OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL PHYSICS

(9630)

PAPER 3
Mark Scheme

Specimen 2019

V2.0

Mark schemes are prepared by the Lead Assessment Writer 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 associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

Section A

Question	Marking guidance	Mark	Comments
01.1	$g = (-)\frac{GM}{r^2}$ ✓ r (= $6.4 \times 10^6 + 2.04 \times 10^7$) = 2.68×10^7 (m) ✓ $g = \frac{6.67 \times 10^{-11} \times 6.0 \times 10^{24}}{(2.68 \times 10^7)^2}$ ✓ (= 0.56 N kg^{-1})	3	
01.2	$g = \frac{v^2}{r}$ $v = [0.56 \times (2.68 \times 10^7)]^{1/2}$ ✓ = 3.9×10^3 m s^{-1} ✓ (3.87×10^3 m s^{-1}) (allow ecf for value of *r* from 01.1)	2	Allow alternative methods

01.3	$T\left(=\frac{2\pi r}{v}\right) = \frac{2\pi \times 2.68 \times 10^7}{3.87 \times 10^3}$ ✓ = $4.3(5) \times 10^4$ (s) ✓ (12.(1) hours) (use of $v = 3.9 \times 10^3$ gives $T = 4.3(1) \times 10^4$ s = 12.0 hours) (allow C.E. for value of v from 01.2	2	

Question	Marking guidance	Mark	Comments
02.1	$(3.0 \times 10^{-10}/24) \times 6.02 \times 10^{23}$ seen ✓ $7.52(5) \times 10^{10}$ Answer seen to at least 3 sf	1	
02.2	Decay constant = $(0.69 / 14.8\ h^{-1})$ or $1.3 \times 10^{-5}\ s^{-1}$ ✓ $A = 1.30 \times 10^{-5} \times 7.5 \times 10^{10}$ ✓ 9.75×10^{5} (Bq) ✓ Allow 2 or 3 sf Allow use of $A = \lambda N$ with an incorrectly calculated decay constant	3	
02.3	Activity 3.5 h later should be $A = 9.8 \times 10^{5}\ e^{-0.0466 \times 3.5}$ ✓ 8.33×10^{5} (Bq)✓ Volume of liquid = $(8.33 \times 10^{5} / 3600) \times 15 = 3470$ (cm^3)✓	3	
02.4	Estimate gives 3700 compared with 3500✓ Flask has more mass than average / liquid is not water✓	2	

Question	Marking guidance	Mark	Comments
03.1	$t = \sqrt{\frac{2s}{g}}$ or $4.5 = \frac{1}{2} \times 9.81 \times t^2$ ✓ t = 0.96 (s)✓	2	
03.2	Field strength = 186 000 V m^{-1}✓ Acceleration = Eq / m or 186 000 × 1.2 × 10^{-6} ✓ 0.22 (m s^{-2}) ✓	3	
03.3	0.10(3) (m) (allow ecf from 03.2)✓	1	

03.4	Force on a particle = *mg* and acceleration = F / m so always = g ✓ Time to fall (given distance) depends (only) on the distance and acceleration ✓ OR: $g = GM / r^2$ ✓ Time to fall = $\sqrt{2s / g}$ so no m in equations to determine time to fall ✓	2	

03.5	Mass is not constant since particle mass will vary ✓ Charge on a particle is not constant ✓ Acceleration = Eq / m or $(V / d)(q / m)$ or Vq / dm ✓ E or V / d constant but charge and mass are 'random' variables so q / m will vary (or unlikely to be the same) ✓	3 max	

Question	Marking guidance	Mark	Comments
04.1	1 N per A per m **or** 1 Wb m^{-2} **or** quotes: $B = F/IL$ with terms defined **or** induced $EMF = \Delta BAN/t$ with terms defined **or** a slightly flawed attempt at the definition in statement form✓ (1 only) It is the flux density (perpendicular to a wire) that produces a force of 1 N per m on the wire when the current is 1 A✓✓(both marks) **or** $B = F/IL$ **and** 1 T is flux density when F = 1N; I = 1A and L = 1 m **or** induced $EMF = \Delta BAN /t$ and 1 T is the flux change when emf = 1V for A=1 N =1 and t =1 or similar	2	
04.2	force on charge due to E field , $F_E = Eq$ **or** Vq/d **and** force due to B field, $F_B = Bqv$ **or** $Eq=Bqv$ ✓ cancels q **and states explicitly** $v = \frac{E}{B}$ or $\frac{V}{dB}$ ✓	2	
04.3	v = 20000/0.14 (seen) **or** 143 × 10^3 (m s^{-1}) ✓	1	

04.4	$Bqv = mv^2/r$ or $r = mv/Bq$ (allow e instead of q) ✓ mass of ion = 1.7 × 10^{-27} × 58 (may be in equation) **or** (9.86 × 10^{-26} kg seen)**or** radius = 0.14 m (may be in equation) ✓ Substitutes and arrives at 0.62 to 0.63 (T) ✓	3	
04.5	Calculates new radius (0.145 m) or diameter (0.288 m) using $r \propto m$ or otherwise **allowing ecf** ✓ 0.010 m (condone 0.01 m) or 0.0096 – 0.0097 m (Allow 0.0079 m or 0.008 m due to use of different sfs for B and v) ✓	2	

Question	Marking guidance	Mark	Comments
05	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 student'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 **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	6	Selects **two** from • Eddy currents • Hysteresis • Copper losses • Flux leakage For each one, student should explain how the losses occur how losses are minimised by design and choice of materials.

Question	Marking guidance	Mark	Comments
6.1	acceleration is proportional to displacement ✓ acceleration is in opposite direction to displacement, or towards a fixed point, or towards the centre of oscillation ✓	2	
06.2	$\frac{25}{23} = 1.09$ seen✓	1	
6.3	(use of $a = (2\pi f)^2 A$ gives) $a = (2\pi \times 1.09)^2 \times 76 \times 10^{-3}$ ✓ $= 3.5$ m s^{-2} ✓	2	
6.4	(use of $x = A\cos(2\pi ft)$ gives) $x = 76 \times 10^{-3} \cos(2\pi \times 1.09 \times 0.60)$ ✓ $= (-)4.3(1) \times 10^{-2}$ m ✓(43 mm) (use of $f = 1.1$ Hz gives $x = (-)4.0(7) \times 10^{-2}$ m (41 mm))	2	
6.5	Energy always positive✓ 4 complete oscillations shown✓ $E_k = 0$ at $t = 0$✓	max 2	
6.6	Mention of resonance✓ large amplitude of vibration of mass✓ because driven close to the natural frequency✓	3	
6.7	the system is now damped ✓ energy is transferred (to the water) so that amplitude is reduced ✓	2	

Question	Marking guidance	Mark	Comments
7.1	28×10^{-6} [C] ✓	1	
7.2	Attempted use of $\frac{1}{2}CV^2$ or $\frac{1}{2}QV$ **and** readoff at 50 s correct (1.2 ± 0.1 V) ✓ 3.4×10^{-6} [J] ✓ Difference between 85 μJ and candidate energy ✓	3	
7.3	Time constant is time taken to fall to $\frac{V_0}{e} = \frac{6.0}{2.72}$ = 2.21 V ✓ reads off time constant as 32 s ✓ Time constant is *RC* ✓ *R* = 6.8 MΩ ✓ **OR** Use of $V = V_0 e^{-\frac{t}{RC}}$ ✓ *V* readoff correct for a *t* > 25 s and correct substitution ✓ *RC* = 32 s ✓ *R* = 6.8 MΩ ✓	4	

Section B

In this section, each correct answer is awarded 1 mark.

Question	Key
8	B
9	C
10	D
11	D
12	D
13	A
14	C

Question	Key
16	A
17	B
18	A
19	B
20	D
21	B
22	A