ray diagram for reflection
- identified the angle of incidence and the angle of reflection or located the position of the image formed by a plain mirror
- identified a given wave as transverse or longitudinal, or the type of wave used in space communication
- stated the effects on sound heard either when its frequency is halved or its amplitude is doubled

- defined the term diffraction or completed the path of the diffracted waves in a given situation
- were able to show in a drawing the idea of refraction or total internal reflection
- completed the path of a ray to show how they reflected inside a periscope
- used v=d/t or v=fλ to solve simple problems.

NOT ACHIEVED

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

- were unable to construct any aspects of a ray diagram for a plane mirror, or unable to identify the angle of incidence or angle of reflection
- were unable to locate the position of the image formed by a plain mirror
- incorrectly identified transverse or longitudinal waves in a given situation
- were unable to correctly describe the effect on sound when the frequency and amplitude is altered
- used formulae and data incorrectly in attempting to solve one-step problems
- were unable to describe the term diffraction or draw the path of the diffracted ray
- drew incorrect diagrams depicting refraction or the path of a ray inside a periscope.

ACHIEVEMENT WITH MERIT

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

- were able to complete a diagram showing the reflected ray and the normal, and locate the angles of incidence and reflection
- for a given situation, partially constructed a ray diagram to show how the virtual image behind the mirror is formed
- identified transverse and longitudinal waves
- explained why electromagnetic waves are used for communication in space
- explained how the pitch is affected by the frequency change or the loudness is affected by the change in amplitude
- linked two basic formulae correctly to calculate the required unknown value
- drew wave fronts of diffracted waves with the correct wavelength in a given situation
- compared the speed of light as it entered plastic from air, to when it left the plastic
- used the idea of optical densities to explain the path a ray takes when it hits a boundary of two media at the critical angle
- completed the path of rays in a periscope to show the formation of an image
- were able to show in a drawing the idea of refraction and total internal reflection.

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:

- accurately constructed a ray diagram to show how the virtual image of a person is formed behind a mirror for a given situation. The virtual nature of the image is shown using dotted lines

- completed an accurate ray diagram to show the full length image of a person in front of a mirror
- explained why a person needs only half the mirror to see a full image
- defined the term period and performed the calculations to find the time period between the drips of water in a given situation
- explained how the change in frequency affects the pitch and how the change in amplitude affects the loudness
- defined the term pulse in terms of energy transfer and solved a numerical problem associated with reflection of pulse in a cable
- drew wave fronts of diffracted waves accurately using the correct wavelength in a given situation
- completed the path of both rays accurately to show how they reflected through the periscope and explained why the image formed would be upright
- explained why dispersion did not occur in a periscope comprising two right angled prisms
- completed a ray diagram to show how a ray refracts and totally internally reflects in a prism.

90939 Demonstrate understanding of aspects of heat

ACHIEVEMENT

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

- identified condensation as process by which water droplets are formed on a window glass
- defined specific heat capacity or carried out a simple specific heat capacity calculation
- drew the arrangement of particles in a liquid and a gas
- identified insulation as the process to reduce heat loss or named an insulating material that could reduce heat loss through walls
- identified aluminium as a good reflector or wood as a poor conductor in a given context
- stated that a metal container with a low specific heat capacity would mean the water in it would heat up faster
- carried out one step simple calculations
- identified that the process of radiation requires no medium
- could identify conduction as the heat transfer mechanism from the chimney of a Thermette
- described convection currents as the heat process when water is heated.

NOT ACHIEVED

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

- were unable to select the right data when calculating specific heat capacity or latent heat
- could not draw a correct distribution of particles in a liquid or gas
- stated that the air-filled space between glass in double glazing was a vacuum

- stated that painting walls white or silver would reduce heat loss through walls
- could not correctly define specific heat capacity
- did not understand latent heat is needed to bring about a phase change
- were unable to correctly identify heat transfer mechanisms in given situations.

ACHIEVEMENT WITH MERIT

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

- understood that a metal container with a low specific heat capacity would heat up quickly and would transfer heat to the water in it at a faster rate
- either explained that latent heat energy is needed to bring about a phase change or that the water particles were moved apart when water boiled to become steam
- calculated the energy required to heat humid air but did not subtract the mass of water from the total mass of air
- could give generic definitions for conduction, convection or radiation but could not relate them to a given context
- knew that trapped air in insulating materials reduced heat loss
- could explain some mechanisms for reducing heat loss in houses correctly
- could carry out specific heat capacity or latent heat calculations correctly
- could explain that convection currents in water are caused by density differences
- could explain conduction in terms of vibrating particles using the idea of the energy being transferred from particle to particle
- explained that wood is a poor conductor of heat (the reason for using wooden handles in heating devices because they are safe to touch).

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:

- could explain the process of condensation of water on a window accurately in terms of energy loss and thus causing a phase change
- were able compare the heat energy required to heat humid air to that of dry air by calculating the appropriate energy requirement
- explained how heat energy is lost to the surroundings in a given context
- could explain in detail that air is a poor conductor of heat and that trapped air minimises heat losses by conduction
- were able to explain that insulation material contained pockets of trapped air and explained how these reduced heat loss by conduction and/or convection
- correctly explained how aluminium foil and double glazing could reduce heat transfer by conduction, convection and radiation for a given context
- solved a two step problem that involved specific heat capacity and latent heat concepts
- could explain that latent heat energy needed to be supplied to bring about a phase change and that the energy was used to overcome attractive forces between water particles when water becomes steam
- were able to explain that if a metal container of low specific heat capacity is used then less heat energy is required to heat the container and more of the heat energy would be transferred to its contents and related this idea to efficient heating

- could explain in relation to the design of a Thermette how radiation and convection processes are reduced to create efficient heating.