GCSE

Science: Physics

Summer 2010

Mark Schemes

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NORTHERN IRELAND GENERAL CERTIFICATE OF SECONDARY EDUCATION (GCSE)
AND NORTHERN IRELAND GENERAL CERTIFICATE OF EDUCATION (GCE)

MARK SCHEMES (2010)

Foreword

Introduction

Mark Schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

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General Certificate of Secondary Education
2010

Science: Physics

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Foundation Tier

[G7602]

FRIDAY 28 MAY, MORNING

MARK SCHEME

Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply to formal proofs and derivations, which must be valid in all the stages shown in the mark scheme to obtain full credit.

2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

				AVAILABLE MARKS
1	(a)	(i)	[wt = mg or wt = $\frac{100}{1000} \times 10$ [1]/[2] force = 1 (N) [2]/[2] [2]	
		(ii)	150 mm [1]	
		(iii)	200 g gives an ext 200 – 150 = 50 mm 100 g gives an ext $\frac{50}{2}$ = 25 mm [1]	
		(iv)	Evidence on graph of attempt to find load at 250 mm [1] Mass = 400 (g) [1]	
		(v)	The extension is proportional to the load [1] Provided the elastic limit is not exceeded [1]	
		(vi)	Straight line from 600 g to 800 g [1] Upward curve from 800 g to 1000 g [1]	
	(b)	(i)	Weight or gravity or drag [1]	
		(ii)	The rocket is speeding up [1]	
	(c)	(i)	Arrow labelled F from satellite to centre of Earth [1]	
		(ii)	The gravitational pull of the Earth or simply gravity [1]	
		(iii)	Arrow labelled V at a **tangent to orbit**, **clockwise**. (both needed) [1]	
		(iv)	Velocity is a vector, speed is not Or velocity depends on direction, speed does not [1] QWC [1]	
		(v)	Speed = distance/time [1] = 40 000/1.5 [1] = 26 667 (km/h) [1]	20

					AVAILABLE MARKS
2	(a)	(i)	KINETIC energy in the wind	[1]	
			KINETIC energy in moving rotor blades	[1]	
			ELECTRICAL output energy from the turbine	[1]	
		(ii)	Noise (sound)	[1]	
			Heat	[1]	
		(iii)	Lack of wind/unreliable	[1]	
		(iv)	30% of input energy appears as electrical energy or 30% of input energy appears as useful output energy or Useful output energy/total input energy = 0.3	[2]	
	(b)	(i)	Burning of fossil fuels/specific examples – using motor cars, etc.	[1]	
			Release of carbon dioxide	[1]	
		(ii)	It does not release carbon dioxide	[1]	
		(iii)	It is radioactive	[1]	
		(iv)	Uranium or plutonium	[1]	
		(v)	There are limited reserves of uranium Or It cannot be replaced in a human lifetime!	[1]	
	(c)	(i)	Rectangle – where diagonals meet (judge by eye)	[1]	
			Centre of circle	[1]	
		(ii)	About the centre but **must** be on the line	[1]	
		(iii)	Mark the current line Suspend from a different point	[2]	
			Re-attach plumb line and mark it – any 2 from these CoM where lines meet – must be present for all 3 marks	[1]	20

					AVAILABLE MARKS
3	**(a)**	**(i)**	X-rays, Ultraviolet, Infra-red, Radio ([1] each)	[4]	
		(ii)	Travel in a vacuum or all travel at the same speed in a vacuum	[1]	
	(b)	**(i)**	Gamma (γ) rays	[1]	
		(ii)	Microwaves	[1]	
		(iii)	Ultraviolet	[1]	
	(c)	**(i)**	Luminous – emit light	[1]	
		(ii)	example – Sun/stars/flames/filament bulbs/anything with potential to emit light	[1]	
		(iii)	Non-luminous – do not emit their own light/scatter/reflect light or seen by reflecting light	[1]	
		(iv)	example – Moon/Earth/pen/book etc	[1]	
	(d)	**(i)**	Normals at A and B (at 90° to mirror by eye)	[1]	
		(ii)	Incident rays from candle flame to points of reflection at mirror. (Both must come from same point between bottom of bulb or right side.)	[1]	
		(iii)	Arrow(s) on incident rays going towards mirror	[1]	
	(e)	**(i)**	50° No ECF to **(ii)**	[1]	
		(ii)	50°	[1]	
		(iii)	Evidence / Recognition } that incident ray strikes M_2 at 90° [1]/[2] Angle of incidence at M_2 is 0°	[2]	
		(iv)	Reflected ray back along path of incidence	[1]	20

				AVAILABLE MARKS
4	(a)	(i)	No of protons = no of electrons/ Equal amounts of +ve and –ve charge [1]	
		(ii)	Negative [1]	
		(iii)	Rod is –ve [1] cloth is +ve [1] [2]	
	(b)	(i)	Ammeter [1]	
		(ii)	Amp or ampere [1]	
		(iii)	Current increases if lamp brightens Current decreases if lamp dims Current constant if brightness unchanged (Any 2) [2]	
		(iv)	+ to left of the battery [1]	
		(v)	Arrow **clockwise** [1]	
	(c)	(i)	In series [1]	
		(ii)	Equal to [1]	
	(d)	(i)	V in parallel with A using ——Ⓥ—— [1]	
		(ii)	0.35 [1]	
		(iii)	1.4 [1]	
		(iv)	$V = V_1 + V_2$ [1]/[2] V = 2.8 [2]/[2] ECF from **(iii)** should be V = 1.4 + Answer to **(iii)** correctly calculated [2]/[2] [2]	
		(v)	R = V/I [1] $= \frac{2.8}{0.2}$ ECF from **(iv)** [1] = 14 [1]	20

					AVAILABLE MARKS
5	**(a)**	**(i)**	electron, proton, neutron ([1] each)	[3]	
		(ii)	proton, neutron (both needed) mention of electron [0]/[1]	[1]	
		(iii)	3 protons and 4 neutrons (ignore references to electrons)	[2]	
	(b)	**(i)**	an electron	[1]	
		(ii)	the nucleus	[1]	
		(iii)	alpha gamma	[1] [1]	
		(iv)	alpha	[1]	
	(c)	**(i)**	lead	[1]	
		(ii)	To reduce / absorb the radiation/protect from radiation/safer	[1]	
			To produce / direct a narrow beam of beta particles	[1]	
		(iii)	The user is further from the source To reduce contact/exposure/avoid damage to skin	[1]	
		(iv)	Remove source and read the detector or measure background [1] Put Al sheet between source and detector/in front of detector or source [1] Take a reading on detector [1] Add extra sheets of/increase thickness of Al [1] UNTIL READING (if mark for reading not given yet) [1] IS CONSTANT or EQUALS BACKGROUND or is ZERO [1] This thickness equals the range [1] Any five points [(Max [5])]	[5]	20
				Total	**100**

Rewarding Learning

General Certificate of Secondary Education
2010

Science: Physics

Paper 2
Foundation Tier

[G7603]

WEDNESDAY 16 JUNE, MORNING

MARK SCHEME

Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote units for intermediate numerical quantities.

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2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6}m) count only as arithmetical slips and lose the answer/unit mark.

					AVAILABLE MARKS
1	**(a)**	Mass in kilograms/grams kg, g	[1]		
		Weight in newtons/N	[1]	[2]	
	(b)	**(i)** CoG marked with an X at the centre of beam on or in the beam		[1]	
		(ii) The centre of mass or centre of gravity		[1]	
		(iii) P = F/A	[1]		
		= 20 000/8	[1]		
		= 2500	[1]		
		Pa or N/m^2	[1]	[4]	
		(iv) Pivot P marked as the RH end		[1]	
		(v) Moment = force × distance (from pivot)	[1]		
		= 12 500 × (5 – 1)	[1]		
		= 50 000 (ecf for position of pivot)	[1]		
		Nm	[1]	[4]	
	(c)	**(i)** 24 cm^3		[1]	
		(ii) 28 – 24	[1]		
		= 4 cm^3	[1]	[2]	
		(iii) D = M/V	[1]		
		= 42/4 (ecf from **(ii)** for volume)	[1]		
		= 10.5	[1]	[3]	
		(iv) Silver ecf from **(iii)**		[1]	20

AVAILABLE MARKS

2 **(a)** **(i)** Kinetic energy is CONSTANT [1]
Potential energy is CONSTANT [1] [2]

(ii) Kinetic energy is INCREASING [1]
Potential energy is CONSTANT [1] [2]

(iii) CHEMICAL [1]

(iv) 8×25 **or** $w = f \times d$ [1]
$= 200$ (J) [1] [2]

(v) 200 ecf from **(iv)** for work [1]
W [1] [2]

(b) Any **four** from:
Known weight or known mass or use of newtonmeter or balance to find it
Two points a measured distance apart/length of string
Switch on motor
Time to move between points/measured with stopclock
Repeat or take average
Plus:
Power = $\frac{\text{work done}}{\text{time taken}}$ **or** Power = weight × speed (essential for full marks) [5]

Quality of written communication [1]

(c) **(i)** Air IN at bottom [1]
Air OUT at the top [1] [2]

(ii) Liquid [1]

(d) **(i)** Upward curve or line starting at same level [1]
Copper rising more quickly [1] [2]

(ii) Collisions } insist on these terms [1]
(iii) Vibrations } insist on these terms electrons vibrate [0] atoms vibrate [0] [1]

(e) **(i)** Metals expand by different amounts [1]

(ii) Gap narrows when it heats up or gap widens when it cools [1]
Forces will damage bridge/cause collapse etc. [1] [2]

25

						AVAILABLE MARKS
3	**(a)**	**(i)**	Transverse [1] Longitudinal [1]		[2]	
		(ii)	Energy, KE, PE or mechanical energy		[1]	
		(iii)	Vibrates/oscillates [1] Perpendicular to the direction of energy transfer/motion of wave [1] moves up or down [1] moves up **and** down [2]		[2]	
		(iv)	0.3 (m)		[1]	
		(v)	0.8 (m)		[1]	
		(vi)	f = no. of vibrations/time taken (or f = 24/8 or equivalent) [1] f = 3 (Hz) [1] $f = \frac{I}{T}$ give [1]		[2]	
		(vii)	$v = f\lambda$ [1] $v = 3 \times 0.8$ ecf from **(v)** for wavelength and **(vi)** for frequency [1] v = 2.4 (m/s) [1]		[3]	
	(b)	**(i)**	1. Hammer seen striking gong or bell still working [1] 2. No sound heard from bell or fainter sound [1]		[2]	
		(ii)	Sound cannot travel in a vacuum **or** sound needs particles for propagation **or** equivalent **or** light can travel through a vacuum		[1]	
		(iii)	Ultrasound/ultrasonic		[1]	
	(c)	**(i)**	One wave shown over the four grid squares [1] of **greater the amplitude** as before [1]		[2]	
		(ii)	**Two waves shown** over the four grid squares [1] Same amplitude [1]		[2]	20

						AVAILABLE MARKS
4	**(a)**	**(i)**	Close the switch		[1]	
		(ii)	Less turns	[1]		
			Remove the iron nail	[1]	[2]	
			Use one cell [0]			
		(iii)	So that current flows around the nail		[1]	
		(iv)	It retains its magnetism		[1]	
	(b)	**(i)**	Variable resistor/rheostat/variable power supply		[1]	
		(ii)	4 points plotted $\pm \frac{1}{2}$ smallest square	[1]		
			joining points [0] max [0]			
			Best fit line	[1]		
			Through 0, 0 $\pm$ 1 square	[1]	[3]	
		(iii)	10 clips			
			1.2 A intersects line at approx 10.5 clips			
			or look at intercept on candidate's graph			
			Answer must be integer (lower one)		[1]	
	(c)	**(i)**	Battery, switch	[1]		
			in series with coil – complete circuit	[1]		
			Coil wound around soft iron core			
			essential point before further credit	[1]	[3]	
			Ignore ammeters/voltmeter – other additional components [–1]			
		(ii)	Iron steel [0] and no further mark	[1]		
			Is attracted when electromagnet switched on	[1]	[2]	
			Is an electromagnet/temporary magnetism/magnetic			
		(iii)	X and Y **both** correct		[1]	
		(iv)	An insulator (may be a named insulator)			
			dependent marking	[1]		
			Otherwise device at XY always ON, there is a short circuit	[1]	[2]	
			Second circuit always on			
	(d)	(5)	3 4 6 2 1		[2]	20
			3 4 2 1 6	[1]		

						AVAILABLE MARKS
5	**(a)**	**(i)**	A collection of stars		[1]	
		(ii)	A galaxy		[1]	
	(b)	**(i)**	Neptune		[1]	
		(ii)	Mercury		[1]	
		(iii)	Venus and Mercury		[2]	
		(iv)	Mars and Jupiter		[1]	
	(c)	**(i)**	Moon	[1]		
		(ii)	Communications/spying/navigation/research any **two**	[2]	[3]	
	(d)	**(i)**	365 days **or** $365\frac{1}{4}$ days		[1]	
		(ii)	A: summer	[1]		
			C: winter	[1]	[2]	
		(iii)	Line { close to / through } the earth's centre inclined to the vertical consistent with answer to **(ii)**		[1]	
		(iv)	Area to left of **vertical** terminator shaded		[1]	15
					Total	**100**

Rewarding Learning

General Certificate of Secondary Education
2010

Science: Physics

Paper 1
Higher Tier

[G7604]

FRIDAY 28 MAY, MORNING

MARK SCHEME

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					AVAILABLE MARKS
1	(a)	(i)	The straight line does not pass through 0,0 **or** The length does not double when the mass doubles	[1]	
		(ii)	From graph 200 g gives an extension of 200 – 150 = 50 100 g gives an extension of 25 mm	[1]	
		(iii)	Straight line from 600 g to 800 g } independent Upward curve from 800 g to 1000 g }	[1] [1]	[2]
	(b)	(i)	Speed = distance/time = 40 000/1.5 = 26 667 (km/h)	[1] [1] [1]	[3]
		(ii)	Momentum = mass × velocity (speed) 26 667 km/hr = 7407.5 m/s allow ecf for speed from **(b)(i)** momentum = 150 × 7407.5 = 1 111 125 kg m/s	[1] [1] [1] [1]	[4]
		(iii)	Velocity is a vector (speed is not) **or** Velocity depends on direction (speed does not) **or** Direction is changing	[1]	
			Quality of written communication	[1]	[2]
		(iv)	Zero, 0		[1]
	(c)	(i)	The centripetal force on the polar satellite is GREATER Because it is nearer than the geostationary one (and has the same mass)	[1] [1]	[2]
		(ii)	Photographing the Earth		[1]
		(iii)	Communications or TV or weather monitoring		[1]
	(d)	(i)	W = mg or Weight of rocket = $\underline{140\,000 \times 10}$ = 1 400 000 N Resultant force = 3 000 000 – 1 400 000 = 1 600 000	[1] [1] [1]	[3]
		(ii)	F = ma or equivalent 1 600 000 = 140 000 × a A = 1 600 000/140 000 = 11.4 (m/s^2) allow ECF from **(i)** for force only	[1] [1] [1]	[3]
		(iii)	The acceleration <u>increases</u> An increase in speed is **not** acceptable		[1]

25

					AVAILABLE MARKS
2	**(a)**	**(i)**	30% of input energy appears as electrical energy **or** 30% of input energy appears as useful output energy **or** useful output energy/total input energy = 0.3	[2]	
		(ii)	Electrical energy = 0.3 × 18 [1] = 5.4 J [1]	[2]	
		(iii)	Output power = 5000 × 5.4 [2] = 27 000 allow ECF from **(ii)** [1] W [1]	[4]	
	(b)	**(i)**	No release of carbon dioxide/greenhouse gases	[1]	
		(ii)	The <u>waste is radioactive</u>/emits radiation (not just toxic/dangerous) [1] It has to be <u>stored for a long time</u> or buried for a long time [1]	[2]	
		(iii)	<u>Small amount</u> or less of uranium compared with coal/oil	[1]	
		(iv)	Decommissioning means to close down (so that there is no threat to the environment or people) [1] Disposal of the <u>radioactive</u> materials/requires special measures/specialist personnel/special equipment [1]	[2]	
	(c)	**(i)**	The momentum before a collision/explosion equals the momentum after a collision/explosion	[1]	
		(ii)	Momentum before = momentum after (no marks for the above already credited in part **(i)** 500 × 1.5 (+ 0) = 750 × V [2] V = 750/750 = 1 (m/s) [1]	[3]	
	(d)	**(i)**	The force creates a pressure or liquids incompressible [1] This pressure is transmitted (through the oil/liquid) [1]	[2]	
		(ii)	Pressure at X = pressure at the large platform or P = F/A [1] = 10 000/400 [2] or 25 = F/10 [1] F = 250 (N) [1]	[5]	25

					AVAILABLE MARKS
3	**(a)**	**(i)**	Luminous objects – emit (their own) light	[1]	
		(ii)	Example – sun, stars, flames, torch, bulb, (incandescent) lamps etc.	[1]	
		(iii)	Non-luminous objects do not produce light object/scatter/reflect light (incident upon them)	[1]	
		(iv)	Example – moon, Earth, book, pencil, pen etc	[1]	
	(b)	**(i)**	Normals at A and B (at 90° to mirror by eye)	[1]	
		(ii)	Incident rays from bulb to points of reflection at mirror must both come from same point between bottom of bulb and right side	[1]	
		(iii)	Arrow(s) on incident rays going towards mirror	[1]	
	(c)	**(i)**	50°	[1]	
		(ii)	50° no ECF to **(ii)**	[1]	
		(iii)	Recognition that incident ray strikes M_2 at 90° on diagram [1] Angle of incidence at M_2 is 0° [1]	[2]	
		(iv)	Reflected ray back along path of incidence	[1]	
	(d)	**(i)**	Distance between principal focus/focal point and (centre of) lens is 2 cm	[1]	
		(ii)	Ray parallel to PA refracted through F (to within ± $\frac{1}{2}$ square) [1] Ray through optical centre passes through lens without refraction [1] Ray through F refracts parallel to PA [1]	[3]	
		(iii)	6 cm (±0.3 cm) i.e. 5.7 to 6.3 1 $\frac{1}{2}$ divisions	[1]	
		(iv)	real inverted magnified ([1] for each)	[3]	
	(e)	**(i)**	Light is travelling TOWARDS less (optically) dense medium [1] Angle of incidence (at boundary) greater than critical angle [1]	[2]	
		(ii)	When angle <u>of incidence</u> in glass equals critical angle (42°), angle of refraction in air is 90° **or** At angles <u>of incidence</u> in glass less than the critical angle, light is refracted or at angles <u>of incidence</u> greater than the critical angle light is totally internally reflected.	[1]	
		(iii)	Medical: Endoscopy or laparoscopy or key-hole surgery or similar [1] Non-medical: Communications or telephony or cable TV or similar, broadband, interact, Christmas tree lights [1]	[2]	25

					AVAILABLE MARKS
4	**(a)**	**(i)**	No. of protons = no. of electrons/ Equal amounts of +ve and –ve charge	[1]	
		(ii)	Rod is –ve [1] cloth is +ve [1]	[2]	
	(b)	**(i)**	V in parallel with A using —Ⓥ—	[1]	
		(ii)	+ to left of the voltmeter	[1]	
		(iii)	(0.2 + 0.15 =) 0.35	[1]	
		(iv)	1.4 ← ECF	[1]	
		(v)	V = V1 + V2	[1]	
			V = 2.8 ← 1.4 + answer to **(iv)**	[1] [2]	
		(vi)	R = V/I		
			$= \frac{2.8}{0.2}$ ← ECF from **(iv)**	[1]	
				[1] [3]	
	(c)	**(i)**	$1/R = 1/R_1 + 1/R_2 + 1/R_3$	[1]	
			$= \frac{1}{4} + \frac{1}{6} + \frac{1}{12}$	[1]	
			R = 2 → ECF for resistance	[1] [3]	
		(ii)	V = IR [0] V = 2 × 2 ([1] each sub)	[2]	
			V = 4	[1] [3]	
		(iii)	I = V/R [0]		
			$I = \frac{4}{4}$ ← ECF from **(ii)**	[1]	
			I = 1.0	[1] [2]	
	(d)	**(i)**	Two way	[1]	
		(ii)	Landing/hall corridor, across room, kitchen-garage	[1]	
		(iii)	Light can be switched on and/or off at either switch	[1]	
		(iv)	Upper terminal	[1]	
		(v)	Between the correct live and switch A no ECF to **(v)**	[1]	25

						AVAILABLE MARKS
5	**(a)**	**(i)**	protons and neutrons (both needed)		[1]	
		(ii)	3 protons, 4 neutrons ([1] each)		[2]	
	(b)	**(i)**	Lead		[1]	
		(ii)	To reduce radiation To absorb the radiation/protect from radiation/safe [1] To produce/direct a (narrow) beam of beta particles [1]		[2]	
		(iii)	The user is further from the source To minimise contact/exposure		[1]	
		(iv)	Remove source and read the detector or measure background Put Al sheet between source and detector/in front of detector (or source) Take a reading on detector Add extra sheets of/increase thickness of Al until reading [1] is constant/equals background/zero [1] This thickness of Al is the range		[5]	
	(c)	**(i)**	$^{90}_{40}Zr$ $^{0}_{-1}\beta$ ([1] each number)		[4]	
		(ii)	Time for half of yttrium 90 to decay (is 64 hrs) [1] mention of mass or activity or number of nuclei or radiation [1]		[2]	
		(iii)	192/64 = 3 or 3 half lives [1] $2^3 = 8$ (or other method) or $\frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8}$ [1] 2/8 = 0.25 or 1/4 [1]		[3]	
	(d)	**(i)**	fusion		[1]	
		(ii)	(Generating) <u>electricity</u>		[1]	
		(iii)	fission is the splitting of one (heavy) <u>nucleus</u> [1] (fusion is the uniting) of two light nuclei [1]		[2]	25
				Total		**125**

Rewarding Learning

General Certificate of Secondary Education
2010

Science: Physics

Paper 2
Higher Tier

[G7605]

WEDNESDAY 16 JUNE, MORNING

MARK SCHEME

Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply to formal proofs and derivations, which must be valid in all the stages shown in the mark scheme to obtain full credit.

2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

					AVAILABLE MARKS
1	(a)	(i)	Mass is an unchanging property/amount of particles/ amount of matter/substance/material [1] Weight is the **force** due to **gravity** [1]	[2]	
		(ii)	D = M/V **or** = 270/(125 – 25) [1] [1] = 2.7 [1] Aluminium [1]	[3]	
	(b)	(i)	P = F/A incorrect physics give [0] [1] = 20 000/8 [1] = 2500 method not required for full marks [1] Pa or N/m^2 [1]	[4]	
		(ii)	Pivot P marked as RH end	[1]	
		(iii)	Weight at centre of beam on or in the beam area	[1]	
		(iv)	CM = ACM [2] [2] F × 4 = 20 000 × 2.5 method not required for full marks [2] [1] [1] no ecf for the marking of the pivot F = 12 500 (N) [1] Equal sign not required in 2nd line [1]	[5]	
	(c)	(i)	Time = distance/(average) velocity – or equivalent [1] = 1.2/0.7 [2] = 1.7 (s) [1]	[4]	
		(ii)	Average velocity = $\frac{1}{2}$ (initial + final) [1] 0.7 = $\frac{1}{2}$ (0 + final) method not required for full marks [1] Final velocity = 1.4 (m/s) [1] Alternative: $s = \frac{1}{2}(u + v)\,t$ 1.2 = $\frac{1}{2}$ (0 + 0.7) 1.7 or 1.2 = $\frac{1}{2}$ (0 + v) 1.7 v = 1.4	[3]	
		(iii)	Acceleration = velocity change/time [1] = (1.4 – 0)/1.7 **ecf from (i) – time – and (ii) – final velocity** [1] = 0.8 (m/s^2) [1] Alternative: $s = ut + \frac{1}{2}at^2$ [1] $v^2 = u^2 + 2as$ [1] 1.2 = 0 + $\frac{1}{2}$ a × $(1.7)^2$ [1] $1.4^2 = 0 + 2 \times a \times 1.2$ [1] $a = 0 + \frac{1.2 \times 2}{1.7^2} = 0.8$ [1] a = 0.8 [1]	[3]	
	(d)	(i)	Thinking distance SAME [1] Braking distance GREATER [1]	[2]	
		(ii)	Thinking distance – **CONSTANT speed**/ same speed as before [1] Braking distance – Deceleration [1] **or** slowing down velocity decreasing	[2]	30

					AVAILABLE MARKS
2	(a)	(i)	200 × 100 [1] = 20 000 (J) [1]	[2]	
		(ii)	200 (J)	[1]	
		(iii)	Work (done) = force × distance (moved) ecf from **(ii)** for work method not required for full marks [1] 200 = F × 8 [2] F = 200/8 = 25 (N) [1] Alternative: 20 000 = F × 800 [1] for [1] F × 8 or F × 800 F = 25 (N) no credit for 200 alone	[4]	
		(iv)	KE = $\frac{1}{2}mv^2$ method not required for full marks [1] = $\frac{1}{2} \times 85 \times 8^2$ [1] = 2720 (J) [1]	[3]	
		(v)	PE = mgh [1] 85 × 10 × h = 1700 ecf from **(iv)** for KE [2] [1] [1] h = 2.0 (m) [1] method not required for full marks PE = 2720 [0]	[4]	
	(b)	(i)	Any **five** from: Known weight or known mass or use of newtonmeter or balance to find it Two points a measured distance apart/length of string Switch on motor Time to move between points/measured with stopclock Repeat or take average Power = $\frac{\text{work done}}{\text{time taken}}$ essential for full marks	[5]	
			Alternative is Power = weight × average speed		
			Quality of written communication	[1]	
		(ii)	Input (electrical energy) or power or energy wasted Energy used by motor = input energy	[1]	
	(c)	(i)	Upward curve or line starting at same [1] Copper rising more quickly – larger rise in temperature in same time [1]	[2]	
		(ii)	Collisions	[1]	
		(iii)	Vibrations insist on these terms **only**	[1]	25

						AVAILABLE MARKS
3	(a)	(i)	Transverse Longitudinal	[1] [1]	[2]	
		(ii)	Energy, KE or PE or mechanical energy		[1]	
		(iii)	Vibrates/oscillates Perpendicular to the direction of energy transfer/motion of wave moves up or down [1] moves up **and** down [2]	[1] [1]	[2]	
		(iv)	0.3 (m)		[1]	
		(v)	0.8 (m)		[1]	
		(vi)	f = no. of vibrations/time taken (or f = 24/8 or equivalent) f = 3 (Hz) f = $\frac{I}{T}$ give [1]	[1] [1]	[2]	
		(vii)	v = fλ v = 3 × 0.8 ecf from **(v)** for wavelength and **(vi)** for frequency v = 2.4 (m/s)	[1] [1] [1]	[3]	
	(b)	(i)	1. Hammer seen striking gong or bell still working 2. No sound heard from bell or fainter sound	[1] [1]	[2]	
		(ii)	Sound cannot travel in a vacuum **or** sound needs particles for propagation **or** equivalent **or** light can travel through a vacuum		[1]	
		(iii)	Ultrasound/ultrasonic		[1]	
	(c)	(i)	One wave shown over the four grid squares of **greater the amplitude** as before	[1] [1]	[2]	
		(ii)	**Two waves shown** over the four grid squares Same amplitude	[1] [1]	[2]	
	(d)	(i)	(1st echo is) from the bottom of the ice (2nd echo is) from the top of the ice	[1] [1]	[2]	
		(ii)	Distance to the ice = 0.26 × 1500/2 = 195	[2] [1]	[3]	25

					AVAILABLE MARKS
4	**(a)**	Two (complete) loops one above and one below coil	[1]		
		One straight line through centre/or continuation of loop	[1]		
		Direction out of RIGHT hand end or in at left hand conflicting arrows – [0]	[1]	[3]	
	(b)	**(i)** Variable resistor/variable power supply/rheostat/potential divider		[1]	
		(ii) 4 points plotted $\pm \frac{1}{2}$ smallest square	[1]		
		Best fit line	[1]		
		Through 0, 0 $\pm$ 1 square	[1]	[3]	
		(iii) 10 clips 1.2 A intersects line at approximately 10 clips		[1]	
	(c)	**(i)** Battery, switch	[1]		
		in series with coil – complete circuit Ignore ammeters/voltmeter	[1]		
		Coil wound around soft iron core – look for this point before any further credit Additional components, e.g. motor [1]	[1]	[3]	
		(ii) Iron	[1]		
		Is attracted when electromagnet switched on Is an electromagnet/temporary magnetism/magnetic	[1]	[2]	
		(iii) X and Y **both** correct		[1]	
		(iv) An insulator (may be a named insulator)	[1]		
		Otherwise device at XY always ON/contacts or X, Y short circuit	[1]	[2]	
	(d)	**(i)** $V_s/V_p = N_s/N_p$ [1] $V_s = 6 \times 240/1800$ [2] $= 0.8$ [1]		[4]	
		(ii) Changing current/magnetic field in primary coil is changing Causes changing current/voltage to be induced in secondary		[1]	
		(iii) step up – increases the voltage	[1]		
		Reduces current/energy losses (in cable)	[1]		
		step down – reduces the voltage	[1]		
		Safer voltage (for domestic appliances) useable/suitable for domestic appliances reduces resistance – [0]	[1]	[4]	25

						AVAILABLE MARKS
5	**(a)**	**(i)**	365 **or** $365\frac{1}{4}$ days		[1]	
		(ii)	A: summer	[1]		
			C: winter	[1]	[2]	
		(iii)	Line through the earth's centre inclined to the vertical, **consistent with answer to (ii)**		[1]	
		(iv)	Area to **left of vertical terminator** shaded		[1]	
	(b)	**(i)**	Hydrogen **only**		[1]	
		(ii)	Gas/hydrogen moves towards centre Due to **gravitational forces *** ***** both needed before full marks awarded Gas cloud spins/pressure increases And heats up *** (Nuclear) fusion** begins when temperature very high Any 4 of the 5 points above nebula contracts [1] or density increases [1] – or gas hydrogen moves toward centre heating associated with fusion – [0]		[4]	
		(iii)	Planets orbit Sun in **same sense/direction** orbit in same way [0]	[1]		
			Planets orbit in same plane	[1]	[2]	
	(c)	**(i)**	(Force) increases		[1]	
		(ii)	Force **decreases** (with decreasing mass) Look for alternative, i.e. increase with increasing mass		[1]	
	(d)	**(i)**	Light year is the distance travelled by light in a year		[1]	
		(ii)	$3 \times 10^5 \times (4 \times 3.15 \times 10^7) = 3.78\ (3.8) \times 10^{13}$ (km) [1] [1] [1]		[3]	
		(iii)	$3.78 \times 10^{13}/25 =$ **1.512×10^{12}** [1] (seconds) ecf from **(ii)**	[1]		
			$= 1.512 \times 10^{12}/3.15 \times 10^7 = 48\,000$ years light 12 000 faster than craft [1] time is 12 000 × 4 years = 48 000 [1]	[1]	[2]	20
					Total	**125**