# Assessment schedule: practice paper 2026

AS 92047 Demonstrate understanding of a physical system using energy concepts · Vertex Academy practice paper, not an NZQA paper

## QUESTION ONE

| Part | Evidence | Achievement (u) | Merit (r) | Excellence (t) |
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| (a) | top: Ep greatest, Ek = 0<br>rolling down: Ep → Ek<br>some Ep → thermal energy and sound<br>energy is not created or destroyed, only transformed or transferred<br>Ep → Ek + thermal + sound; total energy stays the same | Describes Ep being transformed into Ek AND some energy becoming thermal energy (heat) or sound. States that energy cannot be created or destroyed, only transformed or transferred. | | |
| (b) | Ep = mgh = 90 × 10 × 25<br>Ep = 22 500 J<br>P = E ÷ t = 22 500 ÷ 75<br>P = 300 W<br>motor also lifts the chair; friction → thermal energy and sound<br>Ep = 22 500 J; P = 300 W; the motor uses more because of the chair's Ep and energy lost as heat and sound | Correct formula for Ep or power with some correct numbers substituted. OR Mentions energy being lost as heat or sound. | Both calculations correct (22 500 J and 300 W) with working; units not required. OR Explains that some electrical energy is transformed into thermal energy (heat) or sound by friction in the motor or cable, or used to lift the chair. | |

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| (c) | Ep = mgh = 90 × 10 × 25 = 22 500 J<br>assume all Ep → Ek (no friction or air resistance)<br>22 500 = $(\frac{1}{2})$ × 90 × v², so v² = 500<br>v = √500 = 22.4 m s⁻¹<br>Ek = $(\frac{1}{2})$ × 90 × 12.0² = 6480 J<br>22 500 − 6480 = 16 020 J<br>F = W ÷ d = 16 020 ÷ 400 = 40 N<br>6480 ÷ 22 500 × 100 = 28.8%<br>Greatest speed 22.4 m s⁻¹; actual Ek 6480 J; 16 020 J to heat and sound; average resistive force about 40 N | Correct formula for Ek or Ep with some values substituted. OR Assumes all Ep is transformed into Ek. OR States that the real speed will be less because of friction or air resistance. | Calculates the speed with a minor error (for example v² = 500 m² s⁻² without the square root, or a missing or wrong unit). OR Calculates the actual Ek (6480 J) and the energy transformed (16 020 J). OR Explains that the cart is slower because energy is transformed into thermal energy (heat) or sound by friction or air resistance. | Correct greatest speed (22.4 m s⁻¹) with unit AND the assumption that all Ep becomes Ek, AND correct energy transformed (16 020 J) and average force (about 40 N), AND discusses how friction and air particles hitting the cart transform kinetic energy into thermal energy and sound, so the cart cannot reach the calculated speed. |
| (d) | Ek = $(\frac{1}{2})$ × 90 × 12.0² = 6480 J<br>W = Ek = 6480 J<br>F = W ÷ d = 6480 ÷ 8.0 = 810 N<br>Ek → thermal energy (brakes, wheels, track) + sound<br>Ek = $(\frac{1}{2})$ × 90 × 18.0² = 14 580 J<br>d = W ÷ F = 14 580 ÷ 810 = 18 m<br>(18.0 ÷ 12.0)² = 1.5² = 2.25<br>F = 810 N; stopping distance 18 m, 2.25 times longer because Ek depends on v² | Correct Ek formula with some values substituted. OR States that the kinetic energy becomes thermal energy (heat) or sound. | Correct braking force (810 N) with working. OR Correct stopping distance (18 m) for the faster rider. OR Explains that friction in the brakes transforms the kinetic energy into thermal energy. | Correct braking force (810 N) AND stopping distance (18 m) with units, AND discusses that Ek depends on v², so 1.5 times the speed gives 2.25 times the energy and stopping distance, with a consequence for the run-out or the brakes. |

## QUESTION TWO

| Part | Evidence | Achievement (u) | Merit (r) | Excellence (t) |
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| (a) | electrical energy → light energy + thermal energy<br>filament bulb: mostly thermal energy<br>LED: more light, less thermal energy<br>1 W = 1 J each second<br>Electrical → light + heat in both; 60 W means 60 J transformed each second | Describes electrical energy being transformed into light AND thermal energy (heat). States that 60 W means 60 J of energy is transformed (used) each second. | | |
| (b) | P = VI, so I = P ÷ V<br>I = 2400 ÷ 240 = 10 A<br>V = IR, so R = V ÷ I<br>R = 240 ÷ 10 = 24 Ω<br>I = 10 A, R = 24 Ω | Correct formula (P = VI or V = IR) with some correct numbers substituted. | Both answers correct (10 A and 24 Ω) with working AND correct units. | |
| (c) | t = 5 × 90 = 450 h<br>filament: E = 0.060 kW × 450 h = 27 kWh<br>LED: E = 0.008 kW × 450 h = 3.6 kWh<br>filament cost = 27 × $0.34 = $9.18<br>LED cost = 3.6 × $0.34 = $1.22<br>saving = $9.18 − $1.22 = $7.96<br>filament efficiency = 5 ÷ 60 × 100% = 8.3%<br>LED efficiency = 5 ÷ 8 × 100% = 62.5%<br>filament wastes 55 W as heat; LED wastes 3 W<br>Choose the LED: 3.6 kWh ($1.22) against 27 kWh ($9.18), saving $7.96; efficiency 62.5% against 8.3% | Correct formula E = Pt with some values substituted. OR States that the filament bulb wastes more energy as heat. OR Calculates the time as 450 h. | Correct energy for both bulbs (27 kWh and 3.6 kWh) OR correct costs ($9.18 and $1.22). OR Correct efficiency for both bulbs. OR Explains that the LED transforms more of its electrical energy into light and less into heat. | Correct energies, costs and saving ($7.96) AND correct efficiencies (8.3% and 62.5%), AND discusses that both give the same light output, so the LED's smaller heat loss means it needs less electrical energy, linking higher efficiency to lower cost. |
| (d) | high: I = 240 ÷ 24 = 10 A<br>high: P = 240 × 10 = 2400 W<br>low: I = 240 ÷ 48 = 5 A<br>low: P = 240 × 5 = 1200 W<br>t = 2 × 60 × 60 = 7200 s<br>high: E = 2400 × 7200 = 17 280 000 J<br>low: E = 1200 × 7200 = 8 640 000 J<br>R doubles, V fixed → I halves → P halves → E halves in the same time<br>High 17.28 MJ, low 8.64 MJ: doubling R halves I, P and the thermal energy released | Correct formula with some values substituted. OR States that electrical energy is transformed into thermal energy. OR States that a higher resistance gives a smaller current. | Correct current and power on both settings. OR Correct thermal energy on one setting. OR Explains that the smaller current gives a smaller power because P = VI. | Correct current, power and thermal energy on both settings with units, AND discusses the chain: R doubles with V fixed, so I halves (I = V ÷ R), so P halves (P = VI), so E halves in the same time (E = Pt). |

## QUESTION THREE

| Part | Evidence | Achievement (u) | Merit (r) | Excellence (t) |
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| (a) | latent heat of fusion = energy to melt 1 kg with no temperature change<br>ice: particles in fixed positions, held by bonds, vibrating<br>energy taken in breaks bonds; particles move past each other<br>average kinetic energy unchanged<br>Energy melts 1 kg without a temperature change; during melting it breaks bonds, so the temperature stays at 0 °C | Correct definition of specific latent heat of fusion. Describes energy breaking the bonds (forces) between particles so the temperature stays the same while the ice melts. | | |
| (b) | $\Delta T = 100 - 15 = 85$ °C<br>$E = mc\Delta T = 1.5 \times 4200 \times 85 = 535\,500$ J<br>$t = 4 \times 60 + 30 = 270$ s<br>$E = Pt = 2200 \times 270 = 594\,000$ J<br>$594\,000 - 535\,500 = 58\,500$ J<br>Water gains 535 500 J; the jug uses 594 000 J; 58 500 J heats the jug and surroundings | Correct formula ($E = mc\Delta T$ or $E = Pt$) with some correct numbers substituted. OR Mentions energy lost as heat to the jug or surroundings. | Both calculations correct (535 500 J and 594 000 J) with working; units not required. OR Explains that some electrical energy heats the jug or is lost to the surroundings (or as steam or sound), so the water gains less. | |
| (c) | temperature constant at 0 °C from 40 s to 640 s<br>$t = 640 - 40 = 600$ s<br>$E = Pt = 100 \times 600 = 60\,000$ J<br>$L = E \div m = 60\,000 \div 0.200 = 300\,000$ J kg$^{-1}$<br>$0.200 \times 334\,000 = 66\,800$ J needed<br>room 20 °C, ice 0 °C → heat flows in by conduction, convection, radiation<br>Melting took 600 s; $L = 300\,000$ J kg$^{-1}$, about 10% low because the room also heated the ice | Selects $E = mL$ or $E = Pt$. OR Identifies the flat section at 0 °C as melting. OR States a reason the value is different (heat from the room, or an equipment or reading error). | Calculates a value for L with a minor error (wrong time, energy or mass) OR the correct value with a missing or wrong unit. OR Explains that the ice also gained heat from the warmer room, so less heater energy was needed. | Correct melting time (600 s) AND $L = 300\,000$ J kg$^{-1}$ with unit, AND discusses that heat flowed from the warmer room into the cup by conduction, convection or radiation, so the heater supplied less energy than melting really needs and the calculated value is too low. |

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| (d) | water: E = 2.0 × 4200 × 6 = 50 400 J<br>ice: E = 2.0 × 334 000 = 668 000 J<br>ice total = 668 000 + 50 400 = 718 400 J<br>water: t = 50 400 ÷ 20 = 2520 s = 42 min<br>ice: t = 718 400 ÷ 20 = 35 920 s ≈ 10 h<br>718 400 ÷ 50 400 ≈ 14<br>foam: trapped air limits conduction and convection; white: reflects radiation; lid: stops convection<br>Ice packs: 718 400 J, about 10 h; water: 50 400 J, 42 min. Melting absorbs most of the energy | Correct formula (E = mcΔT, E = mL or E = Pt) with some values substituted. OR States that melting ice absorbs energy without a temperature change. OR Links one feature of the chilly bin to a type of heat transfer. | Correct energy for both choices (50 400 J and 718 400 J) OR correct times for both. OR Explains how the foam walls reduce conduction (trapped air is a poor conductor) or how the white outside or the lid reduces heat transfer. | Correct energies AND times (42 min and about 10 h) with units, AND discusses that the latent heat absorbed while melting keeps the temperature at 0 °C much longer, AND explains how the foam, white outside and lid reduce conduction, convection and radiation, linking a smaller heat leak to a longer safe time. |

## Judgement for each question

| N0 | N1 | N2 | A3 | A4 | M5 | M6 | E7 | E8 |
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| No response; no relevant evidence. | One Achievement point. | Two Achievement points. | Three Achievement points. | Four Achievement points. | Two Merit points. | Three Merit points. | One Excellence point and one Merit point. | Two Excellence points. |

Grade score out of 24 (each question's grade: N0 = 0 to E8 = 8): Not Achieved 0 to 6, Achieved 7 to 12, Merit 13 to 18, Excellence 19 to 24 (the 2025 exam's cut scores).