

**UNIVERSITY OF MALTA**

**SECONDARY EDUCATION CERTIFICATE  
SEC**

**PHYSICS  
May 2011**

**MARKING SCHEME**

**MATRICULATION AND SECONDARY EDUCATION  
CERTIFICATE EXAMINATIONS BOARD**

**PHYSICS SEC MAY 2011 – MARKING SCHEME – PAPER I**

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
1	(a) (i)	24 hours, 365 ¼ days, stars, planets	1,1,1,1	Accept ‘1 day’ ‘365 days’ ‘1 year’ ‘12 months’
	(ii)	Gravitational force	1	Accept ‘force due to gravity’
	(iii)	<ul style="list-style-type: none"> <li>• force increases</li> <li>• force decreases</li> </ul>	1 1	
	(b) (i)	Geostationary / equatorial	1	Accept ‘communication’
	(ii)	The satellite orbits at the same time as Earth and in the same direction	1 1	Accept ‘satellite orbits the earth every 24 hours in the same direction as that of the Earth’ Do not accept ‘same speed’
		TOTAL	10 marks	
2	(a)	$v = u + at$ or $a = \text{gradient} = \Delta v / \Delta t$ $10 = 0 + a \cdot 4$ $= 10 / 4$ $a = 2.5 \text{ m/s}^2$ $= 2.5 \text{ m/s}^2$	1 1	correct value correct units
	(b)	Runs with constant velocity/speed	1	Accept ‘runs with uniform velocity / speed’
	(c)	Area under graph = ½ h (a + b) = ½ x 10 (10 + 6) = 80 m	1 1 1	correct method; accept other methods correct value correct units
	(d) (i)	Average velocity = total distance / total time = 80 / 10 = 8 m/s	1 1	correct value correct units
	(ii)	Horizontal line drawn at 8 m/s	1 1	
		TOTAL	10 marks	
3	(a) (i)	9 m	1	

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
	(ii)	36 m	1	
	(iii)	tiredness / stress/ consumption of alcohol or drugs/ age / distraction such as using the mobile phone / agility / poor eyesight	1,1	Do not accept 'visibility', 'foot not on pedal', 'type of shoes'
	(iv)	It will require a longer thinking and braking distance to stop the car	1	Accept 'stopping distance, thinking distance or braking distance is longer'
	(v)	when thinking distance is doubled, the braking increases by a factor of 4	1 1	Accept 'the thinking distance increases, but the braking distance increases at a higher rate'
	(b)	Graph B Force is directly proportional to the rate of change of momentum and is overall lower in magnitude	1 1 1	Accept 'The impact force is spread out over a longer period of time'
		TOTAL	10 marks	
4	(a)	The pressure of the Earth's atmosphere created a very large force on the outer surface of the ball.  No atmospheric pressure on the inside to counteract the outside pressure	1  1	
	(b) (i)	Air particles collide with the walls of the bottle creating a force over an area	1	Accept also 'air particles collide with the walls of the bottle'
	(ii)	The particles inside the bottle have less energy (lower temperature), thus collide with a smaller force on the inside of the bottle  The force of the particles outside the bottle cause the bottle to crush	1  1	Outside pressure is greater than inside pressure - give 1 mark. Due to heat / temperature / KE of particles give 1 mark
	(c)	The weight of the person is measured on a scales The area of the foot in contact with the ground is measured drawing the outline of the foot on graph paper Pressure = weight / area	1 1 1	If 'mass' is used instead of 'weight' give 1 mark less
	(d)	Pressure = $\rho h g$  = 1030 x 100 x 10  = 1,030,000 N/m <sup>2</sup> or Pa or 1030 kPa	1  1	

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
		Total pressure = $1030 + 101 = 1131$ kPa		
		TOTAL	10 marks	
5	(a)	0.25, 0.35	1	Both need to be correct
	(b)			If candidates use wrong values from graph, then all the graph is wrong - 0 marks overall; If graph is not started from 0, give 1 mark less overall
		Correct scale	1	
		Correct axes	1	Verified through correct labels
		Correct points marked & graph is at least half the size of graph paper	1	
		Best straight line graph drawn	1	
	(c)	Force at X is directly proportional to the distance D	1	Do not accept 'proportional'
	(d)	Gradient = change in y / change in x $= 1 \pm 0.1$ N/m	1 1	correct value correct units
	(e) (i)	Ruler will tilt clockwise	1	
	(ii)	By moving pan Y at a distance of D/2 from the pivot	1	
		TOTAL	10 marks	
6	(a) (i)	Acceleration Constant speed / Terminal speed Deceleration / slowing down	1 1 1	Accept 'increasing speed' Accept 'uniform speed' Accept 'decreasing speed' Do not accept 'braking'
	(ii)	Air drag & force due to friction	1,1	Accept 'air resistance' or 'friction'
	(b) (i)	Change in momentum = $mv - mu$ $= 1500(20 - 12)$ $= 12,000$ kgm/s or Ns	1 1 1	correct working correct value correct units
	(ii)	Resultant F = change in momentum / time $= 12,000 / (2 \times 60)$ $= 100$ N or 105N	1 1	conversion of time to sec correct value

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
		TOTAL	10 marks	
7	(a) (i)	8	1	
	(ii)	${}^{14}_6\text{C} \rightarrow {}^{14}_7\text{N} + {}^0_{-1}\beta$ or e	1 1	correct beta rest of equation
	(b) (i)	Half-life is the time taken for half the radioactive substance to decay	1 1	Do not accept 'half the atom'
	(ii)	5730 years	1	
	(iii)	100 % $\rightarrow$ 50% $\rightarrow$ 25% $\rightarrow$ 12.5%	1 1	If answer is given as a fraction deduce 1 mark correct working correct answer
	(iv)	No Because since carbon-14 has a long half life only a few carbon 14 atoms would have disintegrated and thus it will not give an accurate result.	1 1	
		TOTAL	10 marks	
8	(a) (i)	The distance between two consecutive/successive crests or troughs	1	
	(ii)	The maximum displacement from the undisturbed position / mean	1	Accept 'half the height of wave.
	(iii)	The number of complete oscillations per second	1	
	(b) (i)	$v = f \lambda$ $343 = 261.3 \times \lambda$ $1.31 \text{ m} = \lambda$	1 1	correct value correct units
	(ii)	$f = 1 / T$ $T = 1 / 261.3$ $T = 0.004 \text{ s}$ or $0.0038 \text{ s}$	1 1	correct value correct units
	(c) (i)	Sketch shows a higher amplitude but same frequency	1	
	(ii)	Louder means a higher amplitude;	1	Accept 'air particles are

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
		same pitch means same frequency / number of waves per second	1	displaced more'
		TOTAL	10 marks	
9	(a) (i)	The oscillations /vibrations are perpendicular to the direction of travel of the wave	2	If 'crest or trough only' give 1 mark
	(ii)	All travel at the same speed in a vacuum They do not need a medium to travel	1,1	Accept 'carry energy, undergo reflection, refraction, diffraction, etc.
	(b)	Infra-red, ultra violet, frequency	1,1,1	
	(c)	In curing cancer, in sterilization, etc In X-ray photography, scans, etc In heating food, communication, mobile phone, TV remote etc	1 1 1	Do not accept 'kills bacteria'
		TOTAL	10 marks	
10	(a) (i)	A longitudinal wave is one in which the oscillations / vibrations are parallel to the direction of travel of the wave	1 1	If 'compression or rarefaction only' give 1 mark
	(ii)	By a vibrating object / oscillating object	1	
	(iii)	It is impossible to hear sounds in outer space Sound needs a medium (air) to travel	1 1	Accept 'sound cannot travel through a vacuum' - 2 marks Does not hear the sound - 1 mark
	(b) (i)	An echo is the reflection of sound back to the listener some time after	1	
	(ii)	The uneven surface of the cave produces different echoes At different time intervals	1 1	Accept 'reverberation - multiple echos'
	(c)	$v = s / t$ $330 = s / 0.2$ $66 \text{ m} = s$ Distance from wall is 33 m	1 1	

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
			TOTAL 10 marks	

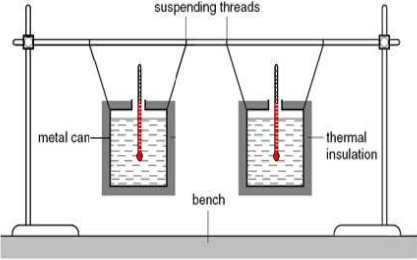
PHYSICS SEC MAY 2011 – MARKING SCHEME – PAPER IIA

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
1	(a) (i)		1 1 1	correct shape of field correct direction of field correct poles
	(ii)	No, Steel is permanently magnetized	1 1	Do not accept 'hard magnet' Accept 'magnetism occurs' or 'S attract N'
	(iii)	Metal bar has a South pole induced near the North pole of steel	1 1	
	(iv)	Variable resistor, ammeter	1,1	Do not accept battery as this is already given in the diagram
	(v)	Set current at a particular value Bring nails close to the electromagnet and close switch Count how many nails are picked up and note current value Increase current and repeat process	1 1 1 1	
	(vi)	Any suitable precaution	1	
	(b) (i)	Iron switch is attracted towards magnet and circuit A is closed. Current flows through circuit A and induces a magnetic field around electromagnet	1 1	
	(ii)	Iron rocker moves upwards to push flexible contacts together Current flows through circuit B and siren is sounded	1 1 1	
	(iii)	The alarm system will still work in case there is a power failure	1	Do not accept answers related to a.c.



		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
		TOTAL	20 marks	
2	(a) (i)	Electrical	1	
	(ii)	100 J	1	
	(iii)	Adv: does not pollute; generates free electricity Disadv: does not generate electricity at night capital expenditure per unit produced is high	1,1,1,1	Accept as an adv: saves money, renewable, good for the environment'. Do not accept as an adv: 'easy to use', efficient'. Accept as a disadvantage: 'needs a large area'
	(b) (i)	Coal / oil / natural gas / nuclear fuel	1,1	Fossil fuel & oil/coal/etc. should only be given 1 mark Do not accept 'gas' only
	(ii)	e.g. they may be used to generate electricity at all times; nuclear fuel yields a very large amount of energy per unit mass, etc	1 1	Any suitable advantage
	(c) (i)	$W = m g$ $= 0.1 \times 10$ $= 1 \text{ N}$	1 1	converting mass to kg correct value
	(ii)	Work is done on a body when a force acts in the same direction as the movement of the body over a certain distance	1 1	If formula only is given, then give 0 marks
	(iii)	$W = F \times s$ $= 5 \times 0.3$ $= 1.5 \text{ J}$	1 1	correct conversion of cm to m correct value
	(iv)	Work done is converted into internal energy in wheels / energy to overcome frictional forces or air resistance / heat / sound	1 1	'Work done is converted to K.E.' - give 1 mark
	(d)	Efficiency = (work output / work input) x 100 $= 294 / 300 \times 100$ $= 98 \%$	1 1	correct value correct units
		TOTAL	20 marks	

3	(a) (i)	Polythene	1	Do not accept 'plastic'
	(ii)	Step 1: metal plate is brought close to insulator Step 2: separation of charges occurs in metal plate Step 3: electrons flow out through the earth provided by the finger; Step 4: earth is removed and metal plate is charged The metal plate will end up positively charged	1 1 1	
	(iii)	Charging by induction	1	Accept 'induction' only
	(iv)	Coulombs	1	Accept 'C' or 'AmpSecond'
	(v)	Accumulation of charge on a moving object Earthing is provided to remove charge safely	1 1	Accept 'lightning rod, refuelling of aircraft, operating theatre'
	(b) (i)	The rubbed balloon is charged it will be attracted to the oppositely induced charge on the wall	1 1	Do not penalise if candidate states that balloon is positively charged. Accept reference to 'neutral wall' as indication of existence of different charges
	(ii)	The damp cloth, being an electrical conductor, enables charge to be earthed The dry cloth retains charge on it as it is not conducting	1 1	
	(iii)	A charged object will attract the paint spray droplets and so will help to spread the paint all over the object instead of being wasted on the floor	1 1	
	(iv)	Paper is has equal amounts of positive and negative charges - neutral and so it will be attracted to both positive and negative charge	1 1	
	(c) (i)	Dust particles are given negative charge when they meet the metal grid They are then attracted to the positively charged plate and collected	1 1	Accept also, 'dust particles are neutral, they are attracted to the -ve grid, some which escape are attracted to the +ve plate
	(ii)	It helps to reduce atmospheric pollution	1 1	Give 1 mark if 'pollution' only is stated

		TOTAL	20 marks	
4	(a) (i)	The PE stored in the two masses is converted into KE	1	Accept 'falling masses' or 'PE of masses'
	(ii)	By the paddle moving in the water	1	Accept 'KE supplied'
	(iii)	Heat gain = $m c \Delta\theta$ $= 0.468 \times 4200 \times 0.01$ $= 19.656 \text{ J or } 19.7 \text{ J}$	1 1 1	correct values to symbols correct value correct units
	(iv)	$19.656 / 2 = 9.828 \text{ J or } 9.8 \text{ J}$	1	
	(v)	Energy = $m g h$ $9.828 = 1 \times 10 \times h$ $0.98m = h$	1	
	(vi)	So that heat increase is not lost to the surroundings	1	Do not accept 'heat is transferred from the outside inwards'
	(vii)	Principle states that energy is neither created nor destroyed but only changed from one form to another	1	Definition has to be complete
	(b) (i)		1,1	This diagram or similar. The diagram should indicate that a fair test is being conducted
	(ii)	Two cans containing water are heated to the same temperature. One can is insulated with a known material, the other with the new material. Cans are left to cool, taking temperature reading every fixed period of time	1 1 1	
	(iii)	The results are presented on a graph of temperature vs time	1 1	
	(iv)	The graph which is less steep / has smaller slope is the one with the best thermal insulation	1 1	
	(v)	The water must initially be at the same temperature, the volume of water in the cans must be equal, the amount of insulation around each can must be equal, stir the water	1,1	Any two appropriate precautions

		TOTAL	20 marks	
5	(a) (i)	In the series circuit the same current flowing out of cells flows through all the bulbs	1	
		In the parallel circuit, only part of the current flowing out of cells flows through each bulb.	1	
	(ii)	In the series circuit the voltage across each bulb is a fraction of the voltage of the cell	1	
		In the parallel circuit the voltage across each bulb is equal to the voltage of the cell	1	
	(b) (i)	$V = I R$ $= 0.5 \times 10$ $= 5 \text{ V}$	1 1	correct value correct unit
		(ii)	$V = I R$ $5 = 0.4 (5 + R)$ $7.5 \Omega = R$	1 1
	(iii)	$P = I V$ $= (0.4 + 0.5) \times 5$ $= 4.5 \text{ W}$	1 1	correct value correct unit
		(c) (i)	The current changes direction 50 times per sec / every 0.02 s	1
	(ii)	$P = I V$ $1080 = I \times 240$ $4.5 \text{ A} = I$	1 1	correct value correct unit
		(iii)	$E = I V t$ $= 4.5 \times 240 \times (30 \times 60)$ $= 1944,000 \text{ J or } 1944 \text{ kJ}$	1 1
	(d) (i)	A thermistor does not obey Ohm's Law as the current is not directly proportional to the voltage	1 1	
		The resistance of the thermistor decreases as the temperature increases	1 1	
	(ii)	Used as a temperature sensor, in self regulating heating elements devices, fire alarm, replacement for fuses, as timers in the degaussing coil circuit	1	Any suitable application

		of most CRT displays & TV, as resistance thermometers, to monitor coolant temp & oil temp in cars, to monitor temp of an incubator, in digital thermostats.		
			TOTAL	20 marks

**PHYSICS SEC MAY 2011 – MARKING SCHEME – PAPER IIB**

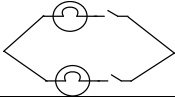
		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
1	(a) (i)		1 1 1	correct shape of field correct direction of field correct poles
	(ii)	No, An electromagnet requires a material which is easily magnetized and demagnetized	1 1	Do not accept 'hard magnet' Accept 'magnetism occurs' or 'S attract N'
	(iii)	Variable resistor, ammeter	1,1	Accept 'rheostat'
	(iv)	By decreasing the resistance of the variable resistor	2	1 mark only if 'by changing the resistance' by 'setting the rheostat' give zero marks
	(v)	As the current increase The number of attached iron pieces increases	1 1	
	(vi)	Table, graph	1,1	Accept 'writing readings' instead of 'table'
	(vii)	Any suitable precaution	1	
	(b) (i)	Current flow through circuit A	1	
	(ii)	A magnetic field is induced in the metal core CD	1	
	(iii)	Side E is attracted toward side D of the metal core	1	
	(iv)	Side F moves upwards and pushes the flexible contacts	1	
	(v)	A current flows through circuit B and siren sounds alarm	1 1	Accept 'current switched on' and siren sounds alarm
		TOTAL	20 marks	

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
2	(a) (i)	Electrical	1	
	(ii)	100 J	1	
	(iii)	Adv: does not pollute; generates free electricity Disadv: does not generate electricity at night capital expenditure per unit produced is high	1 1 1 1	Accept as an adv: saves money, renewable, good for the environment'. Do not accept as an adv: 'easy to use', efficient'. Accept as a disadvantage: 'needs a large area'
	(b) (i)	Coal, nuclear	1,1	
	(ii)	Coal they may be used to generate electricity at all times; Wind is a clean source of energy nuclear fuel yields a very large amount of energy per unit mass, etc	1 1 1	Coal: generates a lot of electrical energy Wind: renewable source
	(c) (i)	100 g = 0.1 kg equivalent to 1 N 30 cm = 0.3 m	1,1 1	
	(ii)	Joules or Nm	1	Accept 'J'
	(iii)	$W = F \times s$ $= 5 \times 0.3$ $= 1.5 \text{ J}$	1 1	correct choice of values correct value
	(iv)	Work done is converted into internal energy in wheels and energy to overcome frictional forces or air resistance / heat / sound	1	
	(d)	Efficiency = (work output / work input) x 100 $= 294 / 300 \times 100$ $= 98 \%$	1 1	correct value correct units
		TOTAL	20 marks	

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
3	(a) (i)	negatively	1	Any other suitable example
	(ii)	No an uncharged object has equal amounts of negative and positive charges	1	If 'no' only is given, allocate zero marks. Accept 'equal charges'.
	(b)(i)	<p>2 3 4 5</p>	1 1 1 1	1 mark each for steps 2, 3, 4 and 5.
	(ii)	Charging by induction	1	Accept 'induction' only
	(iii)	Coulombs	1	Accept 'C' or 'AmpSecond'
	(iv)	Accumulation of charge on a moving object Earthing is provided to remove charge safely	1 1	Accept 'lightning rod, refuelling of aircraft, operating theatre'
	(c) (i)	The rubbed balloon is charged it will be attracted to the opposite charge on the wall	1 1	Accept static charge / electricity occurs. Do not penalise if candidate states that balloon is positively charged. Accept reference to 'neutral wall' as indication of existence of different charges
	(ii)	A charged object will attract the paint spray droplets and so will help to spread the paint all over the object	1 1	
	(iii)	Paper is has equal amounts of positive and negative charges - neutral and so it will be attracted to both positive and negative charge	1 1	Accept answers in terms of separation of charge
	(d) (i)	Dust particles are given negative charge when they meet the metal grid They are then attracted to the positively charged plate and collected	1 1	Accept also, 'dust particles are neutral, they are attracted to the -ve grid, some which escape are attracted to the +ve plate
	(ii)	It helps to reduce atmospheric pollution	1 1	Give 1 mark if 'pollution' only is stated



		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
		TOTAL	20 marks	
4	(a) (i)	The PE stored in the two masses is converted into KE	1	Accept 'falling masses' or 'PE of masses'
	(ii)	Thermometer	1	
	(iii)	Heat gain = $m c \Delta\theta$ = $0.468 \times 4200 \times 0.01$ = 19.656 J or 19.7 J	1 1 1	correct value to symbol correct value correct units
	(iv)	$19.656 / 2 = 9.828 \text{ J or } 9.8 \text{ J}$	1	
	(v)	Energy = $m g h$ $9.828 = 1 \times 10 \times h$ $0.98m = h$	1	
	(vi)	So that heat is not lost to the surroundings	1	Do not accept 'heat is transferred from the outside inwards'
	(vii)	Principle states that energy is neither created nor destroyed but only changed from one form to another	1	Definition has to be complete
	(b) (i)	Two cans containing water are heated to the same temperature. One can is insulated with a known material, the other with the new material. Cans are left to cool, Taking temperature reading ever fixed period of time	1 1 1 1	
	(ii)	The water must initially be at the same temperature, the volume of water in the cans must be equal, the thickness of insulation around each can must be equal, stir the water.	1,1	Any two appropriate precautions
	(iii)	A is the best insulator A retains the higher temperature after the same period of time	1 1 1	Accept 'Graph A is less steep so it indicates the best insulator'
	(iv)	Conduction, radiation	1,1	
		TOTAL	20 marks	

		<i>Answer</i>	<i>Marks</i>	<i>Additional guidelines</i>
5	(a) (i)		1 1	Bulbs drawn in parallel Switches in correct position
	(ii)	In parallel	1	
	(iii)	When one device is switched off the rest of devices can still be operated	1 1	Accept 'consumes less energy'
	(b) (i)	$V = I R$ $= 0.5 \times 10$ $= 5 \text{ V}$	1 1	correct value correct unit
	(ii)	5 V	1	
	(iii)	$V = I R$ $5 = 0.4 (5 + R)$ $7.5 \Omega = R$	1 1 1	correct working correct value correct unit
	(c) (i)	The current changes direction 50 times per sec / every 0.02 s	1	
	(ii)	$P = I V$ $1080 = I \times 240$ $4.5 \text{ A} = I$	1 1	correct value correct unit
	(iii)	$E = I V t$ $= 4.5 \times 240 \times 1800$ $= 1944,000 \text{ J or } 1944 \text{ kJ}$	1 1	correct value correct unit
	(d) (i)	A thermistor does not obey Ohm's Law as the current is not directly proportional to the voltage, i.e. non-ohmic	1 1	
	(ii)	The resistance of the thermistor decreases as the temperature increases	1	
	(iii)	Used as a temperature sensor, in self regulating heating elements devices, fire alarm, replacement for fuses, as timers in the degaussing coil circuit of most CRT displays & TV, as resistance thermometers, to monitor coolant temp & oil temp in cars, to monitor temp of an incubator, in digital thermostats.	1	
		TOTAL	20 marks	