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Mark Scheme
Summer 2007

GCE

GCE Physics (6735/01)

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A PEARSON COMPANY

1.

a) Show that

See ' v = $\frac{2\pi r}{T}$ ' OR '$\omega = \frac{2\pi}{T}$ ' ✓

Substitution of (60×60×24)s or 86400s for T (giving 7.27×10^{-5}, no u.e.) ✓

Unit of ω

s^{-1}/rad s^{-1}

✓

3

b) Height above Earth's surface

Statement / use of $\frac{GM_E m}{r^2} = \frac{mv^2}{r}$ OR $\frac{GM_E m}{r^2} = mr\omega^2$ ✓

[Equations may be given in terms of accelerations rather than forces]

[Third mark (from below) may also be awarded here if (r_E+h) is used for r]

Correct value for r, i.e. $4.2(3) \times 10^7$ m

✓

Use of h = **their** r - R_E

✓

Correct answer = (3.58 - 3.60) $\times 10^7$ m [no ecf] ✓

4

Example of answer:

$$\frac{GM_E m}{r^2} = \frac{mv^2}{r}$$

$$\rightarrow \frac{GM_E}{r^2} = \frac{v^2}{r} = \frac{(\omega r)^2}{r} = \omega^2 r$$

$$\therefore GM_E = \omega^2 r^3$$

$$\therefore r = \sqrt[3]{GM_E/\omega^2} = \sqrt[3]{\frac{6.67\times10^{-11}\ \text{N m}^2\ \text{kg}^{-2} \times 5.98\times10^{24}\ \text{kg}}{(7.27\times10^{-5}\ \text{s}^{-1})^2}}$$

$$= 4.23\times10^7\ \text{m}$$

$$\therefore h = 4.23\times10^7\ \text{m} - 6.38\times10^6\ \text{m}$$

$$= 3.59\times10^7\ \text{m}$$

Total 7 marks

2.

Add to diagram.

Arrows at A and B, both pointing directly away from the nucleus. ✓
[Arrow end (head or tail) need not touch A /B, but direction must be correct. Gauge by eye, accept dotted construction lines as indication of intent]

1

Calculation of force

Use of $F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$ or $F = \frac{kQ_1Q_2}{r^2}$ ✓

[ignore error/omission of '2' and/or '79' or 'e' or '1.6 × 10^{-19}' for this first mark, providing numerator clearly has a product of charges and denominator a distance value squared. Ignore power of 10 errors in values of Q or r]

2 × 1.6 × 10^{-19} C **and 79** × 1.6 × 10^{-19} C seen (**consequential** mark, dependent upon correct use of equation previously) ✓

Correct answer = 1.6 - 1.7 N ✓

3

Example of answer:

$$F = \frac{Q_1 Q_2}{4\pi\varepsilon_o r^2} = \frac{(79\times1.6\times10^{-19}\ \text{C})\times(2\times1.6\times10^{-19}\ \text{C})}{4\pi\times8.85\times10^{-12}\ \text{F m}^{-1}\times(1.5\times10^{-13}\ \text{m})^2}$$

$$= 1.62\ \text{N}$$

Effect on motion of α

Slows down [decelerates] and then speeds up again [accelerates]. (both needed)
[accept 'slows down **at** A and speeds up **at** B]

1

Total 5 marks

3.	
a)	How capacitors are connected Box A = in parallel Box B = in series } [Accept diagrams] ✓ [**N.B.** If A 'in series' and B 'in parallel', max 3 in explanation section below] **1**
	Explanation Answer with no word or symbol reference to energy scores 3/4 max. Answer with no reference to any relevant formulae scores 3/4 max. More energy stored in A ['A' may be implied by argument] ✓ The same p.d. ('V') ✓ (So) $C_A > C_B$ [or demonstration by numerical example] ✓ Use of* $W = \frac{1}{2}CV^2$ [e.g. $\frac{1}{2}C_AV^2 > \frac{1}{2}C_BV^2$] } ✓ OR use/statement of $E = \frac{1}{2}QV$ AND $Q=CV$ Use of* either equivalent capacitance formula ✓ [correctly stated; may be word equation] * i.e. Referred to as part of explanation. Do not credit bald transcription of equations given in the list at the back of the paper without context, nor as marginalia]. [Award marks for correct, non-contradictory statements even if the candidate has given the wrong combinations at a(i), up to a maximum of 3 marks] **Max 4**
b)	Addition of large resistor in discharging circuit Valid observation in terms of **brightness** or **duration of illumination** ✓ **Supporting** explanation in terms of circuit behaviour ✓ **2** [Max 1 mark if explanation does not support observation, or is internally contradictory, or if description does not include a visual observation]
c)	Addition of large resistor in charging circuit Valid observation in terms of **brightness** or **duration of illumination** ✓ **Supporting** explanation in terms of circuit behaviour ✓ **2** [Max 1 mark if explanation does not support observation, or is internally contradictory, or if description does not include a visual observation]
	Total 9 marks

4.

Explanation of kicking

Answer with no reference to moments scores 4/5 max.
Ignore references to electromagnetic induction/Lenz's Law

QoWC ✓

'(Fleming's) left hand rule' / magnetic fields interact/combine/overlap [not 'repel', nor 'interfere'] / reference to current flowing in magnetic field /catapult field ✓

Force acting on the wire linked to moment [not just 'pivoting'] (about P) ✓

Force to right / anticlockwise moment [detail of direction] ✓

When wire leaves mercury, current → 0 / force → 0 / moment → 0 . ✓
[not just 'circuit is incomplete']
Idea that wire's weight produces a moment (returning it to mercury) ✓

Max 5

Show that

Use of moment equation, i.e. 5.0×10^{-4} N m = $F \times d$ ✓
[accept any numerical value for d between 1.5 (cm) and 10.5 (cm)]

Use of 6×10^{-2} m for d ✓

Correct answer = 8.3×10^{-3} (N) [no u.e.] [Reverse argument scores 2/3] ✓

3

Example of answer:

$$F = \frac{Moment}{d} = \frac{5.0\times10^{-4}\ \text{N m}}{(1.5+4.5)\times10^{-2}\ \text{m}} = 8.33\times10^{-3}\ \text{N}$$

Circuit current

Use of $F = BIl$ [or correct rearrangement] with l = 9cm ✓
[Ignore powers of 10. No ecf for their force if different; beware use of 5.0×10^{-4}]

Answer = 2.2/2.3 A ✓

2

Example of answer:

$$F = BIl \rightarrow I = \frac{F}{Bl}$$

$$\therefore I = \frac{8.33\times10^{-3}\ \text{N}}{4.0\times10^{-2}\ \text{T}\times9.0\times10^{-2}\ \text{m}} = 2.31\ \text{A}$$ [8×10^{-3}N → 2.22A]

Total 10 marks

5.

a) Direction of e.m.f.?

Hub '-' and Rim '+'. [Allow mark for either on its own, but not if contradicted.] ✓

1

Why a constant e.m.f.?

Reference to flux cutting / rate of change of flux / change of flux linkage due to spoke motion / spokes moving at right angles to field / Reference to Faraday's Law ✓

Constant rate of spin implies constant rate of flux cutting. [Link made clear] ✓
[continuous process does not mean constant rate]

2

The time for one revolution

Use of $\varepsilon = \frac{BA}{t}$ with 'A' recognisable as area of a circle ✓
[ignore power of 10 errors for e.m.f. and radius values, and inclusion of N=24]

Correct substitution of all values [but only N = 1 acceptable here] ✓

Correct answer 0.31 - 0.32 s ✓
[t = 7.6s scores 1/3; t = 1.12s scores 0/3, t = 0.64s scores 1/3 here]

3

Example of answer:

$$\varepsilon = \frac{\varphi}{t} = \frac{BA}{t} \rightarrow t = \frac{BA}{\varepsilon}$$

$$\therefore t = \frac{2.8\times10^{-5}\ \text{T}\times\pi\times\left(30\times10^{-2}\ \text{m}\right)^2}{25\times10^{-6}\ \text{V}} = 0.317\ \text{s}$$

Alternative answer

Use of $\varepsilon = Blv$ with v = (mean) velocity of spoke. (✓)

$\rightarrow v = 2.98\ \text{ms}^{-1}$ (✓)

Hence rim velocity = $2.98 \times 2 = 5.96\ \text{ms}^{-1}$.

$\rightarrow$ t = $\frac{2\pi r}{v_{RIM}} = \frac{2\pi\times0.3\ \text{m}}{5.96\ \text{ms}^{-1}} = 0.316\text{s}.$ (✓)

[t = 0.63s scores 2/3 here]

What effect?

(i) Reduced [accept 'halved'] **AND**

Rate of flux cutting is reduced / Fewer field lines are being cut / Component of Earth's

	field perpendicular to the wheel is less /Flux through wheel is less / Area of wheel perpendicular to field is less / Wheel is no longer perpendicular to the field ✓ [do not credit answers suggesting changes in the field strength itself] (ii) Increased / increasing **AND** Rate of flux cutting [etc.] would be increasing ✓ (iii) (Reduced to) zero [but not 'very small' / 'negligible', etc.] **AND** No flux cut by spoke(s) / No component of the Earth's field perpendicular to the wheel / No flux through wheel / Wheel is spinning parallel to the field / in plane of field ✓ [but not just '$\Delta\Phi = 0$', nor 'motion is not perpendicular to field'] [Allow 1/3 for three correct statements of 'ε' outcome without any explanation, but **only** if score would otherwise be zero.] [Disallow 'breaking' for 'cutting' on first occasion in entire question, but allow, ecf, thereafter] **3**
	Total 9 marks