Neap

Final Examination 2022

NSW Year 11 Physics

Solutions and Marking Guidelines

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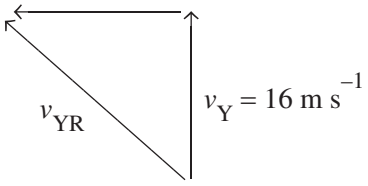
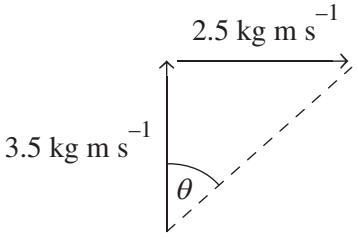
SECTION I

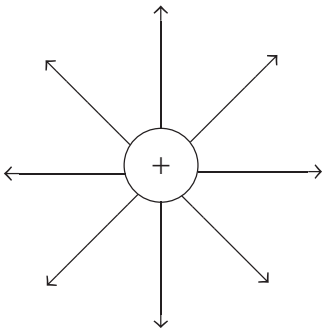
Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 1 **B** $v = \frac{d}{t}$ $= \frac{100}{9.58}$ $= 10.4 \text{ m s}^{-1}$	Mod 1 Kinematics PH11–8 Bands 2–3
Question 2 **A** $\vec{a} = \frac{\vec{F}_{\text{net}}}{m}$ $= \frac{13}{5}$ $= 2.6 \text{ m s}^{-2}$	Mod 2 Dynamics PH11–9 Bands 2–3
Question 3 **C** **C** is correct. A sound wave is longitudinal and requires a medium (thus, it is mechanical). **A** is incorrect. A sound wave is mechanical but not transverse. **B** is incorrect. A sound wave is neither transverse nor electromagnetic. **D** is incorrect. A sound wave is longitudinal but not electromagnetic.	Mod 3 Waves and Thermodynamics PH11–10 Bands 2–3
Question 4 **A** $q = \frac{\vec{F}}{\vec{E}}$ $= \frac{0.1}{1.0}$ $= 0.1 \text{ C}$	Mod 4 Electricity and Magnetism PH11–11 Bands 2–3
Question 5 **C** **C** is correct. Using the right-hand grip rule, all the magnetic field lines around the conducting wire must be in a clockwise direction. **A**, **B**, and **D** are incorrect. These diagrams do not show all the magnetic field lines in a clockwise direction.	Mod 4 Electricity and Magnetism PH11–7, 11–11 Bands 2–3
Question 6 **C** $t = \frac{d}{v}$ $= \frac{2 \times 3000}{340}$ $= 17.6 \text{ s}$	Mod 1 Kinematics PH11–8 Bands 3–4

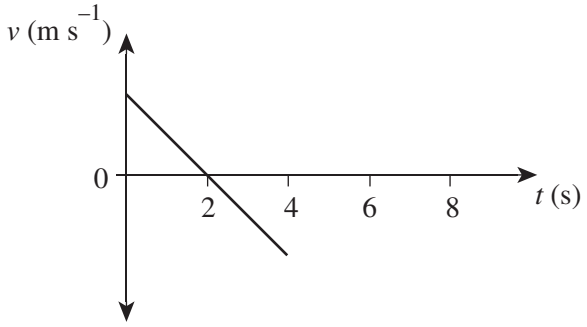
Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 7 **B** **B** is correct. The loud sound indicates that the frequency of the tuning fork matches the natural frequency of the glass, resulting in resonance. **A**, **C**, and **D** are incorrect. Diffraction, dispersion and refraction are all known wave behaviours, but they are not responsible for the loud sound that is heard.	Mod 3 Waves and Thermodynamics PH11–6, 11–10 Bands 3–4
Question 8 **C** **C** is correct. $\Delta U = Vq$ $= 10 \times \left(1.602 \times 10^{-19}\right)$ $= 1.602 \times 10^{-18}$ J **A** and **B** are incorrect. The magnitude of energy is not 10. **D** is incorrect. Joules per coulomb (J C^{-1}) is equivalent to volts (V).	Mod 4 Electricity and Magnetism PH11–11 Bands 3–4
Question 9 **D** **D** is correct. According to Newton's Third Law of Motion, the force of the bullet on the boulder and the force of the boulder on the bullet must be equal and opposite. Their subsequent motion is due to the significant difference in mass. The boulder has a much greater mass than the bullet. The result is that the boulder does not move, while the bullet slows down and changes direction. **A**, **B**, and **C** are incorrect. The force interaction between the bullet and the boulder is equal in magnitude.	Mod 2 Dynamics PH11–6, 11–9 Bands 3–4
Question 10 **B** $n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\theta_1 = \text{angle of incidence}$ $= 90 - 43$ $= 47°$ $1.00 \times \sin 47 = 1.60 \times \sin\theta_2$ $\theta_2 = \sin^{-1}\left(\frac{1.00 \times \sin 47}{1.60}\right)$ $y = 27°$	Mod 3 Waves and Thermodynamics PH11–4, 11–10 Bands 4–5

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 11 **B** $F \propto \frac{q_1 q_2}{r^2}$ $F = \frac{0.6 \times 1}{2^2}$ $= 0.15$ Therefore, the new magnitude of the repulsive force is $0.15F$ newtons.	Mod 4 Electricity and Magnetism PH11–1, 11–11 Bands 4–5
Question 12 **D** $Q = mc\Delta T$ specific heat capacity of water, $c = 4.18 \times 10^3$ J kg^{-1} K^{-1} density of water, $\rho = 1.00 \times 10^3$ kg m^{-3} 140 L = 140 kg $\Delta T = 65 - 20$ $= 45°C$ $Q = 140 \times (4.18 \times 10^3) \times 45$ $= 2.6 \times 10^7$ J	Mod 3 Waves and Thermodynamics PH11–10 Bands 5–6
Question 13 **B** starting height when falling in a vacuum: $s = ut + \frac{1}{2}at^2$ $= \frac{1}{2} \times 9.8 \times 3.2^2$ $= 50$ m difference in height $= 50 - 10$ $= 40$ m	Mod 1 Kinematics PH11–2, 11–8 Bands 5–6

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 14 D **D** is correct, and **A** and **C** are incorrect. $v_{YR} = v_Y + (-v_R)$ $-v_R = 19 \text{ m s}^{-1}$  $v_{YR} = \sqrt{19^2 + 16^2}$ $= 25 \text{ m s}^{-1}$ $\tan\theta = \frac{19}{16}$ $\theta = \tan^{-1}\left(\frac{19}{16}\right)$ $= 50°$ $v_{YR} = 25 \text{ m s}^{-1}$ N50°W **B** is incorrect. The red motorbike is heading east. Therefore, the yellow motorbike is heading west relative to the red motorbike.	Mod 1 Kinematics PH11–6, 11–8 Bands 5–6
Question 15 B Due to conservation of momentum, piece *C* must have a component of its momentum as 2.5 kg m s^{-1} east, and the other component must be 3.5 kg m s^{-1} north. magnitude of the momentum of piece $C = \sqrt{2.5^2 + 3.5^2}$ $= 4.3 \text{ kg m s}^{-1}$ direction of the momentum of piece *C*:  $\tan\theta = \frac{2.5}{3.5}$ $\theta = \tan^{-1}\left(\frac{2.5}{3.5}\right)$ $= 36°$ The magnitude and direction of the momentum of piece *C* is 4.3 kg m s^{-1} N36°E.	Mod 2 Dynamics PH11–4, 11–9 Bands 4–5

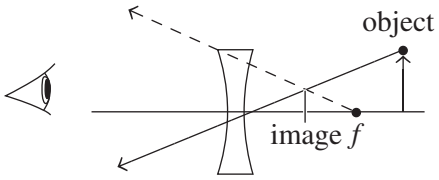
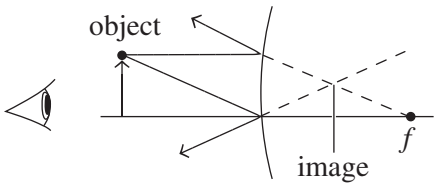
SECTION II

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 16	
$P = Fv$ $= F\left(\frac{at}{2}\right)$ $= 40\left(\frac{2\times 10}{2}\right)$ $= 400$ W	Mod 1 Kinematics Mod 2 Dynamics PH11–8, 11–9 Bands 2–4 • Calculates the power exerted on the box . . . . . .2 • Provides some relevant working . . .1
Question 17	
$d = \frac{V}{E}$ $= \frac{12}{40}$ $= 0.3$ m	Mod 4 Electricity and Magnetism PH11–11 Bands 2–3 • Calculates the distance between the plates . . . . . .2 • Provides some relevant working . . .1
Question 18	
	Mod 4 Electricity and Magnetism PH11–7, 11–11 Bands 2–4 • Draws evenly spaced radiating lines. AND • Draws each line with an arrowhead pointing away from the particle . . . . . .2 • Any ONE of the above points 1
Question 19	
(a) $\Delta U = mg\Delta h$ $= 86.0\times 9.8\times(1912-283)$ $= 1.37\times 10^6$ J	Mod 2 Dynamics PH11–9 Bands 2–4 • Calculates the gain in gravitational potential energy . . . . .2 • Calculates the gravitational potential energy at one of the locations. 1

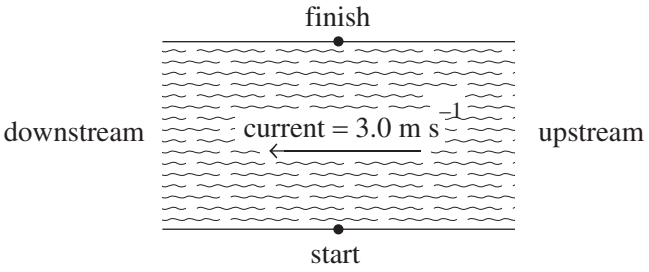
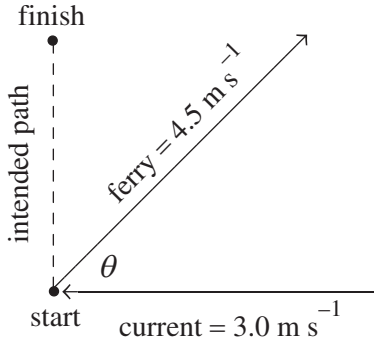
Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(b) difference in height between the top of Mont Ventoux and the spectator's location $= 1912 - 1876$ $= 36$ m **Method 1:** $mg\Delta h = \frac{1}{2}mv^2$ $2 \times 9.8 \times 36 = v^2$ $v = \sqrt{705.6}$ $= 26.6 \text{ m s}^{-1}$ **Method 2:** Using kinematic equations gives: $v^2 = u^2 + 2as$ $v = \sqrt{2as}$ $= \sqrt{2 \times 9.8 \times 36}$ $= 26.6 \text{ m s}^{-1}$	Mod 1 Kinematics Mod 2 Dynamics PH11–8, 11–9 Bands 3–4 • Calculates the cyclist's speed when they pass the spectator . . . . . 2 • Provides some relevant working . . . 1
Question 20	
	Mod 1 Kinematics PH11–8 Bands 3–4 • Draws the graph with the correct shape. AND • Shows the *x*-intercept at two seconds . . . . . 2 • Any ONE of the above points 1
Question 21	
(a) $E = Pt$ $= \left(\frac{1200 + 600}{2}\right) \times 100$ $= 9.00 \times 10^4 \text{ J}$	Mod 4 Electricity and Magnetism PH11–5, 11–11 Bands 3–5 • Calculates amount of energy used by the device . . . . . 2 • Provides some relevant working . . . 1
(b) $P = VI$ $I = \frac{900}{120}$ $= 7.50 \text{ A}$ *Note: Consequential on answer to* ***Question 21(a)****.*	Mod 4 Electricity and Magnetism PH11–11 Bands 2–4 • Calculates the average current drawn by the device . . . . . 2 • Provides some relevant working . . . 1

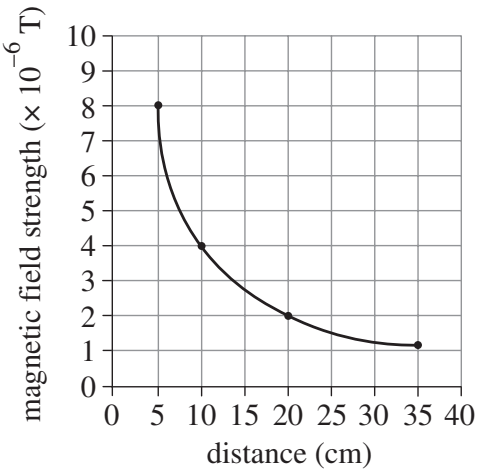
Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 22	
(a) $F_{\text{net}} = \text{total upwards force} - \text{weight}$ $= (2 \times 33.5) - (6 \times 9.8)$ $= 8.2 \text{ N}$ $\vec{a} = \frac{\vec{F}_{\text{net}}}{m}$ $= \frac{8.2}{6}$ $= 1.3667$ $\approx 1.37 \text{ m s}^{-2}$	Mod 2 Dynamics PH11–9 Bands 4–5 • Calculates the net force. AND • Calculates the magnitude of the acceleration . . . . . .2 • Any ONE of the above points 1
(b) When the packages are at rest, the force applied by the 3.50 kg package to the 2.50 kg package must be equivalent to the weight of the 2.50 kg package. When the packages are accelerating upwards, there must be an *additional* force applied to the 2.50 kg package by the 3.50 kg package for this motion to occur.	Mod 2 Dynamics PH11–6, 11–9 Bands 4–5 • Explains that the force applied by the 3.50 kg package to the 2.50 kg package at rest is equivalent to the weight of the 2.50 kg package. AND • Explains that there must be an additional force applied by the 3.50 kg package to the 2.50 kg package for the system to accelerate upwards. . . . . .2 • Any ONE of the above points 1
Question 23	
(a) $n_x = \frac{c}{v_x}$ $1.33 = \frac{3.00 \times 10^8}{v_x}$ $v_x = 2.26 \times 10^8 \text{ m s}^{-1}$	Mod 3 Waves and Thermodynamics PH11–10 Bands 3–4 • Calculates the speed of the laser beam through the water 1
(b) $\sin\theta_c = \frac{n_2}{n_1}$ $\theta_c = \sin^{-1}\left(\frac{1.00}{1.33}\right)$ $= 48.8°$	Mod 3 Waves and Thermodynamics PH11–10 Bands 3–5 • Calculates the angle of incidence . . . . . .2 • Provides some relevant working . . .1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 24	
(a) $I_1 r_1^2 = I_2 r_2^2$ $(1.8\times10^{-2})\times2^2 = (2.0\times10^{-3})\times r_2^2$ $r_2 = \sqrt{\frac{(1.8\times10^{-2})\times2^2}{(2.0\times10^{-3})}}$ $= 6$ metres $6 - 2 = 4$ metres (further away from point X)	Mod 3 Waves and Thermodynamics PH11–10 Bands 4–5 • Calculates how much further away from point X the sound intensity would be measured . . . . . 3 • Calculates the distance from the stage where the sound intensity would be measured . . . . . 2 • Provides some relevant working . . . 1
(b) $P = IA$ $= I4\pi r^2$ $= (1.8\times10^{-2})\times(4\times\pi\times2^2)$ $= 0.9$ W	Mod 4 Electricity and Magnetism PH11–11 Bands 4–5 • Calculates the power output . . . . . 2 • Provides some relevant working . . . 1
Question 25	
As the child slides down the plastic slide, the friction between the child and the slide allows for a net transfer of charge (electrons) between them. This results in the child becoming electrically charged.	Mod 3 Waves and Thermodynamics PH11–6, 11–10 Bands 4–5 • Explains how the net transfer of electrons between the child and the slide, as a result of friction, leads to the child becoming electrically charged . . . . . 3 • Describes how the friction between the child and the slide results in a net transfer of charge between them . . . . . 2 • Provides some relevant information 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 26	
Mirrors reflect light off their surface, whereas lenses refract light as it passes through the lens material. Convex mirrors cause light rays to diverge when they are reflected. It does not matter where an object is placed relative to a convex mirror as the mirror will always produce a virtual image that is upright and smaller than the object. Concave lenses cause light rays to diverge when they are refracted. As with convex mirrors, it does not matter where an object is placed relative to a concave lens as the lens will always produce an image that is virtual, upright, and smaller than the object. concave lens  convex mirror  *Note: Diagrams are not required but may be used to support the response.*	Mod 3 Waves and Thermodynamics PH11–10 Bands 3–5 • Identifies that mirrors reflect light. AND • Identifies that lenses refract light. AND • Outlines that convex mirrors and concave lenses always, regardless of object location, produce an image that is virtual, upright and smaller than the object . . . . . .4 • Identifies that mirrors reflect light. AND • Identifies that lenses refract light. AND • Outlines that convex mirrors and concave lenses always, regardless of object location, produce the same type of image as one another . . . . . .3 • Identifies that mirrors reflect light AND that lenses refract light. OR • Outlines that convex mirrors and concave lenses always, regardless of object location, produce the same type of image as one another . . . . . .2 • Provides some relevant information 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 27	
Louise should measure the length of the piece of resistance wire using a ruler. After switching on the power supply at a set voltage, she should measure and record the amount of current within the circuit using the ammeter. She should also measure and record the voltage drop across the wire using the voltmeter. Using Ohm's Law ($V = IR$), she should then calculate the resistance of the wire. Louise should then repeat these steps with varied lengths of resistance wire and plot her final results in a graph (resistance against length) to determine the relationship between resistance and length.	Mod 4 Electricity and Magnetism PH11–1, 11–7, 11–11 Bands 3–6 • Identifies that the length of wire should be varied and how each length of wire should be measured. AND • Outlines how the current and voltage should be measured. AND • Outlines how resistance should be calculated. AND • Identifies how the relationship between resistance and length will be determined. AND • Identifies a relevant controlled variable. . . . . .5 • Any FOUR of the above points . . . .4 • Any THREE of the above points . . .3 • Any TWO of the above points. . . . .2 • Any ONE of the above points 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 28	
The scenario can be represented diagrammatically.   **Method 1:** $\cos(\theta) = \frac{3.0}{4.5}$ $\theta = \cos^{-1}\left(\frac{3.0}{4.5}\right)$ $= 48°$ The ferry would need to be directed upstream at an angle of 48° from the edge of the river bank. **Method 2:** $\sin(\theta) = \frac{3.0}{4.5}$ $\theta = \sin^{-1}\left(\frac{3.0}{4.5}\right)$ $= 42°$ The ferry would need to be directed upstream at an angle of 42° from perpendicular to the edge of the river bank. *Note: Accept responses that obtain different yet correct angles if an appropriate reference point is provided. Diagrams are not required as part of the response but may assist working.*	Mod 1 Kinematics PH11–6, 11–8 Bands 3–5 • Identifies that the ferry should be directed upstream at an angle. AND • Calculates the angle. AND • Provides an appropriate reference point for the angle . . . . . .4 --- • Identifies that the ferry should be directed upstream at an angle. AND • Calculates an associated angle with an omission or error. . . . . .3 --- • Identifies that the ferry should be directed upstream at an angle . . .2 --- • Provides some relevant information 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 29	
(a) 	Mod 4 Electricity and Magnetism PH11–5, 11–11 Bands 4–6 • Labels axes, including units. AND • Uses an appropriate scale. AND • Plots the data points. AND • Draws a line of best fit. . . . . .4 • Any THREE of the above points. . .3 • Any TWO of the above points. . . . .2 • Any ONE of the above points 1
(b) Magnetic field strength is inversely proportional to distance.	Mod 4 Electricity and Magnetism PH11–5, 11–11 Bands 4–5 • Determines the mathematical relationship between magnetic field strength and distance . . . . . .2 • Provides some relevant information 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 30	
Conduction is the process whereby heat is transferred within and between materials that are in contact with each another. Bulk motion of particles does not occur in this process. Despite still occurring via the neck and lid of the vacuum flask, heat transfer via conduction from the hot water inside the flask to the external environment would be significantly reduced. This is because there are no particles in the vacuum space. Convection is the process whereby heat is transferred from one place to another due to the net movement of particles in fluids. Since there are no fluids contained in the space between the internal and external walls of the flask, heat transfer via convection would only occur if the lid was removed. Unlike conduction and convection, radiation does not require the movement of matter. It involves the transfer of heat via the emission and absorption of electromagnetic radiation. All objects absorb and emit electromagnetic radiation. Given that this method does not rely upon the movement of particles, heat transfer via radiation will still occur between the internal and external walls of the container. However, it would be significantly reduced as the reflective material would allow for minimal absorption of electromagnetic waves. The vacuum space and reflective walls significantly reduce the rate of heat transfer via conduction, convection and radiation. This allows the water to maintain its high temperature for an extended period of time.	Mod 3 Waves and Thermodynamics PH11–7, 11–10 Bands 4–6 • Explains why the vacuum space reduces the rate of heat transfer via conduction and convection. AND • Explains why the reflective walls reduce the rate of heat transfer via radiation. AND • Provides a clear and concise response that comprehensively explains the relevant factors . . . . . .6 • Explains why the vacuum space reduces the rate of heat transfer via conduction and convection. AND • Explains why the reflective walls reduce the rate of heat transfer via radiation . . . . . .5 • Explains why the vacuum space reduces the rate of heat transfer via conduction and convection. OR • Explains why the reflective walls reduce the rate of heat transfer via radiation . . . . . .4 • Describes the THREE processes of heat transfer. OR • Outlines how the vacuum space AND reflective walls reduce the rate of heat transfer . . . . . .3 • Describes at least ONE process of heat transfer. OR • Outlines how the vacuum space OR reflective walls reduce the rate of heat transfer . . . . . .2 • Provides some relevant information 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 31	
Method 1: $v^2 = u^2 + 2as$ $v^2 = 10^2 + 2 \times -9.8 \times -80$ $v^2 = 1668$ $v = \sqrt{1668}$ $= 40.8412 \text{ m s}^{-1}$ down $= -40.8412 \text{ m s}^{-1}$ $v = u + at$ $-40.8412 = 10 - 9.8t$ $t = \frac{-50.8412}{-9.8}$ $= 5.2$ seconds **Method 2:** $s = ut + \frac{1}{2}at^2$ $-80 = 10t - 4.9t^2$ $4.9t^2 - 10t - 80 = 0$ $a = 4.9,\ b = -10,\ c = -80$ $t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-(-10) \pm \sqrt{(-10)^2 - (4 \times 4.9) \times (-80)}}{2 \times 4.9}$ $= \frac{10 \pm \sqrt{1668}}{9.8}$ $= 5.2, -3.2$ Taking the positive value gives $t = 5.2$ seconds.	Mod 1 Kinematics PH11–4, 11–8 Bands 4–6 • Calculates the time it will take for the coin to hit the ground . . . . . 4 • Calculates the time it will take for the coin to hit the ground with ONE omission or error . . . . . 3 • Makes significant progress attempting to calculate the time it will take for the coin to hit the ground. . . . . 2 • Provides some relevant working . . . 1