

# JABstem

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Past Papers

# Nat 5

# Physics

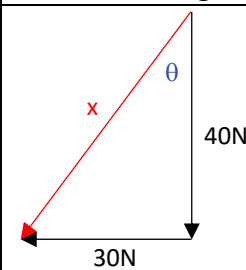
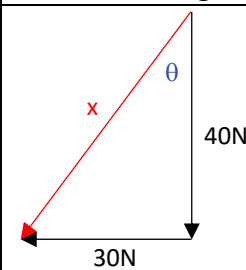
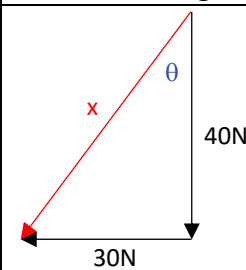
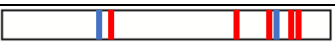
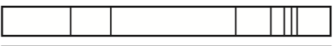
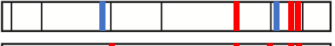
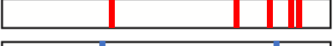
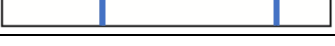
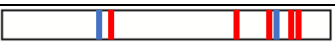
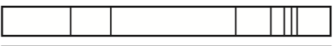
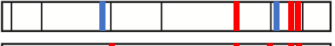
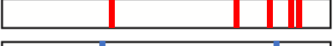
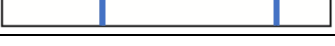
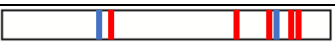
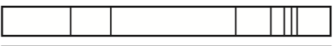
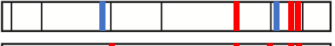
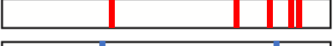
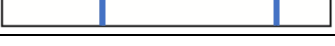
# 2017 Marking Scheme

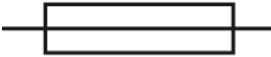
Grade Awarded	Mark Required (/100)	% candidates achieving grade
A	68+	31.7%
B	56+	21.5%
C	45+	20.0%
D	39+	9.4%
No award	<39	17.5%

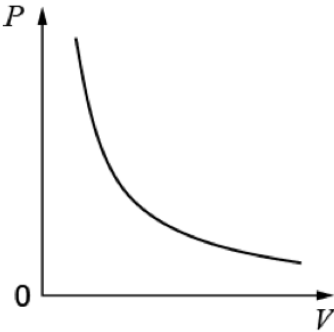
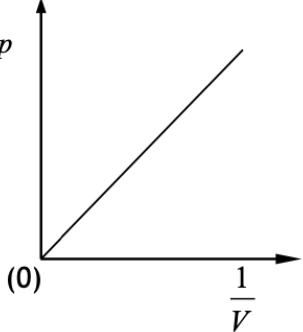
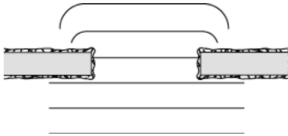
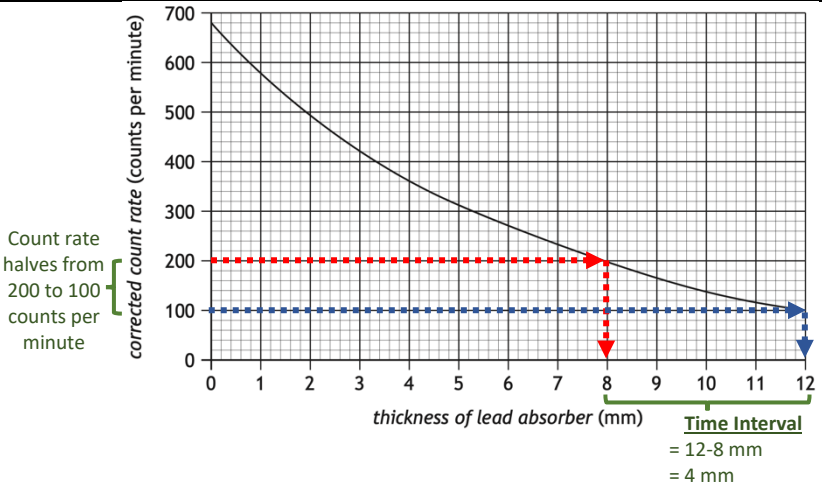
Section:	Multiple Choice	Extended Answer	Assignment
Average Mark:	11.9 /20	31.7 /60	13.5 /20

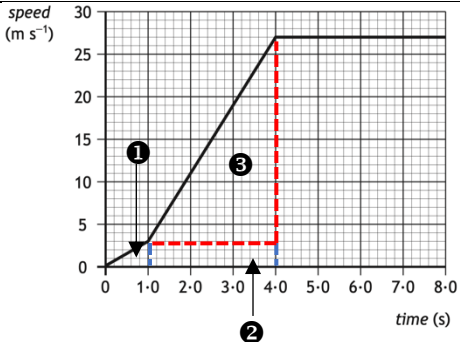
# 2017 Nat5 Physics Marking Scheme

Question	Answer	Physics Covered																																
1	A	The kinetic energy is at its greatest when velocity is at its greatest due to the equation $E_k = \frac{1}{2}mv^2$ . <ul style="list-style-type: none"> <li>• The mass of cyclist &amp; cycle will be constant</li> <li>• the greater the velocity the greater the kinetic energy</li> </ul>																																
2	D	Current in branch with lamp = $A_1 - A_2 = 5.0A - 2.0A = 3.0A$ $Q = ?$ <span style="float: right;"><math>t = 30\text{ s}</math></span> $Q = I t$ $Q = 3.0 \times 30$ $Q = 90\text{ C}$																																
3	A	<input checked="" type="checkbox"/> A Voltage is constant & current decreases $\therefore$ resistance must <i>increase</i> if $R = \frac{V}{I}$ <input checked="" type="checkbox"/> B Voltage is constant & current decreases $\therefore$ resistance must <i>increase</i> if $R = \frac{V}{I}$ <input checked="" type="checkbox"/> C Current <i>decreases</i> from 0.4A to 0.2A between 0.05 s to 0.45s <input checked="" type="checkbox"/> D Current <i>decreases</i> from 0.4A to 0.2A between 0.05 s to 0.45s <input checked="" type="checkbox"/> E Current <i>decreases</i> from 0.4A to 0.2A between 0.05 s to 0.45s																																
4	E	<input checked="" type="checkbox"/> A The <i>battery</i> supplies energy to the circuit <input checked="" type="checkbox"/> B The <i>variable resistor</i> increasing in resistance will decrease the voltage across $R_1$ <input checked="" type="checkbox"/> C The <i>motor</i> changes electrical energy into kinetic energy <input checked="" type="checkbox"/> D The transistor will only supply energy to the motor only when the transistor is switched on <input checked="" type="checkbox"/> E The <i>transistor</i> will switch on the motor when the voltage is correct																																
5	B	<input checked="" type="checkbox"/> A The copper block should be insulated to give a more accurate value of specific heat capacity <input checked="" type="checkbox"/> B The thermometer is in the copper block and the block is insulated <input checked="" type="checkbox"/> C The copper block should be insulated to give a more accurate value of specific heat capacity <input checked="" type="checkbox"/> D The copper block should be insulated to give a more accurate value of specific heat capacity <input checked="" type="checkbox"/> E The reading on the thermometer will only be accurate if the thermometer is in the block when read																																
6	D	$W = ?$ <span style="float: right;"><math>g = 5.0\text{ N kg}^{-1}</math></span> $m = 1200\text{ kg}$ $W = m \times g$ $W = 1200 \times 5.0$ $W = 6000\text{ N}$ $P = ?$ <span style="float: right;"><math>A = 1.5\text{ m}^2</math></span> $F = 6000\text{ N}$ $P = \frac{F}{A} = \frac{6000}{1.5} = 4000\text{ Pa} = 4.0 \times 10^3\text{ Pa}$																																
7	B	Temperature Change in degrees Celsius = $60^\circ\text{C} - (-15^\circ\text{C}) = 75^\circ\text{C}$ $\therefore$ Temperature Change in Kelvin = $75\text{ K}$																																
8	E	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Statement I - Incorrect</th> <th style="width: 33%;">Statement II - Correct</th> <th style="width: 33%;">Statement III - Correct</th> </tr> </thead> <tbody> <tr> <td>Transverse waves have the direction of vibration at right angles to the direction of wave travel</td> <td>All electromagnetic waves are transverse and water waves are transverse</td> <td>Sound waves are longitudinal</td> </tr> </tbody> </table>	Statement I - Incorrect	Statement II - Correct	Statement III - Correct	Transverse waves have the direction of vibration at right angles to the direction of wave travel	All electromagnetic waves are transverse and water waves are transverse	Sound waves are longitudinal																										
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10	C	Total distance = 30km up to aeroplane and 30km back from aeroplane = 60km = 60,000m $t = \frac{d}{v} = \frac{60000\text{ m}}{3.0 \times 10^8\text{ m s}^{-1}} = 0.0002\text{ s} = 2 \times 10^{-4}\text{ s}$																																
11	B	<input checked="" type="checkbox"/> A Gamma has higher frequency than X rays <input checked="" type="checkbox"/> B UV has shorter $\lambda$ than visible and lower $f$ than X-rays <input checked="" type="checkbox"/> C infrared has a longer wavelength than visible light <input checked="" type="checkbox"/> D microwaves have a longer wavelength than visible <input checked="" type="checkbox"/> E radio waves have a longer wavelength than visible <table border="1" style="float: right; margin-top: 10px; border-collapse: collapse;"> <thead> <tr> <th>EM Type</th> <th>Gamma</th> <th>X-Ray</th> <th>Ultra-violet</th> <th>Visible</th> <th>Infra-Red</th> <th>Microwave</th> <th>Radio &amp; TV</th> </tr> </thead> <tbody> <tr> <td>Energy</td> <td>High</td> <td>←</td> <td>←</td> <td>←</td> <td>←</td> <td>←</td> <td>Low</td> </tr> <tr> <td>Frequency</td> <td>High</td> <td>←</td> <td>←</td> <td>←</td> <td>←</td> <td>←</td> <td>Low</td> </tr> <tr> <td>Wavelength</td> <td>Low</td> <td>←</td> <td>←</td> <td>←</td> <td>←</td> <td>←</td> <td>High</td> </tr> </tbody> </table>	EM Type	Gamma	X-Ray	Ultra-violet	Visible	Infra-Red	Microwave	Radio & TV	Energy	High	←	←	←	←	←	Low	Frequency	High	←	←	←	←	←	Low	Wavelength	Low	←	←	←	←	←	High
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Wavelength	Low	←	←	←	←	←	High																											

12	A	<input checked="" type="checkbox"/> A Q is the angle of incidence and S is the angle of refraction as both are measure from the normal <input checked="" type="checkbox"/> B The angle of incidence must be outside the glass so cannot be S <input checked="" type="checkbox"/> C P is not the angle of incidence and R is not the angle of refraction as they are not measured from the normal <input checked="" type="checkbox"/> D The angle of incidence must be outside the glass so cannot be R <input checked="" type="checkbox"/> E Q is the angle of incidence but R is not the angle of refraction as the angle is measured from the normal															
13	B	Total Equivalent Dose = Equivalent does for Alpha Radiation + Equivalent Dose for Gamma Radiation = $D w_R$ + $D w_R$ = $(15 \mu\text{Gy} \times 20)$ + $(20 \mu\text{Gy} \times 1)$ = $300 \mu\text{Sv}$ + $20 \mu\text{Sv}$ = $320 \mu\text{Sv}$															
14	C	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Magnitude of force</th> <th style="width: 50%;">Bearing of Force</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">  <math display="block">x = \sqrt{(40)^2 + (30)^2}</math> <math display="block">x = \sqrt{1600 + 900}</math> <math display="block">x = \sqrt{2500}</math> <math display="block">x = 50 \text{ N}</math> </td> <td style="text-align: center;"> <math display="block">\tan \theta = \frac{\text{opp}}{\text{adj}} = \frac{30}{40} = 0.75 \quad \therefore \theta = 37^\circ</math> <math display="block">\text{Bearing} = 180^\circ + 37^\circ = 217</math> </td> </tr> </tbody> </table>	Magnitude of force	Bearing of Force	 $x = \sqrt{(40)^2 + (30)^2}$ $x = \sqrt{1600 + 900}$ $x = \sqrt{2500}$ $x = 50 \text{ N}$	$\tan \theta = \frac{\text{opp}}{\text{adj}} = \frac{30}{40} = 0.75 \quad \therefore \theta = 37^\circ$ $\text{Bearing} = 180^\circ + 37^\circ = 217$											
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15	C	<input checked="" type="checkbox"/> A A ball falling freely would increase in velocity due to acceleration due to gravity <input checked="" type="checkbox"/> B A rocket accelerating upwards would have an increasing velocity not a decreasing velocity <input checked="" type="checkbox"/> C A ball thrown into the air would decrease in velocity, come to a stop (zero) and reverse direction <input checked="" type="checkbox"/> D A ball falling to Earth would increase in velocity due to gravity <input checked="" type="checkbox"/> E Graph shows a reversal of direction when the lone goes below zero on x-axis															
16	E	<input checked="" type="checkbox"/> A acceleration is the same at any point as the gravitational field strength is the same. <input checked="" type="checkbox"/> B the average velocity from Y is less through light gates as trolley has not accelerated for as long as from X <input checked="" type="checkbox"/> C acceleration is the same at any point as the gravitational field strength is the same. <input checked="" type="checkbox"/> D acceleration is the same at any point as the gravitational field strength is the same. <input checked="" type="checkbox"/> E Acceleration increases and average velocity is less when released from Y.															
17	D	<input checked="" type="checkbox"/> A As Mars has a lower gravitational field strength than Earth, weight of rocket will be less on mars <input checked="" type="checkbox"/> B As Mars has a lower gravitational field strength than Earth, weight of rocket will be less on mars <input checked="" type="checkbox"/> C As Mars has a lower gravitational field strength than Earth, weight of rocket will be less on mars <input checked="" type="checkbox"/> D Rocket has less weight on Mars and unbalanced force is greater on Mars. <input checked="" type="checkbox"/> E Rocket is identical in its thrust but the rocket has less weight $\therefore$ unbalanced force will be greater															
18	B	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Statement I - Incorrect</th> <th style="width: 33%;">Statement II - <b>Correct</b></th> <th style="width: 33%;">Statement III - Incorrect</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">The greater the altitude the <i>longer</i> the orbital period</td> <td style="text-align: center;">A satellite has constant vertical velocity due to gravity being constant</td> <td style="text-align: center;">Satellites will have a constant velocity to maintain their orbit.</td> </tr> </tbody> </table>	Statement I - Incorrect	Statement II - <b>Correct</b>	Statement III - Incorrect	The greater the altitude the <i>longer</i> the orbital period	A satellite has constant vertical velocity due to gravity being constant	Satellites will have a constant velocity to maintain their orbit.									
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19	B	In 1s heat transfer is 1130 J $\therefore$ in 120s the heat transfer is $1130 \times 120 = 135600 \text{ J}$ $E = 135600 \text{ J}$ <span style="margin-left: 150px;"><math>m = ?</math></span> <span style="margin-left: 150px;"><math>l = 22.6 \times 10^5 \text{ J kg}^{-1}</math></span> $E = m \times l$ $22.6 \times 10^5 = m \times 22.6 \times 10^5$ $m = 0.06 \text{ kg} = 6.0 \times 10^{-2} \text{ kg}$															
20	D	<table style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 20%;">Star X</td> <td style="width: 40%;"></td> <td style="width: 40%;">Contains Hydrogen and Helium</td> </tr> <tr> <td>Star Y</td> <td></td> <td>Contains Helium but not Hydrogen</td> </tr> <tr> <td>Star Z</td> <td></td> <td>Contains Hydrogen and Helium</td> </tr> <tr> <td style="text-align: center;">Helium</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">Hydrogen</td> <td></td> <td></td> </tr> </tbody> </table>	Star X		Contains Hydrogen and Helium	Star Y		Contains Helium but not Hydrogen	Star Z		Contains Hydrogen and Helium	Helium			Hydrogen		
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Helium																	
Hydrogen																	

Question	Answer	Physics Covered						
1a(i)		A fuse protects a circuit from too much current flowing and the fuse will blow when a specified current is exceeded.						
1a(ii)	One answer from:	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>stops too large a current</td> <td>prevents wiring overheating</td> <td>protect wiring (from damage)</td> </tr> </table>	stops too large a current	prevents wiring overheating	protect wiring (from damage)			
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1a(iii)	3A Fuse	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>Power Rating</td> <td>Up to 720W</td> <td>Over 720W</td> </tr> <tr> <td>Fuse Selected</td> <td>3A</td> <td>13A</td> </tr> </table>	Power Rating	Up to 720W	Over 720W	Fuse Selected	3A	13A
Power Rating	Up to 720W	Over 720W						
Fuse Selected	3A	13A						
1b	One answer from:	direction of $\left\{ \begin{array}{l} \text{electron (flow)} \\ \text{charge (flow)} \end{array} \right\}$ (continually) changing $\left\{ \begin{array}{l} \text{back and forth} \\ \text{to and fro} \end{array} \right\}$						
2a(i)	7.50 V	<p>When switch S1 is closed, <math>R_T = R_1 + R_2 = 15.0\Omega + 25.0\Omega = 40.0\Omega</math> (1 mark)</p> <p><math>V = 12.0\text{ V}</math> <span style="float: right;"><math>I = ?</math> <math>R = 40.0\Omega</math></span></p> <p><math>V = I R</math> (1 mark if written here or below)</p> <p><math>12.0 = I \times 40.0</math> (part of Substitution mark)</p> <p><math>I = 0.300\text{ A}</math></p> <p>Voltage Across Motor = ? <span style="float: right;"><math>I = 0.300\text{ A}</math> <math>R = 25.0\Omega</math></span></p> <p><math>V = I R</math> (1 mark if written here or below)</p> <p><math>V = 0.300 \times 40.0</math> (part of Substitution mark)</p> <p><math>V = 7.50\text{ V}</math> (1 mark)</p>						
2a(ii)	2.25W	<p><math>P = ?</math> <span style="float: right;"><math>V = 7.5\text{ V}</math> <math>R = 25.0\Omega</math></span></p> <p><math>P = \frac{V^2}{R} = \frac{(7.5)^2}{25.0} = \frac{56.25}{25.0} = 2.25\text{ W}</math></p> <p>(1 mark) (1 mark) (1 mark)</p>						
2b(i)	10.5 $\Omega$	<p><math>\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}</math> (1 mark)</p> <p><math>\frac{1}{R_T} = \frac{1}{15.0} + \frac{1}{35.0}</math> (1 mark)</p> <p><math>R_T = 10.5\Omega</math> (1 mark)</p>						
2b(ii)	Answer to include:	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">1 mark</td> <td style="text-align: center;">(power dissipated is) <math>\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \\ \text{higher} \end{array} \right\}</math></td> </tr> <tr> <td style="text-align: center;">1 mark</td> <td style="text-align: center;">combined parallel total <math>\left\{ \begin{array}{l} \\ \\ \end{array} \right\}</math> resistance less</td> </tr> <tr> <td style="text-align: center;">1 mark</td> <td style="text-align: center;">voltage across motor is <math>\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \end{array} \right\}</math> <u>or</u> Current in motor is <math>\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \end{array} \right\}</math></td> </tr> </table>	1 mark	(power dissipated is) $\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \\ \text{higher} \end{array} \right\}$	1 mark	combined parallel total $\left\{ \begin{array}{l} \\ \\ \end{array} \right\}$ resistance less	1 mark	voltage across motor is $\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \end{array} \right\}$ <u>or</u> Current in motor is $\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \end{array} \right\}$
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1 mark	combined parallel total $\left\{ \begin{array}{l} \\ \\ \end{array} \right\}$ resistance less							
1 mark	voltage across motor is $\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \end{array} \right\}$ <u>or</u> Current in motor is $\left\{ \begin{array}{l} \text{greater} \\ \text{increased} \end{array} \right\}$							
3a	$2.5 \times 10^5\text{ Pa}$	<p>Temperature: Constant <span style="float: right;"><math>p_1 = 1.0 \times 10^5\text{ Pa}</math> <math>V_1 = 4.0 \times 10^{-4}\text{ m}^3</math></span></p> <p><math>p_2 = ?</math> <span style="float: right;"><math>V_2 = 1.6 \times 10^{-4}\text{ m}^3</math></span></p> <p>(1 mark) <math>p_1 V_1 = p_2 V_2</math></p> <p>(1 mark) <math>1.0 \times 10^5 \times 4.0 \times 10^{-4} = p_2 \times 1.6 \times 10^{-4}</math></p> <p><math>\frac{1.0 \times 10^5 \times 4.0 \times 10^{-4}}{1.6 \times 10^{-4}} = p_2</math></p> <p>(1 mark) <math>2.5 \times 10^5\text{ Pa} = p_2</math></p>						
3b	Answer to include:	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">1 mark</td> <td style="text-align: center;">(individual) particles collide with container walls more frequently (than before)</td> </tr> <tr> <td style="text-align: center;">1 mark</td> <td style="text-align: center;">(overall) force (on walls) is greater</td> </tr> <tr> <td style="text-align: center;">1 mark</td> <td style="text-align: center;">pressure increases</td> </tr> </table>	1 mark	(individual) particles collide with container walls more frequently (than before)	1 mark	(overall) force (on walls) is greater	1 mark	pressure increases
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1 mark	(overall) force (on walls) is greater							
1 mark	pressure increases							

3c	One graph from:	<p><u>1 mark</u> axes labelled <b>p</b> and <b>V</b> (axes can be transposed)</p>	<p><u>1 mark</u> graph of <b>p</b> against <math>\frac{1}{V}</math> (or <b>V</b> against <math>\frac{1}{p}</math>)</p>	
		<p><u>1 mark</u> correct shape (curved)</p>	<p><u>1 mark</u> labelled with straight line through the origin</p>	
				
4a(i)	0.40 Hz	$T = \frac{1}{f}$ (1 mark) $2.5 = \frac{1}{f}$ (1 mark) $f = 0.40 \text{ Hz}$ (1 mark)		
4a(ii)	One answer from:	measure the time for more waves to pass	count the number of waves in a longer period of time	repeat (the measurement) and average
4b	$3.2 \text{ m s}^{-1}$	$v = ?$ $f = 0.4 \text{ Hz}$ $\lambda = 8.0 \text{ m}$ $v = f \times \lambda$ (1 mark) $v = 0.40 \times 8.0$ (1 mark) $v = 3.2 \text{ m s}^{-1}$ (1 mark)		
4c		<p>1 mark   diffraction of waves into 'shadow' regions behind walls</p> <p>1 mark   straight sections in middle and consistent wavelengths before and after gap</p>		
4d	energy decreases/lost	The amplitude of a wave is proportional to the energy of the wave. As the wave loses energy the amplitude of the wave decreases.		
5	Answer to include:	<p><u>1 mark</u></p> <p>Candidate has demonstrated a limited understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood at least a little of the physics within the problem.</p>	<p><u>2 marks</u></p> <p>Candidate has demonstrated a reasonable understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood the problem.</p>	<p><u>3 marks</u></p> <p>Candidate has demonstrated a good understanding of the physics involved. They show a good comprehension of the physics of the situation and provide a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. The answer does not need to be 'excellent' or 'complete' for the candidate to gain full marks.</p>
6a	background count (rate)	The background count rate must be subtracted from the activity count to exclude the contribution of background radiation from the activity.		
6b(i)	4.4 mm	<p>Count rate halves from 200 to 100 counts per minute</p>  <p>corrected count rate (counts per minute)</p> <p>thickness of lead absorber (mm)</p> <p>Time Interval = 12-8 mm = 4 mm</p>	<p>Take any halving of the corrected count rate on the y-axis.</p> <p>Work out the thickness on the x-axis for this halving.</p>	

6b(ii)	13.2mm	$\frac{1}{8}$ th of initial Corrected Count Rate = 3 half-thicknesses used (1 mark) 1 half-thickness = 4.4mm $\therefore$ 3 half-thicknesses = 3 x 4.4 = 13.2mm (1 mark)															
6b(iii)	Greater	Aluminium is used to prevent beta radiation passing through but will allow gamma radiation through. Thicker aluminium will be needed to stop the same quantity of radiation that lead would stop.															
6c	8000 h	$\dot{H} = 2.5 \times 10^{-6} \text{ Sv h}^{-1}$ $H = 20 \text{ mSv} = 20 \times 10^{-3} \text{ Sv}$ $t = 15 \text{ min} = 15 \times 60 \text{ s} = 900 \text{ s}$ $\dot{H} = \frac{H}{t} \quad (1 \text{ mark})$ $2.5 \times 10^{-6} = \frac{20 \times 10^{-3}}{t} \quad (1 \text{ mark})$ $t = 8000 \text{ h} \quad (1 \text{ mark})$															
7a	80000 decays per unit time or 80000 decays per second	80kBq = 80000 Bq A Becquerel is a nuclei decay per second/unit time															
7b(i)	Answer to include:	<table border="1"> <tbody> <tr> <td>1 mark</td> <td>neutrons can go on to</td> <td rowspan="2"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding-left: 5px;">           cause further fission reactions            split more uranium nuclei         </div> </td> </tr> <tr> <td>1 mark</td> <td>causing a chain reaction</td> <td>or this process repeats</td> </tr> </tbody> </table>	1 mark	neutrons can go on to	<div style="border-left: 1px solid black; border-right: 1px solid black; padding-left: 5px;">           cause further fission reactions            split more uranium nuclei         </div>	1 mark	causing a chain reaction	or this process repeats									
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1 mark	causing a chain reaction		or this process repeats														
7b(ii)	$1.6 \times 10^9 \text{ W}$	Energy = $3.0 \times 10^{21} \times 3.2 \times 10^{-11}$ (1 mark) = $9.6 \times 10^{10} \text{ J}$ $P = ?$ $E = 9.6 \times 10^{10} \text{ J}$ $t = 1 \text{ minute} = 60 \text{ s}$ $P = \frac{E}{t} = \frac{9.6 \times 10^{10}}{60} = 1.6 \times 10^9 \text{ W}$ (1 mark)      (1 mark)      (1 mark)															
7c	Any suitable use including:	<table border="1"> <tbody> <tr> <td>treating cancer</td> <td>tracers</td> <td>sterilisation</td> <td>smoke detectors</td> <td>measuring thickness of paper</td> </tr> </tbody> </table>	treating cancer	tracers	sterilisation	smoke detectors	measuring thickness of paper										
treating cancer	tracers	sterilisation	smoke detectors	measuring thickness of paper													
8a	0 m	The distance travelled by 4 laps of track by motorbike = $4 \times 380 \text{ m} = 1720 \text{ m}$ However, displacement = 0m as the start and end positions are the same after four laps.															
8b(i)	46.5 m	 <table border="1"> <thead> <tr> <th>Area ①</th> <th>Area ②</th> <th>Area ③</th> </tr> </thead> <tbody> <tr> <td>Distance = area under graph</td> <td>Distance = area under graph</td> <td>Distance = area under graph</td> </tr> <tr> <td><math>= \frac{1}{2} \times 1.0 \times 3</math></td> <td><math>= 3.0 \times 3</math></td> <td><math>= \frac{1}{2} \times 3.0 \times 24</math></td> </tr> <tr> <td><math>= 1.5</math></td> <td><math>= 9.0</math></td> <td><math>= 36.0</math></td> </tr> <tr> <td colspan="3" style="text-align: center;"><b>Total distance = 1.5 + 9.0 + 36.0 = 46.5 m</b></td> </tr> </tbody> </table>	Area ①	Area ②	Area ③	Distance = area under graph	Distance = area under graph	Distance = area under graph	$= \frac{1}{2} \times 1.0 \times 3$	$= 3.0 \times 3$	$= \frac{1}{2} \times 3.0 \times 24$	$= 1.5$	$= 9.0$	$= 36.0$	<b>Total distance = 1.5 + 9.0 + 36.0 = 46.5 m</b>		
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8b(ii)	$8 \text{ m s}^{-2}$	Greatest Acceleration in first 8.0s is steepest gradient (1.0s to 4.0s) $a = ?$ $v = 27 \text{ m s}^{-1}$ $u = 3 \text{ m s}^{-1}$ $t = 3.0 \text{ s}$ $a = \frac{v - u}{t} = \frac{27 - 3}{3.0} = 8 \text{ m s}^{-2}$ (1 mark)      (1 mark)      (1 mark)															
8c	$19 \text{ m s}^{-1}$	$d = 4 \times 380 \text{ m} = 1520 \text{ m}$ $\bar{v} = ?$ $t = 79 \text{ s}$ $d = \bar{v} t$ (1 mark) $1520 = \bar{v} \times 79$ (1 mark) $\bar{v} = 19 \text{ m s}^{-1}$ (1 mark)															
9a	Answer to include:	(The forces are) equal (in size) <u>and</u> opposite (in direction)															

9b	120 kg	$W = 1176 \text{ N}$ $W = m \times g$ (1 mark) $1176 = m \times 9.8$ (1 mark) $m = 120 \text{ kg}$ (1 mark)	$g = 9.8 \text{ N kg}^{-1}$ $m = ?$						
9c	$1.4 \text{ m s}^{-2}$	$F = 1344 \text{ N} - 1176 \text{ N} = 168 \text{ N}$ $F = 168 \text{ N}$ $F = m \times a$ (1 mark) $168 = 120 \times a$ (1 mark) $a = 1.4 \text{ m s}^{-2}$ (1 mark)	$m = 120 \text{ kg}$ $a = ?$						
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11a	Q	<input checked="" type="checkbox"/> Graph P Ball must start with zero velocity just before the ball is hit by the racket	<input checked="" type="checkbox"/> Graph Q Ball increases in velocity from zero when the ball is hit by the racket.	<input checked="" type="checkbox"/> Graph R Ball must start with zero velocity just before the ball is hit by the racket					
11b	Answer to include:	<table border="1"> <tbody> <tr> <td>1 mark</td> <td>equal (to)</td> <td>(this mark must be attained to achieve second mark)</td> </tr> <tr> <td>1 mark</td> <td colspan="2">vertical/downward acceleration is the same</td> </tr> </tbody> </table>	1 mark	equal (to)	(this mark must be attained to achieve second mark)	1 mark	vertical/downward acceleration is the same		
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1 mark	vertical/downward acceleration is the same								
11c	220 N	$E_w = 5.5 \text{ kJ} = 5500 \text{ J}$ $E_w = F \times d$ (1 mark) $5500 = F \times 25$ (1 mark) $F = 220 \text{ N}$ (1 mark)	$F = ?$ $d = 25 \text{ m}$						
12a(i)	$3.0 \times 10^8 \text{ m s}^{-1}$	All electromagnetic waves travel at $3.0 \times 10^8 \text{ m s}^{-1}$							
12a(ii)	$7.4 \times 10^{16} \text{ m}$	$d = v \times t$ (1 mark) $d = 3 \times 10^8 \times 7.8 \times 365.25 \times 24 \times 60 \times 60$ (1 mark) $d = 7.4 \times 10^{16} \text{ m}$ (1 mark)							
12b(i)	One answer from:	Photographic film LDR	photodiode retina (of the eye)	charge coupled device/CCD phototransistor					
12b(ii)	Equal (to)	All electromagnetic waves travel at $3.0 \times 10^8 \text{ m s}^{-1}$ so radio waves and light waves will arrive at the same time.							