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General Certificate of Education (A-level)
June 2012

Physics B: Physics in Context PHYB4

(Specification 2455)

Unit 4: Physics inside and out

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from: aqa.org.uk

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NOTES

Letters are used to distinguish between different types of marks in the scheme.

M indicates OBLIGATORY METHOD MARK
This is usually awarded for the physical principles involved, or for a particular point in the argument or definition. It is followed by one or more accuracy marks which cannot be scored unless the M mark has already been scored.

C indicates COMPENSATION METHOD MARK
This is awarded for the correct method or physical principle. In this case the method can be seen or implied by a correct answer or other correct subsequent steps. In this way an answer might score full marks even if some working has been omitted.

A indicates ACCURACY MARK
These marks are awarded for correct calculation or further detail. They follow an M mark or a C mark.

B indicates INDEPENDENT MARK
This is a mark which is independent of M and C marks.

ecf is used to indicate that marks can be awarded if an error has been carried forward (ecf must be written on the script). This is also referred to as a 'transferred error' or 'consequential marking'.

Where a correct answer only (**cao**) is required, this means that the answer must be as in the Marking Scheme, including significant figures and units.

cnao is used to indicate that the answer must be numerically correct but the unit is only penalised if it is the first error or omission in the section (see below).

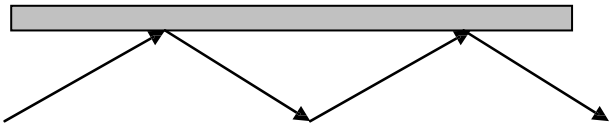
Marks should be awarded for **correct** alternative approaches to numerical question that are not covered by the marking scheme. A correct answer from working that contains a physics error (PE) should not be given credit. Examiners should contact the Team Leader or Principal Examiner for confirmation of the validity of the method, if in doubt.

GCE Physics, Specification B: Physics in Context, PHYB4, Physics Inside and Out

1	a	i	Maximum **displacement** (of carriage/pendulum from rest position)	B1	1
1	a	ii	6.0 (m)	B1	1
1	a	iii	Clear evidence of what constitutes period 4.8-4.9 (s)	C1 A1	2
1	b	i	Use of $v = 2\ fA$ 7.07 (ms^{1})	C1 A1	2
1	b	ii	Use of $a = 4\ ^{2}f^{2}A$ 11.1 (ms^{2}) ecf	C1 A1	2
1	b	iii	Substitution into or rearrangement of $T = 2\pi\sqrt{l/g}$ 3.98 (m)	C1 A1	2
1	c		Applied frequency = natural frequency Mention or clear description of resonance	B1 B1	2
1	d		Resistive/frictional/damping/air resistance forces due to friction in named place (eg in bearings)/air resistance acting on named part (allow ride/gondola here) low friction/large mass or inertia /streamline/smooth surface etc.	C1 A1 B1	3
2	a	i	*coherent bundle:* fibres maintained in fixed positions relative to each other/ordered arrangement/same arrangement at each end owtte *non-coherent bundle:* relative positions unimportant/random arrangement of fibres owtte	B1 B1	2
2	a	ii	*coherent bundle:* transmit images *non-coherent bundle:* light source/illumination	B1 B1	2
2	b	i	**any 2 from** high resolution/better defined (clearer) images more flexible bundle finer fibres allow bending round tighter curves without escape of light more/brighter light/more pixels – covers area more completely avoids multipath dispersion failure or single fibre has less effect on image	B1 B1	max 2

2	b	ii	(lower refractive index) allows total internal reflection/allows critical angle avoids light passing between fibres	B1 B1	2

2	c	i	sinc = 1.40/1.52 67(.1)°	C1 A1	2

2	c	ii	No more than 5 internal reflection angles shown 	B1	1

2	d	i	**any 2 from** more sensitive to light than film/more effective in low light (intensity) / higher quantum efficiency no need to develop film electronic enhancement of image/computer analysis image can be projected onto monitor /continuous (real time) imaging / image manipulation film cannot be reused no need to develop CCDs/faster to obtain image	B1 B1	2

2	d	ii	photons of light fall on capacitors/photosites/pixels charge/voltage generated /electrons liberated each charge/voltage measured charge/voltage/number of electrons generated is proportional intensity on display	B1 B1 B1	3

3	a	i	Correct method (*v x =k* or *1/ v x=k*) 2 pairs of coordinates (correctly read) 3 pairs of coordinates (correctly read and multiplied) and conclusion (*v x* ≠ const)	C1 C1 A1	3

3	a	ii	6200 and1800 correctly read 5.8×10^{11} and 4.9×10^{10} seen or sub into equ ecf 5.3×10^{11} (J) ecf	C1 C1 A1	3

3	a	iii	Answer to **(a)(ii)** (negative sign or 'decrease' needed) Work is being done on module (by the gravitational field)	B1 B1	2

3	a	iv	Potential is work done per unit mass in bringing object from infinity to point Potential energy is work done in bringing object from infinity to point	B1 B1	2

3	b	i	Passengers, crew, instruments, or equipment carried On combustion of fuel tanks are jettisoned Total mass reduced Allowing greater acceleration with same thrust/or relatively less energy required to raise rocket and payload further	B1 B1 B1 B1	4
3	b	ii	Required to combust propellant – no oxygen in space so that crew can breathe	B1	1
3	b	iii	Relates impulse to change in momentum Correctly substituted values ($34 \times 10^6 \times 15/2.95 \times 10^6$) 1.7×10^2 (m s ^{1}) 2 sf only (allow 170 but not 172)	C1 C1 A1 B1	4
3	b	iv	Mass of fuel is used up so average mass less As *mg* falls the net upward force increases	B1 B1	2
4	a	i	Car needs to be moving fast enough Mention of centripetal force (***but can talk out***) Centripetal force must be ≥ weight	C1 A1 A1	3
4	a	ii	Recognises zero reaction Equates weight and centripetal force (or *g* with centripetal acceleration) $mg = mv^2/r$ Manipulation of equations	B1 B1 B1	3
4	a	iii	v_{min} calculated (1.25 m s ^{1}) Equates *mgh* and $½mv^2 + mg2r$ 0.40 (m)	C1 C1 A1	3
4	b		Needs to be released from higher/ *h* larger Potential energy would need to provide both linear and rotational kinetic energy / need same linear velocity but rotates too owtte	M1 A1	2
4	c	i	Opposition to change in rotational motion Depends upon mass and its distribution (accept radius)	B1 B1	2
4	c	ii	Use of $½ I^{2}$ equated to *v/r* (=256) Substitutions irrespective of powers 1.28 x 10 ^{3} (J)	C1 C1 C1 A1	4
4	d		attempted use of conservation of angular momentum values substituted into equation 180(.08) (rad s ^{1})	C1 C1 A1	3

5	a	i	5.3-5.5 squares Time difference 0.106-0.110(ms) Distance 0.159-0.165(m) Width = 0.079-0.083(m)	C1 C1 C1 A1	4

5	a	ii	Absorption Spreading/dispersion/scattering Reflections at interfaces (multiple reflections)	B1 B1	Max 2

5	b		The marking scheme for this question includes an overall assessment for the quality of written communication (QWC). There are no discrete marks for the assessment of QWC but the candidate's QWC in this answer will be one of the criteria used to assign a level and award the marks for this question. **Descriptor** – an answer will be expected to meet most of the criteria in the level descriptor. **Level 3 – good** claims supported by an appropriate range of evidence good use of information or ideas about physics, going beyond those given in the question argument well-structured with minimal repetition or irrelevant points accurate and clear expression of ideas with only minor errors of grammar, punctuation and spelling (no more than 3 minor errors and coherent) **Level 2 – modest** claims partly supported by evidence good use of information or ideas about physics given in the question but limited beyond this the argument shows some attempt at structure the ideas are expressed with reasonable clarity but with a few errors of grammar, punctuation and spelling **Level 1 – limited** valid points but not clearly linked to an argument structure limited use of information about physics unstructured errors in spelling, punctuation and grammar or lack of fluency **Level 0** incorrect, inappropriate or no response		5-6

			Examples of the sort of information or ideas that might be used to support an argument: ultrasound transmitter/receiver used pulses sent out by transmitter waves reflected from different tissue boundaries to receiver transmission properties of air and tissue very different gel aids transmission and reduces reflection gel matches acoustic impedance ultrasound can produce moving images over extended time period high frequency/short wavelength short wavelength allows better resolution of small objects (organs etc)		

6	a	i	Force per unit current length /flux per unit area When current carrying conductor perpendicular to flux/when flux and area perpendicular	A1 M1	2

6	a	ii	Telsa	B1	1

6	a	iii	Vector (quantity) Both magnitude and directions considered therefore need vector addition owtte	M1 A1	2

6	a	iv	Regions/bodies in which the magnetic properties (of the Earth) are different from their surroundings owtte	B1	1

6	b		Induced emf/current when there is change of flux (linkage) – statement of Faradays law Larger rate of change of current (ac) Produces larger rate of change of field (in C) Induces larger emf/current (in sensor coil)	B1 B1 B1 B1	4

6	c	i	Attempted use of emf equation (= 200 x 3.3 x10 $^{-9}$) 6.6 x 10^{-7} (V)	C1 A1	2

6	c	ii	(c)(i)/5.2 0.13 (A)	B1 B1	2

6	C	iii	Increase number of turns (on sensor coil) Reduce the resistance (of either coil) Idea of higher permeability core Higher frequency ac Larger applied current/voltage (for coil)	B1 B1	Max 2

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