



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1, 2004

Physics

**Demonstrate understanding of
wave and light behaviour (90182)**

**Demonstrate understanding of
mechanics in one dimension (90183)**

**Demonstrate understanding of heat
transfer and nuclear physics (90184)**

**Demonstrate understanding of
electricity and magnetism (90185)**

National Statistics

Assessment Report

Assessment Schedule

Physics, Level 1, 2004

General Comments

Physics: Demonstrate understanding of wave and light behaviour (90182)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
2,458	30.6%	36.7%	22.0%	10.8%

Assessment Report

Most of the candidates displayed a good level of understanding in both the light and wave sections of this standard.

Achievement required an understanding of:

- rectilinear propagation of light
- terms such as angle of incidence, angle of reflection and lateral inversion
- refraction of light at a straight boundary between two media
- terms such as transverse wave, amplitude, wavelength and period.

In addition to the above, candidates were expected to solve simple problems such as calculation of wave speed and period given the correct data.

Achievement with Merit or Achievement with Excellence required a detailed understanding of:

- critical angle and total internal reflection
- dispersion of light through a prism
- the use of prisms in binoculars to change the direction of light
- how sound waves travel in air
- why light refracts at a straight boundary between two media.

In addition to the above, candidates were expected to analyse real life situations and use their skill to solve problems that involve multiple steps.

Answers to the ray diagrams must be clear and precise. Many candidates demonstrated a thorough knowledge and understanding with fully set-out answers to numerical problems and sound responses to questions requiring explanations. However, the following needed further attention.

- A significant number of candidates lacked a clear understanding of the use of prisms in binoculars to change the direction of light.
- Some candidates were limited in the level of achievement gained, due to lack of detailed explanation of why a certain phenomenon takes place such as in Questions Two (b), Two (c) and Three (c).
- Many candidates showed a poor understanding of how to rearrange the data in Question Two (e) to calculate v_1 .

Physics: Demonstrate understanding of mechanics in one dimension (90183)**National Statistics**

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
3,223	18.0%	58.9%	16.9%	6.1%

Assessment Report

Candidates who gained Achievement in the first criterion were able to:

- identify and describe the concepts of displacement, velocity and acceleration from a graph
- understand the concept of vectors and apply it in a practical situation
- apply the concepts of unbalanced forces, pressure and conservation of energy.

Candidates who gained Achievement were able to solve straightforward problems involving acceleration, force, average speed, kinetic energy, gravitational potential energy, work and power.

Candidates who gained Achievement with Merit or Achievement with Excellence in the second criterion, gave concise explanations to show a clear understanding of concepts like forces and dynamic equilibrium, transformation of energy and relationship between pressure and areas in real life contexts.

Candidates who gained Achievement with Merit or Achievement with Excellence in the second criterion were able to solve problems that involved more than one process, and to recognise at least two different concepts, as in the calculation of combined mass in 1(f), pressure and area in 1(g), deceleration in 2(g), and transformation of energy in 3(e).

In general, candidates displayed a high level of understanding in this standard. However the following concepts were misinterpreted by some candidates:

- “Negative acceleration” may mean “acceleration in the opposite direction”. It does not necessarily mean deceleration.
- Area is the product of two sides of a rectangle, not the sum of two sides, nor the perimeter.
- When a balloon is stationary in air, the upthrust / buoyancy / lift force balances, or is equal and opposite to the weight / gravity. Other forces like air resistance, viscous force, drag, reaction and air pressure do not contribute to this static equilibrium.
- When a skydiver has reached terminal velocity, there is no unbalanced / resultant / net force acting on the skydiver.

Physics: Demonstrate understanding of heat transfer and nuclear physics (90184)**National Statistics**

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
2,145	22.9%	50.3%	17.3%	9.5%

Assessment Report

Achievement in this standard requires an understanding of concepts in both heat transfer **and** nuclear physics. Candidates are not awarded this standard if they show a high level of understanding in only **one** of the two topics.

Achievement required a basic understanding of:

- heat energy transfer methods, conduction and convection
- the difference between a conductor and an insulator
- absorption or reflection of heat by different materials
- nuclear structure.

In addition to the above, candidates must also show an ability to select an appropriate formula and solve simple problems relating to specific heat capacity and latent heat.

Achievement with Merit or Achievement with Excellence requires a detailed understanding of:

- heat transfer methods of convection and conduction
- the methods of heat loss to the surroundings in a given situation
- conservation laws used in nuclear equations.

In addition to the above, candidates must also show ability to:

- solve multiple step problems using the idea of latent heat and specific heat capacity.
- synthesise nuclear equations.

In general, candidates displayed a good level of understanding for this standard. Most candidates demonstrated a clear understanding of the concepts of specific heat capacity, latent heat, and nuclear structure. Many candidates solved problems to an Achievement or higher level, but were unable to provide satisfactory detailed explanations of methods of transfer of heat energy to complete the requirements to gain Achievement with Merit or Achievement with Excellence. Candidate answers must address the key words in the question.

Physics: Demonstrate understanding of electricity and magnetism (90185)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
3,425	16.4%	35.6%	20.5%	27.4%

Assessment Report

Most candidates were able to adequately answer the questions on movement of negative charges, subsequent charge distribution on the sphere, and the concept of earthing, which indicated that the knowledge and understanding of static electricity was generally good. Many candidates demonstrated a sound understanding of current and voltage in series and parallel circuits, and were able to use Ohm's law accordingly to solve problems.

Achievement required an understanding of:

- the process of charging, charge distribution on the sphere and earthing

- series and parallel circuits at basic level
- Ohm's law to solve simple circuit problems
- the shape of magnetic fields produced by a long straight wire and by a solenoid.

Achievement with Merit or Achievement with Excellence required a detailed understanding of:

- charge transfer, charge distribution and law of charges
- the relationship between brightness, power and voltage
- how to solve two step problems relating to series and parallel circuits using Ohm's law and power equation
- shape and direction of magnetic fields produced by a long straight wire and by a solenoid.

Even though most of the candidates displayed a good level of understanding in this standard, it is worth noting the following:

- Some candidates explained the charging process as transfer of positive electrons, moving positive charges, and some even mentioned transferring magnetic charges.
- Some explanations stated that current is being used up at different places in a circuit.
- Relationship between power and brightness was not clearly understood by many candidates.
- Question Three (b) required the candidates to draw the magnetic field inside the coil. Despite the word "inside" being in bold, many candidates drew the magnetic field outside the coil.

Assessment Schedule

Physics: Demonstrate understanding of wave and light behaviour (90182)

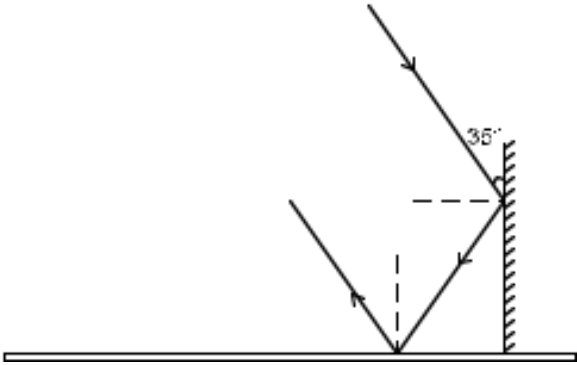
Evidence Statement

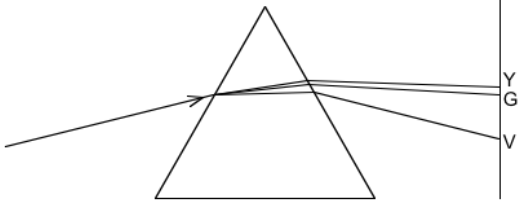
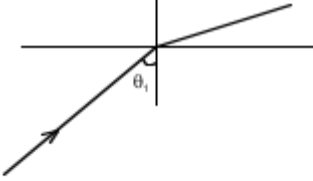
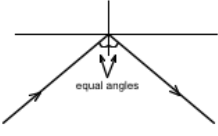
Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct, provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

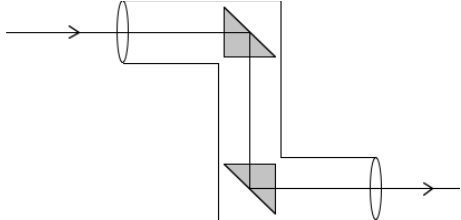

- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Italics indicate replacement evidence.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a)	2.5 (± 0.3) m	² Correct answer with correct path drawn for the light.		
1(b)	Light travels in straight lines.	¹ Correct answer.		
1(c)	2.0 m	² Correct answer.		
1(d)	The image is turned around sideways /180°.	¹ Explanation shows an understanding of the concept of lateral inversion.		
1(e)	55°	² Correct answer.		
1(f)(i)		¹ Correct ray diagram. The outgoing ray is NOT parallel to the incoming ray.	¹ Correct ray diagram. The outgoing ray must be parallel to the incoming ray Or correct angles are shown.	
1(f)(ii)	$90 - 55 = 35^\circ$		² Evidence of method with correct answer.	

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(a)	Yellow is just above green and violet well below green. 	¹ One ray is drawn correctly. OR order of colours are correct but wrong diagram.	¹ Both rays are drawn correctly.	
2(b)	Different colours have different frequency (wavelength). Each frequency / wavelength (colour) is travelling at a different speed in the prism, so each is bent by a slightly different angle.	¹ Identifies a colour with wavelength/ frequency as the cause of different refraction.	¹ Different colours have different speed in the prism OR The glass prism has different refractive index for each colour which causes the bending.	¹ Relates colour to wavelength or frequency as the cause of different speed and hence different refraction.
2(c)(i)	 Ray bends away from the normal.	¹ Ray is drawn correctly.		
2(c)(ii)	 Ray is reflected so that $\angle i = \angle r$.	¹ Ray reflects back to the water.	¹ Ray reflects back to the water so that the angle of reflection equals to angle of incidence.	
2(d)	The ray bends away from the normal because it is travelling faster in air compared to water. It speeds up in air so the direction changes.	¹ Light is travelling from a denser medium to a less dense medium so in the air the ray bends away from the normal.	¹ Water is optically denser than air, at the boundary of water-air the ray bends away from the normal.	¹ Answer identifies the change in speed as the cause of refraction.
2(e)	$n_1 v_1 = n_2 v_2$ $1.6 \times v_1 = 1.3 \times 2.3 \times 10^8$ $v_1 = 1.87(1.9) \times 10^8 \text{ ms}^{-1}$	² Correct substitution but wrong answer.	² Correct working and answer.	

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(f)			¹ Correct answer.	
3(a)	$T = \frac{1}{f}$ $= \frac{1}{0.050 \times 1000}$ $= 0.02$	² . Used f as 0.05 and $T = 20$ s.	² Correct working and answer.	
	Unit: second	¹ Correct unit.		
3(b)	Shows a series of compressions and rarefactions. E.g. 	¹ Shows compressions and rarefactions.	¹ Shows equally spaced compressions and rarefactions.	
3(c)	As the cone vibrates, the air molecules near the cone vibrate at the same frequency. This sets up compressions and rarefactions in the air which propagate the sound wave through the air.	¹ .The speaker sets up vibrations in air.	¹ .The speaker sets up vibrations in air causing compressions and rarefactions.	¹ Explanation shows a clear understanding of the phenomenon.
3(d)	Wavelength = $\frac{2.55}{15} = 0.17$ m $V = f\lambda = 2000 \times 0.17 (= 340 \text{ m s}^{-1})$ OR Period, $T = \frac{1}{2000} = 0.0005$ s Time of travel = $0.0005 \times 15 = 0.0075$ s $V = \frac{d}{t} = \frac{2.55}{0.0075} (= 340 \text{ ms}^{-1})$		² Correct calculation of wavelength. OR calculation of travel time	² Correct calculations.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(e)	$d = v \times t = 340 \times 0.01 = 3.4 \text{ m}$ $\lambda = 3.4/10 = 0.34 \text{ m}$ OR frequency = $1/(0.01/10) = 1000 \text{ Hz}$ $\lambda = v/f = 340/1000 = 0.34 \text{ m}$		² Correct calculation of the distance 3.4 m OR correct calculation of frequency.	² Correct calculation and correct answer.
3(f)	Sound waves propagate through vibration. (The speed of sound is directly related to the frequency of the collisions in the medium.) In a liquid, the molecules are reasonably close together and the frequency of collision is higher than in air, therefore the sound wave is able to travel faster.		¹ Relates the closeness of the particles to the increase in speed.	¹ Explanation shows a clear understanding of the phenomenon.
3(g)	Water waves in a pond, light waves, radio-waves, secondary earthquake waves, gamma waves etc.	¹ Correct answer.		
3(h)	$= 0.30/2$ $= 0.15 \text{ m}$	² Correct answer.		
3(i)	$\lambda = 3.6/3 = 1.2 \text{ m}$	² Correct answer.		
3(j)	$F = 1/T = 1 / 0.4 = 2.5 \text{ Hz}$ $v = f\lambda$ $= 2.5 \times 1.2$ [COE from (i) possible] $= 3.0 \text{ ms}^{-1}$ OR $V = d/t = 3.6/(3 \times 0.4) = 3.0 \text{ ms}^{-1}$ OR $V = \lambda/T = 1.2/0.4 = 3.0 \text{ ms}^{-1}$		² Correct working and answer for frequency.	² Correct working and answer.
		A1 : 12 A2 : 7	M1 : 9 M2 : 6	E1 : 4 E2 : 3
	Total	19 As	15 Ms	7Es

Judgement Statement

Physics: Demonstrate understanding of wave and light behaviour (90182)

The following is a guide to the standard required for each grade in the two criteria.

Criterion 1

Achievement:

Total of 6 opportunities answered at Achievement (or higher).

6 × A1

Achievement with Merit:

Total of 8 opportunities answered with 4 at Merit level (or higher) **and** 4 at Achievement level.

4 × M1 + 4 × A1

Achievement with Excellence:

Total of 8 opportunities answered with 1 at Excellence level **and** 3 at Merit level **and** 3 at Achievement level.

1 × E1 + 3 × M1 + 4 × A1

Criterion 2

Achievement:

Total of 4 opportunities answered at Achievement (or higher).

4 × A2

Achievement with Merit:

Total of 7 opportunities answered with 3 at Merit level (or higher) **and** 4 at Achievement level.

3 × M2 + 4 × A2

Achievement with Excellence:

Total of 7 opportunities answered with 1 at Excellence level **and** 3 at Merit level **and** 3 at Achievement level.

1 × E2 + 3 × M2 + 3 × A2

Note: For Excellence overall a minimum of 3 opportunities answered at Excellence level is required, with at least one from each of criterion 1 and 2.

Achievement Criteria			
Achievement	Merit	Excellence	
6 A1	4 A1 and 4 M1	4 A1 + 3 M1	3 Es At least 1 from each category.
4 A2	4 A2 and 3 M2	3 A2 + 3 M2	

Assessment Schedule

Physics: Demonstrate understanding of mechanics in one dimension (90183)


Evidence Statement

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct, provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a)	Area under the graph $= (\square \times 50 \times 10) + (10 \times 100) +$ $(\square \times 50 \times 10)$ $= 250 + 1000 + 250$ $= 1500 \text{ m}/1.5\text{km}$	² Shows a process of working but not correct answer. Physics is correct but Maths is not correct.	² 1500m accepted with no working	
1(b)	<i>SHOW QUESTION</i> $Gradient = \frac{10}{50}$	² Correct working.		
1(c)	$F = m \times a$ $= (2250 + 800) \times 0.20$ $= 3050 \times 0.20$ $= 610 \text{ N}$	² Mass value is wrong.	² Correct answer (610N)	
1(d)	Since the graph shows the velocity to north direction as positive, the velocity on the return trip to the south is negative.	¹ To show the return journey/velocity has direction. (Look for idea of return journey – implies.)	¹ Both direction and velocity is in the explanation.	
1(e)	The bus is accelerating at a constant rate of 0.24 ms^{-2} in the south direction. (Problem with this question is it asks for description of motion.)	¹ accelerating/ acceleration is mentioned DO NOT accept deceleration.	¹ Both constant acceleration / accelerating at 0.24ms^{-2} Accept –ve constant acceleration.	
1(f)	$a = Gradient = \frac{12}{100} = 0.12 \text{ ms}^{-2}$ $F = m \times a$ $342 = m \times 0.12$ $m = \frac{342}{0.12}$ $= 2850 \text{ kg}$	² Calculated gradient correctly (0.12 ms^{-2}) Accept if 0.24ms^{-2} is used and all other processes are correct ($\frac{342}{0.24} = 1425$ plus mass of the bus = 3675kg)	² Correct process/working but answer not calculated correctly.	² Correct working and answer.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(g)	Area = $0.20 \times 0.25 = 0.05 \text{ m}^2$ Contact area = $60\% \times 0.05$ = 0.03 m^2 $P = \frac{F}{A}$ = $6048/0.030$ = $201\,600$ (Rounded off to 200 000)	² Area calculated correctly (0.05 m^2)	² Contact area calculated correctly (0.03 m^2).	¹ Correct answer. (pressure = 201 600)
	Unit: Pascal (Nm^{-2}) Kpa/pa accepted	Correct unit.		
2(a)	 <p style="text-align: center;">Support (buoyancy) force</p> <p style="text-align: center;">weight force</p>	¹ Correct answer (two equal sized arrows in the opposite direction with correct labels) * At least ONE label correct even if second label is wrong		
2(b)	Average speed = Total Distance/Total time = $\frac{21}{2.1}$ = 10 ms^{-1}	² Correct answer.		
2(c)	SHOW QUESTION Velocity is shown in final answer Distance = area under the graph $\frac{1}{2} \times v \times 2.2 = 21$ $v = 42/2.1$ $= 20 \text{ ms}^{-1}$ [Note: Difficult question for most candidates.]		² Correct working.	
2(d)	$E_k = \frac{1}{2} \times m v^2$ $= \frac{1}{2} \times 0.73 \times 20^2$ $= 146 \text{ J}$	² Correct answer. *If (b) for velocity is substituted it is wrong. If using 2(c) velocity for 2(d), so it will be 160.97(161 J).	Watch the use of the wrong formula (E_p).	

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(e)	At the start, the air resistance is extremely small and there is only one force acting on her weight. This unbalanced force makes her accelerate.	¹ Unbalanced force / weight force.	¹ Unbalanced force is gravity/weight force is greater than air resistance causing acceleration.	
2(f)	As she travels further, the air friction/drag increases. Eventually the two forces acting in the opposite directions are equal. She stops accelerating and travels at a constant/uniform speed (Terminal Velocity).	¹ <i>Air resistance increases with velocity.</i>	¹ Air Resistance equal to force weight.	¹ Constant Terminal Velocity Note: If not concise enough it is not an excellent answer.
2(g)	$F = m \times a = 95 \times 10 = 950 \text{ N}$ $F_{\text{resultant}} = 1300 - 950 = 350\text{N}$ $a = F/m = 350/95$ $= 3.68 \text{ (3.7) ms}^{-2}$ <p>Note: Difficult question for most candidates.</p>	² Correct answer for weight force. <i>Accept 13.7 ms⁻² (9.8 used)</i>	² Resultant force (upward force).	² Correct Answers (Force weight, resultant force, acceleration.)
2(h)	The bottom surface of a snowshoe has a larger area than that of an ordinary shoe. The person exerts the same force on the ground. Since pressure is force per unit area, the snowshoe will exert less pressure on the snow, so it penetrates less and easier to walk.	¹ Snowshoes have a greater surface area. Need to show some comparison between the two shoes.	¹ Achieved plus less pressure.	¹ Merit plus Person exerts the same weight force on the ground.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(a)	SHOW Question $W = F \times d$ $= 21 \times 28$ $(= 588 \text{ J})$	² Correct working.		
3(b)	$P = \frac{W}{t}$ $= 588/15$ $= 39.2 \text{ W}$	² Correct answer.		
3(c)	$F_{\text{support}} = m \times a$ $= 88 \times 10$ $= 880 \text{ N}$ upwards	² Correct answer. ¹ Correct direction.		
3(d)	$E_p = m \times g \times h$ $= 85 \times 10 \times 18$ $= 15300 \text{ J}$ Accept 14 994 J (9.8 used).	² Correct working and answer.		
3(e)	Difficult question for most. Loss of $E_p = m \times g \times h = 85 \times 10 \times 6$ $= 5100 \text{ J}$ Gain of $E_k = \frac{1}{2} \times m v^2 = 5100$ $v^2 = (2 \times 5100)/85$ $v = 10.95/(11) \text{ ms}^{-1}$ Must show loss of E_p and gain of E_k in working.	² Correct calculation of loss of E_p . Accept 5100 J / 4998 J	² Correct process or working but the answer not calculated correctly.	² Correct working and answer.
3(f)	As Moana slows down, some of her kinetic energy is used to overcome friction (changed into heat energy?) and some into gravitational potential energy. The energy against friction is due to the board being at right angles to the motion and gravitational potential energy, due to her going up hill.	¹ Shows some knowledge of energy change. $E_k > E(\text{heat})/GE_p$	¹ Correct idea of energy change into E_p and energy to overcome friction but no mention of the reasoning.	¹ Gravitation Potential Energy to gain height/ Describes Energy lost as Heat Energy because of friction

Judgement Statement

Physics: Demonstrate understanding of mechanics in one dimension (90183)

The grade awarded is the highest one that has been demonstrated in all achievement criteria up to and including that grade.

The following is a guide to the standard required for each grade in the two criteria.

Criterion 1

Achievement:

Total of 3 opportunities answered at Achievement (or higher)

3 × A1

Achievement with Merit:

Total of 6 opportunities answered with 3 at Merit level (or higher) **and** 3 at Achievement level

3 × M1 + 3 × A1

Achievement with Excellence:

Total of 7 opportunities answered with 1 at Excellence level **and** 3 at Merit level **and** 3 at Achievement level

1 × E1 + 3 × M1 + 3 × A1

Criterion 2

Achievement:

Total of 7 opportunities answered at Achievement (or higher)

7 × A2

Achievement with Merit:

Total of 10 opportunities answered with 3 at Merit level (or higher) **and** 7 at Achievement level

3 × M2 + 7 × A2

Achievement with Excellence:

Total of 11 opportunities answered with 1 at Excellence level **and** 3 at Merit level **and** 7 at Achievement level

1 × E2 + 3 × M2 + 7 × A2

Note:

For Merit, at least 7 Merit grades in total are achieved

For Excellence, at least 3 Excellence grades in total are achieved

Assessment Schedule

Physics: Demonstrate understanding of heat transfer and nuclear physics (90184)

Evidence Statement

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct, provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Italics indicate replacement evidence.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a)	Process – Conduction Heat flows from the hot plate to the bottom of the pot and from the bottom of the pot to other parts of it, without the actual bodily movement of the particles in the material of the pot.	¹ Correct answer for the process or correct explanation.	¹ Conduction, and answer shows an understanding of conduction by stating what conduction is in general terms. (‘absorb’ – not accepted ‘vibrate’ Accept)	¹ Conduction, and answer clearly states what conduction is in relation to the given situation.
1(b)	Process – Convection The water at the bottom of the pot becomes warmer and starts to expand. Its density decreases and rises to the top. The cooler water from the top sinks to replace it. This circulation continues.	¹ Correct answer for the process or correct explanation.	¹ Convection, and answer shows an understanding of convection by stating what convection is in general terms. (Steam/vapour accept)	¹ Convection, and answer clearly states what convection is in relation to the given situation with the idea of density difference causing convection.
1(c)	The lid reduces heat loss by radiation or convection in the air and evaporation.	Loss of heat is reduced so water boils faster.	States evaporation or radiation or convection as the method of heat loss.	States how the lid reduces heat loss by radiation and evaporation.
1(d)	Polished surfaces are bad emitters (radiators) of heat, hence heat lost by radiation is reduced. Dull black surfaces are good emitters of heat, hence heat loss is greater.	¹ Polished surfaces are bad emitters of heat or dull black surfaces are good emitters of heat. Accept polished surface reflects heat energy.	¹ Mention of bad emitters and less heat loss by radiation and compares with a dull surface.	
1(e)	Plastic is a poor conductor of heat, so the pot can be handled safely.	¹ Mentions plastic as a poor conductor (of heat).	¹ Explanation relates poor conduction and safe handling.	
1(f)	$Q = mc\Delta t$ $= 1.5 \times 4200 \times 85 (= 535\,000 \text{ J})$	² Correct, substitution and working.		

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(g)	$Q = mc\Delta t$ $= 0.5 \times 447 \times 95$ $= 21\,232.5 \text{ J}$ <p>Total Energy = 21 232.5 + 53 5500 = 55 6732.5 J</p> $P = \frac{E}{t}$ $= P = \frac{55\,6732.5}{5 \times 60}$ $P = 1856 \text{ W}$	² Correct working for the total energy. OR calculation of 21 232.5 and followed by the correct method of calculating power using time as 5 min.	² Correct working and answer is 111 346.5 W by using time as 5.0 minutes OR calculated power using 21 232.5/300 (=70.78).	² Correct working and answer.
2(a)	$Q = m L \text{ (} Q = mc\Delta t \text{ nothing)}$ $= 0.015 \times 2\,260\,000$ $= 33\,900 \text{ J}$	² Correct, substitution and working		
2(b)	$Q = mc\Delta t$ $= 0.015 \times 4200 \times 15$ $= 945 \text{ J}$ <p>Total = 945 + 33 900 = 34 845 J</p>	² Correct working for 945 J	² Correct working and answer.	
2(c)	$Q = m L \text{ (} Q = mc\Delta t \text{ nothing)}$ $= 0.04 \times 2\,260\,000 = 90\,400 \text{ J}$ $P = \frac{E}{t}$ $t = \frac{90\,400}{600}$ $t = 150.66 \text{ s}$ $t = 2.5 \text{ minutes}$ <p>No Process = nothing</p>	Correct working and answer of 90 400 J	² Correct working and answer is in seconds ie 150.7 s OR Wrong answer for Q but the overall process is correct.	² Correct working and answer.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(a)	Atoms with the same number of protons but a different number of neutrons or mass number.	¹ Correct answer.		
3(b)	²³⁸ U has 92 protons and 146 neutrons.	² Correct answer.		
3(c)	x = 94. Sum of atomic numbers (or protons or charge) before the reaction equals sum of atomic numbers after the reaction.	¹ Correct value of x or correct explanation.	¹ Both value of x and explanation are correct.	
3(d)	y = 3. Sum of mass numbers before the reaction equals sum of mass numbers (or nucleon) after the reaction. Accept neutrons. Atomic mass = nothing	¹ Correct value of y or correct explanation.	¹ Both value of y and explanation are correct.	
3(e)	Correct equation is ${}^{15}_7\text{N} + {}^1_1\text{H} \rightarrow {}^{12}_6\text{C} + {}^4_2\text{He} + \text{energy}$	² Either H or He is correct.	² Values of m and n are calculated correctly	² Both symbols and values are correct.
3(f)	In order to combine nuclei, enormous temperatures are required. These temperatures are similar to that found on the sun – it is difficult to generate these temperatures and to contain the reaction in a suitable vessel.	¹ Enormous temperature (heat or energy) is required.	¹ Explanation states the requirement of higher temperature and the difficulty to produce it/ or containment.	¹ Explanation shows a clear understanding of needing higher temperature and difficulty to generate this and hold the reaction in a contained space on earth.

Judgement Statement**Physics: Demonstrate understanding of heat transfer and nuclear physics (90184)**

The following is a guide to the standard required for each grade in the two criteria.

Criterion 1**Achievement:**

Total of 5 opportunities answered at Achievement (or higher)

5 × A1

Achievement with Merit:

Total of 7 opportunities answered with 5 at Merit level (or higher) **and** 2 at Achievement level

5 × M1 + 2 × A1

Achievement with Excellence:

Total of 8 opportunities answered with 2 at Excellence level **and** 3 at Merit level **and** 2 at Achievement level

2 × E1 + 3 × M1 + 2 × A1

Criterion 2**Achievement:**

Total of 3 opportunities answered at Achievement (or higher)

3 × A2

Achievement with Merit:

Total of 5 opportunities answered with 2 at Merit level (or higher) **and** 3 at Achievement level

2 × M2 + 3 × A2

Achievement with Excellence:

Total of 5 opportunities answered with 1 at Excellence level **and** 2 at Merit level **and** 2 at Achievement level

1 × E2 + 2 × M2 + 2 × A2

Note: For Achievement, at least 1 A1 and 1 A2 must be from each of heat and nuclear

Minimum sufficiency requirement	5 A1s and 3 A2s At least 1 A1 and 1 A2 from each of heat and nuclear	5 M1 and 2 A1 plus 2 M2 and 3 A2	2 E1 and 3 M1 and 2 A1 and 1 E2 and 2 M2 and 2 A2
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Assessment Schedule

Physics: Demonstrate understanding of electricity and magnetism (90185)


Evidence Statement


Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct, provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

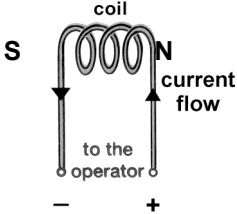
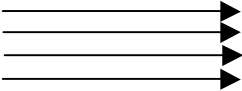
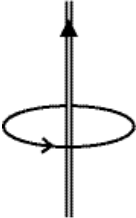
- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Italics indicate replacement evidence.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a)	Negative charge / electrons	¹ Correct answer.		
1(b)	Friction causes charge separation and negative charges (electrons) are transferred to the rod.	¹ (Negative) charges are transferred to the rod during rubbing.	¹ Correct answer implies friction as the cause of charge separation and then transfer of negative (electrons) to the rod. (not protons or positive charges moving)	
1(c)	Copper is a good conductor of charge (electric current) and negative charges (electrons) are conducted away to Mark's hand or to the wool.	¹ Copper is a good conductor of electric current (and it conducts charges).	¹ Achieved PLUS charges transferred to Mark or to the wool.	
1(d)		¹ Correct charge distribution.		
1(e)	Negative charges are induced at the end of the ball closer to the rod. Since opposite charges attract the ball now moves towards the rod.	¹ Explanation mentions separation of charges only OR opposite charges attract.	¹ Explanation involves separation of charges AND the resulting attraction between opposite charges.	
1(f)	When the ball touches the rod, negative charges are transferred to the rod, leaving the ball positively charged. Since like charges repel, the ball repels away from the rod.		¹ When the ball touches the rod, it becomes positively charged. So it repels.	¹ Correct explanation involves of transfer of negative charges and like charges repel. (If positive electrons used in explanation— merit only)

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(g)		¹ Correct answer.		
1(h)	The negative charges (electrons) are transferred from her body to the ball, thereby cancelling out the positive charges in the ball. The ball is now uncharged and no force of repulsion is acting on it. So it is now attracted back to the rod.	¹ <i>The ball becomes neutral.</i>	¹ The negative charges (electrons) are transferred from her body to cancel out the positive charges in the ball.	¹ M plus lack of force of repulsion (If positive electrons used in explanation – merit only).
2(a)	$R = V/I$ $= 12/4.6$ $= 2.6 \text{ ohms}$	² Correct working and answer.		
2(b)	$P = VI$ $= 12 \times 4.6$	² Correct working.		
2(c)	$E = P \times t$ $= 55 \times 2 \times 60$ $= 6600 \text{ J (6624 J for 55.2W)}$		² Correct working and answer.	
2(d)	$I = P/V = 18/12 = 1.5 \text{ A}$ $R = V/I$ $= 12/1.5$ $= 8.0 \text{ ohms}$	² Correct calculation of current.	² Achieved plus correct method but incorrect answer.	² Correct working and answer.
2(e)	Brightness depends on power, which depends on voltage. Fog lamp requires 12 V to produce the maximum power. Since head lamp and fog lamp are in series, 12 V is shared between them, so the power is less.	¹ Explanation implies requirement of 12 V to produce full brightness or sufficient current to produce full brightness.		¹ A clear understanding of the brightness being dependent on power , which depends on the correct voltage.
2(f)	$R_T = R_1 + R_2 = 1.3 + 1.8$ $= 3.1 \text{ ohms}$ $I = V/R = 12/3.1 = 3.87$ $= 3.9 \text{ A}$	² Correct working and answer for the total resistance OR I consistent with wrong R	² Correct working and answer.	
2(g)	$V = IR = 1.8 \times 3.87 / 1.8 \times 3.9$ $= 6.97 / 7.02 (= 7.0) \text{ V}$	² Correct working and answer.		
2(h)	Current through CD $= 18/12$ $= 1.5$ or c from 2(d) Total current $= 3.9 + 1.5 = 5.4 \text{ A}$ $R_{\text{total}} = 12/5.4 = 2.2 \text{ ohms}$		² Correct working and answer for total current.	² Correct working and answer.
2(i)	$I = V/R = 12/3.2 = 3.75 \text{ A}$ $P = VI = 12 \times 3.75 = 45 \text{ W}$ (or $V^2/R = 12^2/3.2$)		² Correct working and answer for current or use of V^2/R .	² Correct working and answer.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(a)		¹ Correct labelling on the coil.		
3(b)		¹ Parallel lines drawn.	¹ Parallel lines drawn AND correct direction or direction correct c with 3(a).	
3(c)	When the switch is closed, the current passes through the coil which results in a magnetic field. The field then attracts the iron bar towards the coil, thereby unlocking the door.	¹ Mention of a magnetic field appearing.	¹ Current in coil; coil magnetised; iron bar attracted.	
3(d)		¹ Correct shape, circular or elliptical.	¹ Correct shape and direction.	
3(e)	$B = \frac{1.26 \times 10^{-6} \times 5.0}{2\pi \times 0.30}$ $= 3.3 \times 10^{-6}$	² Correct working but used d as 30 cm. 3.3×10^{-8}	² Correct working and answer.	
	Unit: Tesla	¹ Tesla or T		

Judgement Statement

Physics: Demonstrate understanding of electricity and magnetism (90185)

The following is a guide to the standard required for each grade in the two criteria.

Achievement:

Total of 9 opportunities answered at Achievement (or higher) with at least 3 from each criterion

Min $3 \times A1 + 3 A2$ **and** Total of 9A

Achievement with Merit:

Total of 9 opportunities answered with at least 3 at Merit level (or higher) from each criterion **and** a total of 7 at Merit level, plus 2 at Achievement level

Min $3 \times M1 + 3 \times M2$ **and** Total of 7M plus 2A

Achievement with Excellence:

Total of 9 opportunities answered with at least 1 at Excellence level from each criterion **and** a total of 3 at Excellence level, plus 4 at merit level **and** 2 at Achievement level

Min $1 \times E1 + 1 \times E2$ **and** Total of 3E plus 4M + 2A