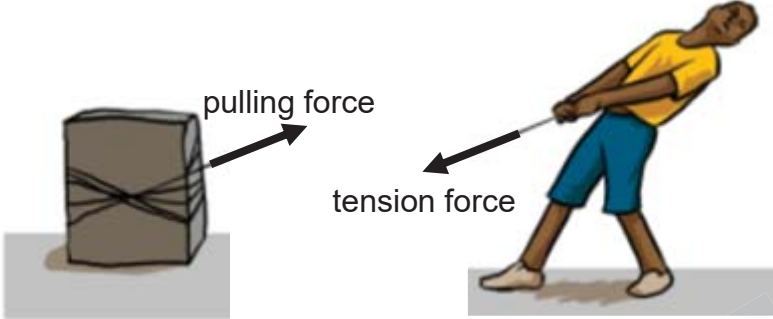


Solution to Sec 4 Physics Prelim Exam 2019 Paper 1

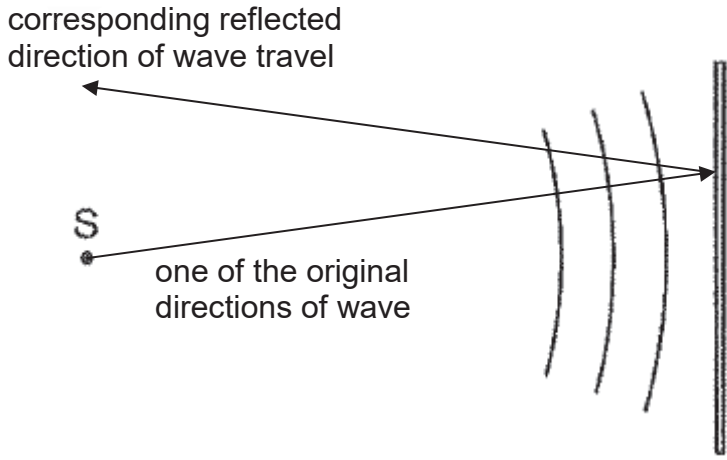
1	C	6	C	11	D	16	A	21	A	26	A	31	B	36	C
2	A	7	D	12	C	17	D	22	D	27	D	32	A	37	A
3	A	8	B	13	A	18	A	23	D	28	C	33	D	38	D
4	D	9	C	14	B	19	A	24	B	29	A	34	D	39	C
5	B	10	A	15	C	20	C	25	B	30	A	35	B	40	B

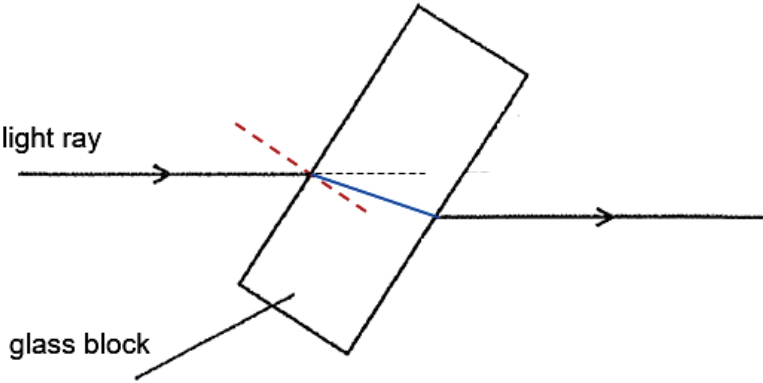
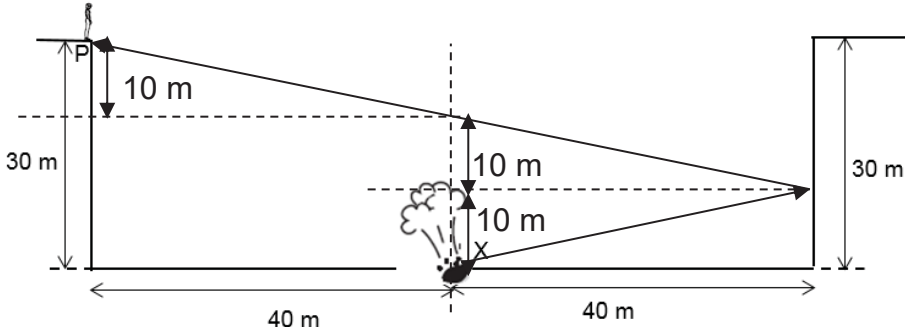
Qn	Solution	Ans
1	<p>Thickness of a fingernail is approximately 1 mm.</p> <p>Note: A student can use his existing ruler to estimate that the fingernail must be around 1 mm.</p>	C
2	<p>To measure a length of several metres, the measuring instrument will have to be measuring tape. Other measuring instruments can only measure up to 1 m.</p> <p>To determine the volume of the pipe, both external and internal diameter of the pipe is needed. Thus, the best measuring instrument will be vernier caliper. Laboratory micrometer screw gauge can only up to 25.0 mm and only for external diameter.</p>	A
3	<p>Maximum resultant force occurs when all the three forces are in the same direction and the value is 3+4+8+15 N.</p> <p>Thus, option D is possible resultant force.</p> <p>By elimination, option A will be the not be a possible value of the resultant force.</p> <p>Note: We can always pair up two forces and determine the maximum and minimum value. Thus, if we pair up 3 N and 4 N forces, their resultant force will be in the range of 1 N to 7 N. When this resultant force is combined with 8 N force, then the total resultant force will be in the range of 1 N and 15 N.</p>	A
4	<p>When the car is accelerating, this means that the speed of the car is increasing. This implies that the distance travelled by the car per unit time (in this case, for every one second interval) should be increasing.</p> <p>Note: For option D, the distance travelled in the 1st second (from t=0 s to t =1 s) = 80 m the distance travelled in the 2nd second (from t=1s to t=2 s) = 110 m</p>	D

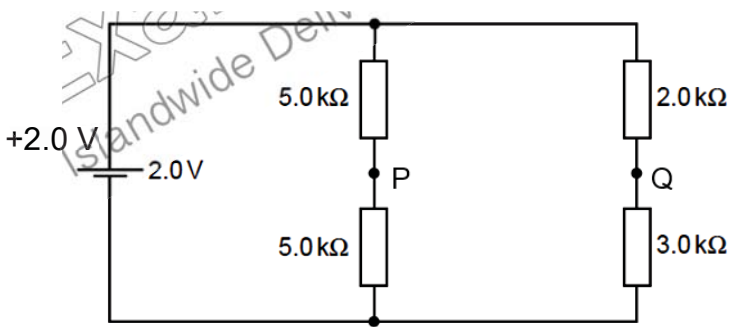
<p>5</p>	<p>Action-reaction forces must be acting on mutually opposite bodies and cannot be on the same body.</p> <p>For option A, the pulling force on the block is due to the rope. The tension (always acting away from the body of interest) experienced by the rope is due to the block. See free body diagram below illustrating the two forces</p> 	<p>B</p>
<p>6</p>	<p>Acceleration of the car (through the journey) = rate of change in velocity = $10/2.0$ = 5.0 m s^{-2}</p> <p>Using Newton's 2nd Law,</p> <p>Resultant force, F_{net} = $m \times a$ = 1000×5.0 = 5000 N</p>	<p>C</p>
<p>7</p>	<p>The question is focus on the effect of gravitational field strength on mass and weight.</p> <p>Mass of a body will be constant and hence with the same amount of applied force and hence resultant force acting on the block, the acceleration of the block will be constant.</p> <p>Note: Although the period of pendulum T is not dependent on the mass, it is dependent on gravitational field strength g. $T^2 = 4 \pi^2 l / g$.</p>	<p>D</p>
<p>8</p>	<p>Concept of flotation: Object or liquid of a smaller density will float above the liquid of larger density.</p> <p>Thus, liquid Q must have the smallest density and liquid S must have the largest density.</p> <p>Since liquid R floats on top of object P, density of object P must be larger than liquid R.</p>	<p>B</p>

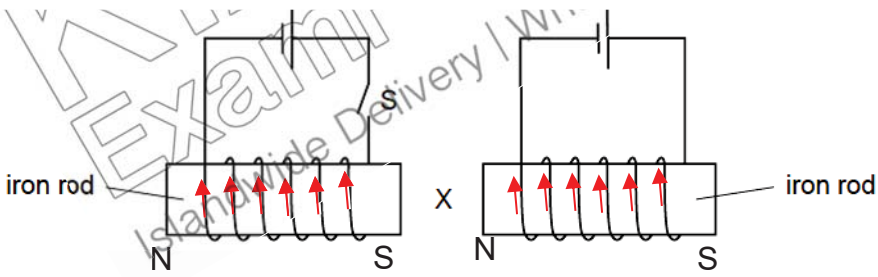
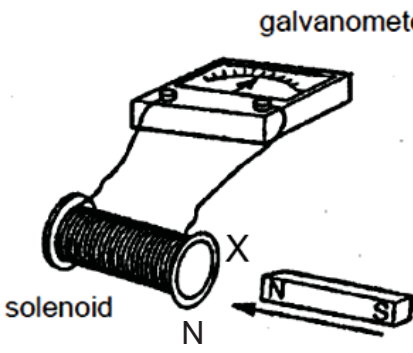
<p>9</p>	<p>Let the length of ladder by l m. By principle of moment, taking moment about point X,</p> <p>anti-clockwise moment due to force F = clockwise moment due to weight of the ladder</p> $F \times l \sin 30^\circ = 500 \times \frac{1}{2} l \cos 30^\circ$ $F \sin 30^\circ = 250 \cos 30^\circ$ $F = 433 \text{ N}$ <p>Note: (1) Perpendicular distance between line of action of the force F and the pivot point X is $l \sin 30^\circ$ (2) Since the c.g of the ladder is at the mid-point of the ladder, perpendicular distance between line of action of the force F and the pivot point X is $\frac{1}{2} l \cos 30^\circ$</p>	<p>C</p>
<p>10</p>	<p>As more water is added to the bottom, the combined centre of gravity will be raised as the centre of gravity of the water will be raised.</p> <p>There is no change in the base area. Thus, with a higher centre of gravity, the bottle with water will be less stable as the line of action of the weight of the bottle with water is likely to be outside the base area of the bottle when displaced slightly.</p>	<p>A</p>
<p>11</p>	<p>The pin is not moving. Thus, the pin is at equilibrium. The force of the pin is equal on the finger and on the thumb.</p> <p>Since pressure = force / area of contact, and the area of contact between the pin and the thumb is smaller as compared to that at the finger, the pressure of the pin is larger on the thumb.</p>	<p>D</p>
<p>12</p>	<p>The pressure of the gas supply = pressure due to a liquid column of 18 cm + atmospheric pressure.</p> <p>The new pressure of the gas supply = pressure due to a liquid column of 20 cm + atmospheric pressure.</p> <p>Thus, the difference in level X and Y = 20 cm</p> <p>Note: Level X will have dropped by 1 cm and level Y have risen by 1 cm.</p>	<p>C</p>
<p>13</p>	<p>As air rushes in, the external pressure acting on the marshmallow increases.</p> <p>The resultant pressure hence produces a resultant force acting inward towards the centre of marshmallow. The size of the marshmallow decreases.</p> <p>With a reduction in the size of the marshmallow, the area of contact between the gas particles in the marshmallow and the internal surface of the marshmallow decreases. Pressure in the marshmallow increases.</p>	<p>A</p>

14	<p>Fixed points must be easily reproducible and obtainable through any physical processes. Two fixed points are required so that the length of the liquid can be divided into equal intervals.</p> <p>Note: Option C is not entirely correct as the fixed point must be below the boiling point so that the substance remains in liquid state.</p>	B
15	<p>The two given temperatures are not 0°C and 100°C. Thus, the temperature formula cannot be used.</p> <p>Using the underlying concept that the change in the thermometric property is directly proportional to the change in the temperature.</p> <p>change in resistance \equiv change in temperature $(80 - 20) \Omega \equiv 90^\circ\text{C} - 10^\circ\text{C}$ $60 \Omega \equiv 80^\circ\text{C}$</p> <p>Using 10°C as the reference temperature,</p> <p>When resistance changes from 20 Ω to 100 Ω, change in resistance = 80 Ω.</p> <p>Corresponding change in temperature $= 80 / 60 \times 80$ $= 107^\circ\text{C}$</p> <p>Thus, the expected temperature = 107 + 10 = 117 °C</p>	C
16	<p>For thermocouple, to have deflection for galvanometer, two conditions must be met:</p> <p>(1) There is a temperature difference between the hot and the cold junctions. (2) The wires connecting at the two junctions must be of different metal.</p>	A
17	<p>The focus of the question is the metal spoon which is gaining heat from the hot water which has a higher temperature. Since the spoon is a metal which a good conductor of heat and the spoon is in physical contact with the water, the main process of heat transfer is conduction.</p> <p>Note: The initial temperature of the metal spoon is assumed to be the same as the surrounding air.</p>	D
18	<p>In this case, the heat capacity of the object is given, rather than the specific heat capacity.</p> <p>Using $Q = C \Delta\theta$,</p> <p>Amount of heat, $Q = 500 \times (40 - 30) = 500 \times 10$</p>	A

19	<p>Specific latent heat of vaporisation = amount heat absorbed by 1.0 kg of liquid as it changes from liquid to gas at boiling point = amount of heat absorbed by 1.0 kg of gas as it changes from gas to liquid at condensation point.</p> <p>Boiling point = condensation point.</p>	A
20	<p>Rate of evaporation depends on how readiness the liquid molecules at the surface of the liquid is able to leave the liquid, and this depends on whether the liquid molecules have sufficient energy to escape from the surface of the liquid.</p> <p>In this case, atmospheric pressure and temperature of the liquid are the only two factors that affect the rate of evaporation.</p>	C
21	<p>In this case, it is noted that p is not the maximum height of the water surface at a particular point. Thus, p is the displacement of the water.</p> <p>This is the displacement-time graph, and hence the graph only provide the information on period (the time taken for the particle to complete one oscillation).</p>	A
22	<p>The wavelength has increased as it travels from regions X to Y. Frequency of wave remains constant (as there is no change in the source).</p> <p>Using $v = f \times \lambda$, this implies that the speed of the wave increases. Thus, region X is shallower and region Y.</p> <p>Using the concept of refraction, the direction of wave travel will bend away from the normal as speed of the wave increases.</p>	D
23	<p>Strategy: (1) Sketch a direction of wave travel and use the concept of reflection (2) Wavefronts always perpendicular to the direction of wave travel.</p> 	D

<p>24</p>	<p>Light ray bends towards the normal as it travels from optically less dense medium to more dense medium, and vice versa.</p> 	<p>B</p>
<p>25</p>	<p>Using infra-red radiation and ultra-violet as reference, red light will have a larger wavelength and smaller frequency than the violet light.</p>	<p>B</p>
<p>26</p>	<p>The electromagnetic waves must be safe for usage and hence must not have high ionisation energy (or high frequency).</p> <p>Note: Ultrasound is not an electromagnetic wave.</p>	<p>A</p>
<p>27</p>	<p>Due to atoms or molecules are closer to each other in solid as compared to that in the air, the speed of sound is larger in solid than in the air.</p> <p>However, as there is no change in the source, the frequency of the sound remains unchanged.</p>	<p>D</p>
<p>28</p>	<p>The first sound heard by the engineer is the sound that travels directly from the source to him.</p> <p>Distance travelled by this sound to reach the engineer</p> $= \sqrt{30^2 + 40^2}$ $= 50 \text{ m}$ <p>The second sound heard by the engineer is the sound that reflected on the vertical wall on the right.</p> <p>Distance travelled by this sound to reach the engineer (See below)</p> $= 3 \times \sqrt{10^2 + 40^2}$ $\approx 124 \text{ m}$ 	<p>C</p>

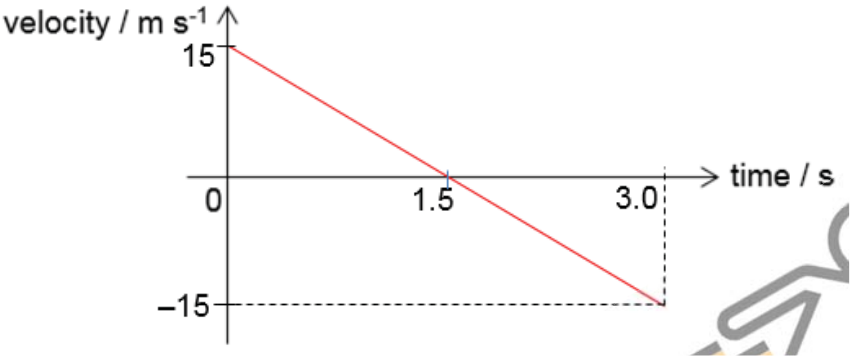
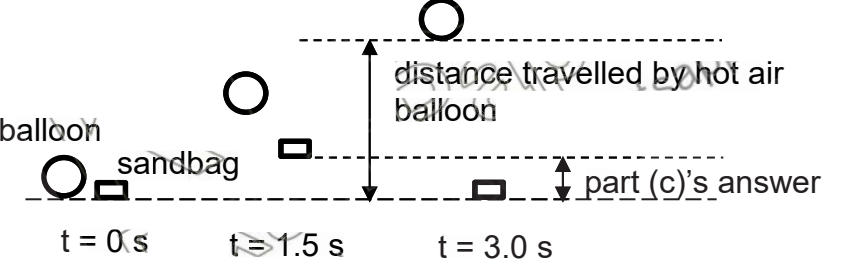
	<p>Time lapse between the two sounds $= (124 - 50) / 300$ $= 0.25 \text{ s}$</p>	
29	<p>Initially, the force applied on the object is equal to the frictional force (since the object is moving with constant speed).</p> <p>When the negative charged object enters the electric field, there will be a downward electric force acting on the object and pressing the object against the rough surface. The frictional force acting on the object will increase.</p> <p>By Newton's 2nd Law, as there is a now resultant force acting on the object opposing the motion. The object will decelerate.</p> <p>Note: The direction of electric field shows the direction of the electric force acting on the positively charged object.</p>	A
30	<p>When an object is neutrally charged, induced separation of charges can cause an object to be attracted to a charged object. On the other hand, an object that is oppositely charged can also be attracted to a charged object.</p> <p>Thus, only repulsion can determine the state of charge of an object.</p>	A
31	<p>Using definition of electromotive force, $\mathcal{E} = W / Q$</p> <p>Amount of electrical energy transferred, W $= \mathcal{E} \times Q$ $= 350 \times 100 \times 10^{-3}$ $= 35 \text{ J}$</p>	B
32	 <p>Potential at P $= 2.0 - \text{potential difference across } 5.0 \text{ k}\Omega$ $= 2.0 - 1.0$ $= 1.0 \text{ V}$</p> <p>Potential at Q $= 2.0 - \text{potential difference across } 2.0 \text{ k}\Omega$ $= 2.0 - \frac{2.0}{2.0 + 3.0} \times 2.0$ $= 1.2 \text{ V}$</p> <p>Potential difference across P and Q = $1.2 - 1.0 = 0.2 \text{ V}$</p>	A

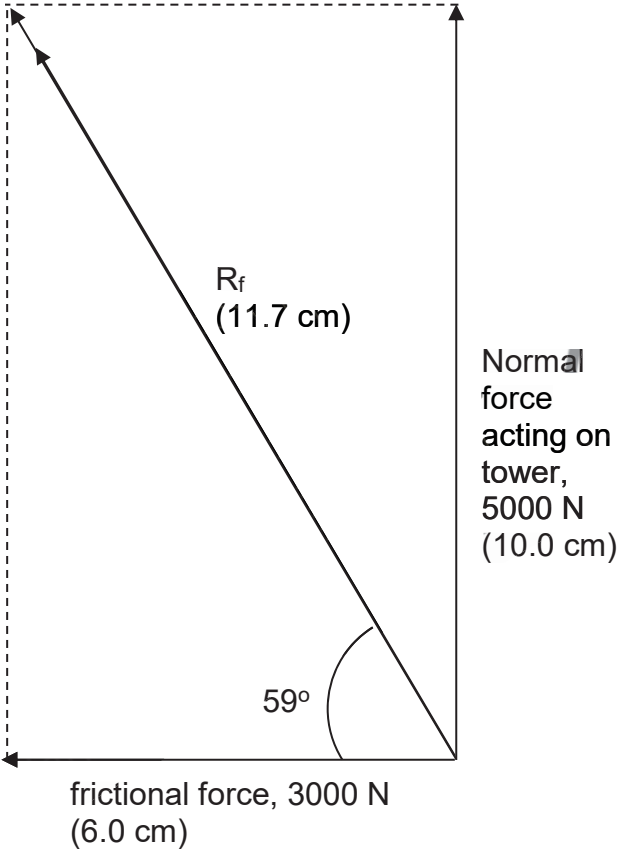
33	<p>The symbol shown is the symbol for thermistor. At high temperature, thermistor will have low resistance.</p> <p>Total effective resistance in the circuit = $3.0 + 2.0 = 5.0 \Omega$</p> <p>Using $R = V / I$,</p> <p>ammeter reading = $R / V = 6.0 / 5.0 = 1.2 \text{ A}$</p>	D
34	<p>This is one of the method to demagnetise a magnet. When the magnet is dropped onto the floor, the energy absorbed by the magnet will disorientate the atomic magnets and hence the atomic magnets will no longer align themselves in the same direction. Thus, the magnet will lose magnetism.</p>	D
35	<p>This is a recall question. Flow of positive charge is equivalent to the flow of conventional current and hence the motion of positive charge will create a magnetic field. Using right hand grip rule with the thumb pointing into the paper, the direction of magnetic field will be in clockwise direction (as given by the fingers).</p>	B
36	<p>This is a recall question. The ultimate function of split ring commutator is to ensure the direction of current in the coil is always in the same direction so that the coil will always turn in the same direction at all times.</p> <p>Note: A motor is to convert electrical energy to mechanical energy, rather than producing electrical energy.</p>	C
37	<p>Direction of current when switch S is closed:</p>  <p>Both iron rods will be magnetised with opposite polarities as shown above. Since unlike poles attracts, the spacing at X will decrease.</p>	A
38	 <p>The induced current in the solenoid will flow such that it can induce a</p>	D

	<p>N-pole at X when the magnet moves into the solenoid at X.</p> <p>Thus, to create the same deflection, the cause should be able to create a N-pole at X, that is, pulling a S-pole of the magnet out from X and pulling a solenoid away from a S-pole.</p>	
39	<p>By Faradays' Law of electromagnetic induction, the magnitude of the induced emf is directly proportional to the rate of cutting of magnetic field lines by the conductor.</p> <p>Thus, when the number of coils increases to three times as before, the induced emf will be 3V.</p> <p>When the frequency of rotation is now 2F (twice of the original rate of rotation), the induced emf will be 2 times of 3V, that is 6V.</p>	C
40	<p>Using $\frac{N_s}{N_p} = \frac{V_s}{V_p}$,</p> <p>Voltage across secondary coil, $V_s = 100 / 50 \times 25 = 50 \text{ V}$</p>	B

Solution to 2019 Sec 4 Physics Prelim Paper 2

Section A

Qn	Solution	Marking Scheme
1(a)	Due to inertia, the sandbag will have a reluctance to change its state of motion and will appear to move with an initial velocity of 15 m s^{-1} .	B1
(b)		<p>B1 – straight line with gradient of 10 m s^{-2}</p> <p>B1 – coordinates of all the critical points.</p>
(c)	<p>Distance travelled</p> <p>= area under the v-t graph from $t = 0 \text{ s}$ to $t = 1.5 \text{ s}$</p> <p>= $\frac{1}{2} \times 15 \times 1.5$</p> <p>$\approx 11 \text{ m}$ (also accept 11.3 m)</p>	B1
(d)	 <p>At $t = 3.0 \text{ s}$, the sandbag is back at the original drop off point.</p> <p>Distance between the sandbag and the hot air balloon</p> <p>= distance travelled by the hot air balloon from the original drop off point</p> <p>= 3.0×15</p> <p>= 45</p>	<p>M1 – student shows attempts to find this value</p> <p>A1</p>
2(a)	Principle of moment states that when an object is in equilibrium, the total clockwise moments about a point is equal to the total anti-clockwise moments about the same point.	B1

<p>(b)</p>	<p>By principle of moment, taking moment about the point at which the steel cable is connected to the windmill,</p> $f_r \times 20.0 = 2000 \times (30.0 - 20.0)$ $f_r = 1000 \text{ N}$	<p>M1 A1</p>
<p>(c)</p>	<p>Normal reaction force on the tower = 5000 N</p> <p>Frictional force on the tower = 3000 N (to the left)</p> <p>Scale: 1.0 cm to 500 N</p>  <p>Resultant force = $11.7 \times 500 = 5850 \text{ N}$ (also accept 5550 N to 6150 N)</p> <p>Direction = 59° clockwise from the frictional force (also accept 56° to 62°)</p>	<p>M1 – correct drawing</p> <p>A1 – correct magnitude</p> <p>A1 – correct direction</p>

<p>3(a)</p>	<p>The chemical potential energy possessed by Spiderman is converted to work done on the ground by his foot as Spiderman is walking backwards.</p> <p>This energy is then converted to elastic potential energy of the flag pole.</p> <p>The total energy in the system remains a constant. The loss in chemical potential energy of Spiderman is equal to the gain in the elastic potential energy of the pole.</p>	<p>B1</p> <p>B1</p> <p>B1</p>
<p>(b)</p>	<p>Loss in kinetic energy</p> <p>= initial kinetic energy – final kinetic energy</p> <p>= $\frac{1}{2} \times 65.0 \times 40.0^2 - \frac{1}{2} \times 65.0 \times 15.0^2$</p> <p>= 44687.5</p> <p>$\approx 44\,700\text{J}$</p>	<p>M1</p> <p>A1 – accept only 3 sf</p>
<p>(c)</p>	<p>By conservation of energy,</p> <p>loss in kinetic energy = gain in GPE + work done against air resistance</p> $44687.5 = 65.0 \times 10 \times h + 5000$ $h \approx 61.1 \text{ m}$	<p>M1</p> <p>A1</p>
<p>4(a) (i)</p>	<p>As the base of the lid moves up, this increases the surface area at which the air molecules hitting the internal surface of the container.</p> <p>The number of air molecules hitting per unit area of the internal surface of container (that is, the frequency of collisions of the air molecules with the internal surface of the container) decreases.</p> <p>Since the amount of force exerted by each air molecules on the internal surface of container remains unchanged during collision, the pressure of the air in the container decreases.</p>	<p>B2 – student's answer contains all the three points</p> <p>B1 – student's answer contains all one to two points</p> <p>B0 – student's answer does not contain any of these three points</p>
<p>Note:</p> $\text{Pressure} = \frac{\text{Total force exerted by molecules}}{\text{Total surface area}}$ $\text{Pressure} = \frac{\text{Force exerted by one molecule} \times \text{Total no. of molecules}}{\text{Total surface area}}$		

	Pressure = Force exerted by one molecules \times frequency of collision	
(ii)	The atmospheric pressure acting on the lid is much larger than the pressure of the air in the container. A large upward force is needed to overcome this pressure difference.	B1

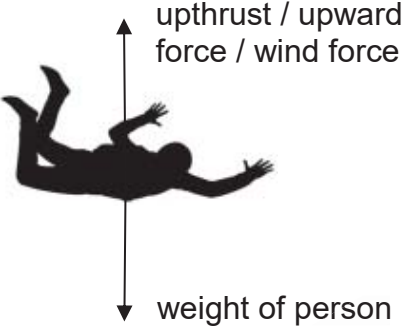
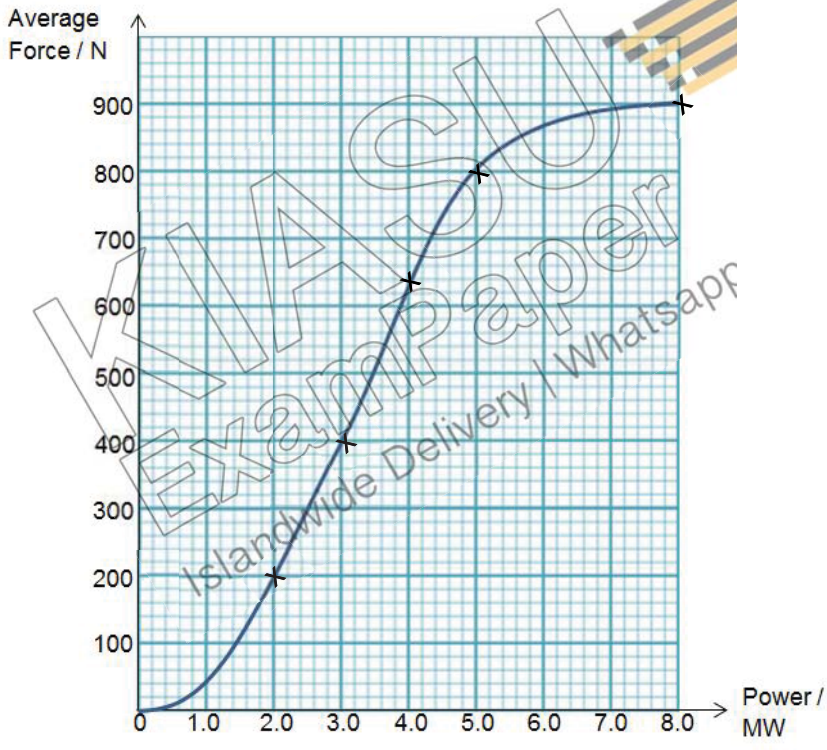
(b) (i)	Molecules are closely packed due to strong intermolecular forces of attraction, however, the molecules are still free to move.	B1
(ii)	Pressure on piston A = Pressure on piston B $\frac{F_A}{A_A} = \frac{F_B}{A_B}$ $\frac{30}{\pi (2.5)^2} = \frac{F_B}{\pi (7.5)^2}$ $F_B = 9 \times 30$ $F_B = 270 \text{ N}$	M1 A1
5(a)	As the light intensity increases, the resistance of LDR decreases or vice versa.	B1
(b)	The graph does not show a straight line passing through the origin, that is, potential difference across LDR is not directly proportional to the current flowing through it.	B1
(c) (i)	Resistor B and LDR are connected parallel to each other. $\frac{1}{R_{\text{eff}}} = \frac{1}{3000} + \frac{1}{2000}$ $\frac{1}{R_{\text{eff}}} = \frac{1}{1200}$ $R_{\text{eff}} = 1200 \Omega$	M1 A1
(ii)	Using potential divider concept, p.d across resistor A $= \frac{1000}{1000+1200} \times 9.0$ $\approx 4.1 \text{ V}$	M1 A1 - accept 2 sf only
(iii)	p.d across LDR = 9.0 – 4.1 = 4.9 V Using R = V / I, Current through LDR = V / R = 4.9 / 2000 = 0.00245 A ≈ 0.0025 A	M1 A1 – sf must be consistent with part (ii)

6(a)	<p>Using $P = IV$,</p> <p>Current through the heating element $= P / V$ $= (2.4 \times 10^3) / 240$ $= 10 \text{ A}$</p>	M1 A1
(b)	<p>When there is a current exceeding 13 A, the fuse will be heated up and melt when the melting point is reached.</p> <p>This cause the circuit to be an open circuit and current will no longer flow through the appliance. Hence, this protect the appliance which can be damaged due to over-heating.</p>	B1 B1
(c)	<p>When the water heater has double insulation, this means that the outer-casing is made of non-electrical conducting material.</p> <p>Hence, even if there is an electrical fault such that live wire touching the casing, the casing remains at low potential. A person touching the casing will not get electric shock. Thus, earth wire is not required to be connected to the casing.</p>	B1 B1
7(a)	<p>By adjusting the resistance of variable resistor to a smaller value, this will increase the current flowing through the coil winding around the soft iron core.</p> <p>The increase in the current will increase the magnetic field strength in the coil and the soft iron core will be magnetised and become a stronger magnet.</p> <p>Due to induced magnetism, one end of the iron armature will be attracted towards the soft iron core and the turning effect on the iron armature will close the contacts and close the circuit connecting to the motor and motor is switched on.</p>	B2 – student's answer contains all the three points B1 – student's answer contains all one to two points B0 – student's answer does not contains any of these three points
(b)	<p>South pole.</p> <p>Note: Student needs to first establish the direction of current flowing in the coil and then apply right hand grip rule.</p>	B1
(c) (i)	<p>Diode</p> <p>Note: Diode only allows current to flow in a single direction.</p>	B1

(ii)	<p>The magnetic force on the wire PQ is in the upward direction as the magnetic field strength below the wire PQ is larger than that above the wire PQ.</p> <p>The difference in the magnetic field strength is due to the interaction of the magnetic field due to the current that is flowing from Q to P and the magnetic field due to the permanent magnet.</p>	<p>B1</p> <p>B1 – student is required to state the direction of the current in wire PQ</p>
8(a)	<p>Faraday’s law of electromagnetic induction states that the magnitude of the induced emf is directly proportional to the rate of cutting of magnetic field lines by the conductor.</p> <p>or</p> <p>Faraday’s law of electromagnetic induction states that the magnitude of the induced emf is directly proportional to the rate of change magnetic flux linkage with the conductor.</p>	<p>B1</p>
(b)	<p>When the switch is first closed, the increase in the current flowing through coil A result in an increase in the magnetic field strength experienced by coil B.</p> <p>By Faraday’s Law, there is an induced emf in coil B. Since it is a closed circuit between coil B and the galvanometer, there is an induced current flowing through galvanometer which shows a deflection.</p>	<p>B1</p> <p>B1</p>
(c) (i)	<p>The batteries is replaced by an alternating current supply.</p> <p>Also accept any changes that can produce a continuous changing magnetic field in coil A.</p>	<p>B1</p>

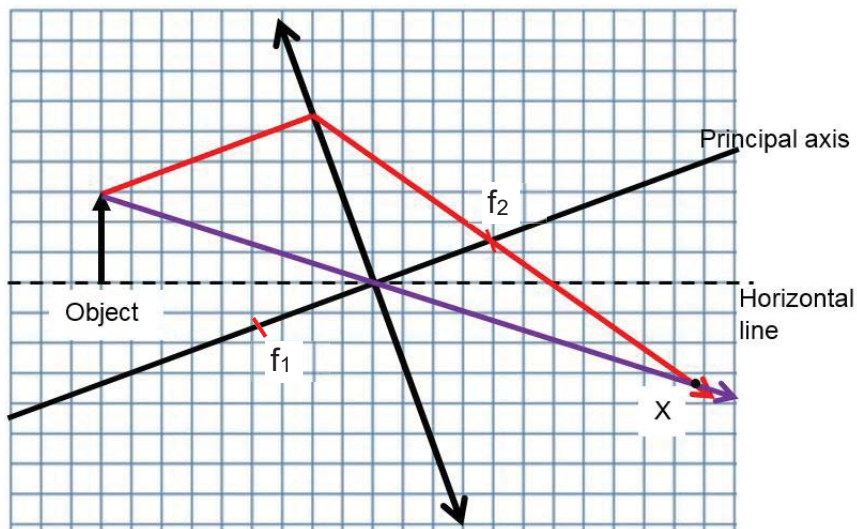
<p>(ii)</p>	<p>One of the following:</p> <ul style="list-style-type: none"> - decreasing the number of turns in coil B (explanation: use $N_s/N_p = V_s/V_p$ and $P = I_s V_s$, since V_s decreases) - increasing the number of turns in coil A (explanation: use $N_s/N_p = V_s/V_p$ and $P = I_s V_s$, since V_s decreases) - Use a more sensitive galvanometer (explanation: greater deflection for the same amount of current flow through the galvanometer) - Use connecting wire of a lower resistance (explanation: will give a larger amount of current flow for the same power output, use $P = I^2 R$) <p>(Do not accept open and close the switch faster as this will not affect the rate of cutting of magnetic field lines by the conductor. The magnetic field is produced at the instant when the switch is just close)</p>	<p>B1</p>
--------------------	--	-----------

Section B

Qn	Solution	Marking Scheme														
9(a)	Newton's 1 st law of motion states that an object will remain at rest or continue to move with a constant speed along a straight line unless a resultant force acts on the object.	B1														
(b)		<p>B1 – students name the two forces correctly</p> <p>B1 – both arrows must have the same length</p>														
(c)	 <table border="1" data-bbox="252 913 1082 1659"> <caption>Data points from the graph</caption> <thead> <tr> <th>Power / MW</th> <th>Average Force / N</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>2.0</td> <td>200</td> </tr> <tr> <td>3.0</td> <td>400</td> </tr> <tr> <td>4.0</td> <td>640</td> </tr> <tr> <td>5.0</td> <td>800</td> </tr> <tr> <td>8.0</td> <td>900</td> </tr> </tbody> </table>	Power / MW	Average Force / N	0	0	2.0	200	3.0	400	4.0	640	5.0	800	8.0	900	<p>B1 – correct plotting of points</p> <p>B1 – correct shape of graph (no marks if student draws a straight line)</p>
Power / MW	Average Force / N															
0	0															
2.0	200															
3.0	400															
4.0	640															
5.0	800															
8.0	900															
(d)	750 N	B1														
(i)	From the graph,	B1 – allow ecf from part (c)														
(ii)	the power required = 4.6 MW															

(iii)	<p>Corresponding wind force = 800 N</p> <p>Using Newton's 2nd Law,</p> $F_{\text{net}} = m \times a$ $800 - 750 = 75 \times a$ $a \approx 0.067 \text{ m s}^{-2} \text{ (2 sf)}$	<p>M1</p> <p>A1 – accept only 2 sf</p>
(e)	<p>As <u>the wind force can be smaller than the weight of the person</u>, the person will descend vertically and a safety net will be able to prevent the person from any impact with the base of the chamber.</p>	<p>B1</p>
10(a) (i)	<p>The light ray is moving away from the normal as it across the boundary. This implies that the speed of light ray in the medium X is higher than the speed of the light ray in the diamond.</p> <p>Thus, the refractive index of medium X is smaller than of the diamond.</p>	<p>M1</p> <p>A1</p>
(ii) 1.	<p>Critical angle is the angle of incidence when the light ray is travelling from an optically denser medium to a less dense medium and the angle of refraction is 90°.</p>	<p>B1</p>
(ii) 2.	<p>As the angle of incidence is larger than the critical angle, the light ray will go through total internal reflection.</p> <p>Using law of reflection, the angle of reflection will be equal to the angle of incidence.</p>	<p>B1</p> <p>B1</p>
(ii) 3.	<p>Critical angle is smaller than 39°.</p> <p>Note: For the same angle of incidence, the light ray will bend more away from the normal if medium X is water. Thus, this implies that the critical angle will not need to reach 39° for angle of refraction to be 90°.</p>	<p>B1</p>
(b) (i)	<p>Principal axis is defined as a straight line passing through the optical centre and perpendicular to the vertical plane of the lens.</p>	<p>B1</p>

(ii)



Marking points:

1. Correct construction of principal axis and labelling of focal points
2.
 - **Ray** from object passing through optical centre
 - **Ray** parallel to principal axis and passing through focal point.
 - **Direction** of rays from object
 - **Labelling** of image X

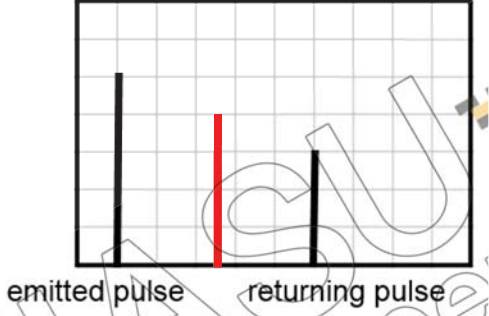
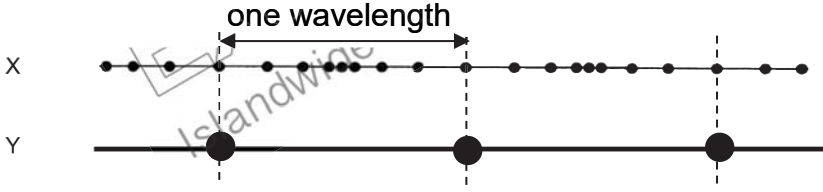
B1 mark

B2 marks –all 4 correct marking point

B1 marks – only 2 or 3 correct

(allows ecf from part (ii)1.)

Either

<p>11(a)</p>	<p>Ultrasound is defined as sound with a frequency that is greater than 20 000 Hz.</p>	<p>B1</p>
<p>(b) (i)</p>	<p>It means that for every one second, the particle will make 25000 complete oscillations about its undisturbed position.</p> <p>Note: Do not accept the source generates 25000 completes waves in one second.</p>	<p>B1</p>
<p>(ii)</p>	<p>Distance between the obstacle and the back bumper $= \frac{1}{2} \times \text{total distance travelled by the ultrasound}$ $= \frac{1}{2} \times (\text{speed of sound} \times \text{time taken})$ $= \frac{1}{2} \times 330 \times 800 \times 10^{-6}$ $= 0.132 \text{ m}$ $= 13.2 \text{ cm}$</p>	<p>M1 A1</p>
<p>(iii)</p>		<p>B1 – the returning pulse should have a larger amplitude and nearer to the emitter pulse.</p>
<p>(c) (i)</p>	<p>Rarefaction is the region in the sound wave which has the lowest air pressure (the adjacent particles are the furthest apart).</p>	<p>B1</p>
<p>(ii) 1. 2.</p>		<p>B1 B1</p>
<p>3.</p>	<p>After 1 period, all the particles will have returned back to the original position. When another $\frac{1}{2}$ period has progressed, all the rarefaction zone will be changed to compression zone.</p> <p>The particle at the centre of rarefaction would have moved to its furthest point and returned back to its undisturbed position and will now be at the centre of compression zone.</p>	<p>B1 B1</p>

