edexcel

GCE

Edexcel GCE

Physics (6731/01)

Summer 2005

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Mark Scheme (Results)

Edexcel GCE
Physics (6731/01)

Contents

Notes on the Mark Schemes

1. *Alternative responses:* There was often more than one correct response to a particular question and these published mark schemes do not give *all* possible alternatives. They generally show only the schemes for the most common responses given by candidates. They are **not** model answers but indicate what the Examiners accepted in this examination.

2. *Error carried forward:* In general, an error made in an early part of a question is penalised there but not subsequently, i.e. candidates are penalised once only, and can gain credit in later parts of a question by correct reasoning from an earlier incorrect answer.

3. *Quantity algebra:* The working for calculations is presented using quantity algebra in the mark schemes for Units PHY1, PHY2, PHY3 (Topics), PHY4, PHY5/01, and PHY6 but candidates are not required to do this in their answers.

4. *Significant figures:* Use of an inappropriate number of significant figures in the theory papers will normally be penalised only in "show that" questions where too few significant figures has resulted in the candidate not demonstrating the validity of the given answer. Use of an inappropriate number of significant figures will normally be penalised in the practical tests. In general candidates should nevertheless be guided by the numbers of significant figures in the data provided in the question.

5. *Unit penalties:* A wrong or missing unit in the answer to a calculation will generally lose one mark unless otherwise indicated.

6. *Quality of written communication:* Each theory paper will usually have 1 or 2 marks for the quality of written communication. The mark will sometimes be a separate mark and sometimes be an option in a list of marking points.

Within the schemes:

- / indicates alternative marking point
  ( ) brackets indicate words not essential to the answer
  [ ] brackets indicate additional guidance for markers

- The following standard abbreviations are used:

a.e.	arithmetic error (–1 mark)
e.c.f.	error carried forward (allow mark(s))
s.f.	significant figures (–1 mark only where specified)
no u.e.	no unit error

6731 Unit Test PHY1

1.

Unit	Physical Quantity	
$m\ s^{-1}$	*Velocity*	
$m\ s^{-2}$	Acceleration / deceleration	✓
$kg\ m^{-3}$	Density	✓
N m	Moment / energy / (gravitational)potential energy / kinetic energy/heat/work (done) / torque	✓
$kg\ m\ s^{-1}$	Momentum / impulse	✓
$N\ m\ s^{-1}$	Power	✓

5

2. (a) Free body force diagram for magnet

(Electro)magnetic / (force of) repulsion / push ✓

Weight / W / mg / pull (of Earth) / gravitational (attractive force) / attraction (of Earth) ✓ **2**

[NOT gravity]

[An additional incorrect force cancels 1 mark awarded]

(b) Newton's third law pairs

Force	Body on which corresponding force acts	Direction of the corresponding force
Contact	(Wooden) stand/base	Downwards / down / ↓ ✓✓
Magnetic	(Magnet) M_1	Upwards / up / ↑ ✓✓
Weight	Earth / Earth's surface	Upwards / up / ↑ ✓✓

6

8

3. (a) Principle of moments

In equilibrium	✓	
sum of clockwise moment (about any point) is equal to sum of anticlockwise moment (about that point)	✓	**2**

(b)(i) Weight

Use of "width x thickness x length"	✓	
Use of "density = $\frac{\text{mass}}{\text{volume}}$"	✓	
Correct value	✓	**3**

$V = 1.2 \times 0.6 \times 200\ (\text{cm}^3) = 144\ (\text{cm}^3)$

Using $\rho = \frac{m}{V}$, $m = 8\ (\text{g cm}^{-3}) \times 144\ (\text{cm}^{-3}) = 1152\ \text{g}$

Weight = $mg = 1152 \times 10^{-3}\ (\text{kg}) \times 9.81\ (\text{m s}^{-2}) = 11.3\ (\text{N}) / 12\ (\text{N})$

(ii) Force *F*

Correct substitution into correct formula	✓	
Correct value with correct unit	✓	**2**

$F \times 60\ (\text{cm}) = 11.3\ (\text{N}) \times 40\ (\text{cm}) / 12\ (\text{N}) \times 40\ (\text{cm}) / 11(\text{N}) \times 40\ (\text{cm})$

= 7.5 N / 8 N / 7.3 N

(iii) Force *R*

18.3 N / 18.8 N / 20 N	✓	**1**

(iv) Sketch graph

Any line upwards	✓	
Correct shape for *F* [concave shaped curve]	✓	**2**
		10

4. (a) Moment

Correct substitution into correct formula ✓

Correct value with correct unit ✓ **2**

Moment = force × distance

$= 1 \times 10^{-4}$ (kg) × 9.81 (N kg^{-1}) × 5×10^{-2} (m)

$= 4.9 \times 10^{-5}$ N m

(b) Work done

Correct substitution of a distance and weight into correct formula ✓

Calculation of distance ✓

Correct value ✓ **3**

Work done = force × distance in the direction of the force
EITHER
Use circumference = $2\pi r$

whence distance = $\frac{2\pi 5 \times 10^{-2}}{60} = 5.2 \times 10^{-3}$ (m)

OR

Use $\sin 6^{o} = \frac{\text{distance}}{5 \times 10^{-2}}$

whence distance = $5 \times 10^{-2} \times 0.1045 = 5.2 \times 10^{-3}$ (m)

Work done = 1×10^{-4} (kg) × 9.81 (N kg^{-1}) × 5.2×10^{-3} (m) = 5.1×10^{-6} (J)
OR

Use $\tan 6^{o} = \frac{\text{distance}}{5 \times 10^{-2}}$

whence distance = $5 \times 10^{-2} \times 0.1051 = 5.3 \times 10^{-3}$ (m)

Work done = 1×10^{-4} (kg) × 9.81 (N kg^{-1}) × 5.3×10^{-3} (m)
= 5.2×10^{-6} (J)

(c) Comparison

No work is done on the hand to move it horizontally (so value is less) / as movement is perpendicular to force / distance moved in direction of force is zero/less / moment is smaller. ✓ **1**

(d) Average power

Identifying "power = $\frac{\text{work done / energy}}{\text{time}}$" ✓

Correct value with correct unit ✓ **2**

Centre of gravity raised by 10×10^{-2} (m)

Work done = 1×10^{-4} (kg) × 9.81 (N kg^{-1}) × 10×10^{-2} (m)

= 9.81×10^{-5} (J)

Average power = $\frac{\text{work done}}{\text{time taken}} = \frac{9.81 \times 10^{-5}\ \text{(J)}}{30\ \text{(s)}} = 3.3 \times 10^{-6}$ W

(e) Different design

Less/zero work done / less friction / less wear on the mechanism ✓

the c of g/weight is not raised OR less/zero moment OR (hand is) balanced/in equilibrium ✓ **2**

10

5. (a) Explanation

V_b has a horizontal component equal to V_a	✓	
V_b has a vertical component	✓	**2**

[V_b has two components of velocity is 1 mark]
[V_b cos 45 = V_a is 2 marks]

(b) Explanation

EITHER

QoWC	✓	
The average speed / velocity of A is greater (than B) / converse	✓	
(because) A continually accelerates whereas B slows down / decelerates (initially)	✓	

[description of both A and B necessary for this 2nd physics mark]

OR

QoWC	**(✓)**	
V_a = horizontal component of V_b and they travel the same horizontal distance	**(✓)**	
Vertical component of projectile's motion does not affect horizontal motion	**(✓)**	**3**
		5

6. (a) Energy change

Both parts correct [NB 1 mark only] ✓ **1**

Gravitational potential (energy) to kinetic / movement (energy) / work done

(b) Principal of conservation of energy

EITHER ✓✓
Energy can be neither created nor destroyed

OR
Energy cannot be created/destroyed / total energy is not lost/gained **(✓)**

merely transformed from one form to another / in a closed/isolated system **(✓)** **2**

(c) Speed of water

Correct substitution into correct formula ✓

Correct value with correct unit ✓ **2**

Power = force × velocity

1.7×10^9 (W) = 3.5×10^8 (N) × V

V = 4.86 m s^{-1}

(d) **Explanation**

Not all the energy of the falling water is transferred to the output power OR system is not 100% efficient OR water is not brought to rest OR friction OR some of the energy is transferred to heat/sound/surroundings. ✓ **1**

(e) Time

Correct value with correct unit. ✓ **1**

$$\text{Time} = \frac{7 \times 10^6\,(\text{m}^3)}{390\,(\text{m}^3\,\text{s}^{-1})} = 17\,949 \text{ s } (= 299 \text{ min}) (= 5 \text{ h})$$

(f) Work done

Correct substitution into correct formula to find mass of water ✓

Identifying
"work done = force x distance moved in direction of force" ✓

Correct value with correct unit ✓

3

Mass of water = volume × density

$= 7 \times 10^6 (m^3) \times 10^3 (kg\ m^{-3})$ $(= 6.9 \times 10^9 kg)$

Work done = force × distance

Work done = 6.9×10^9 (kg) x 9.81 (ms^{-2}) x 500 (m)

$= 3.43 \times 10^{13}$ J

10

7.(a)(i) Complete equation

Correct identification of $^{4}_{2}$ for α ✓

Correct substitution ✓ **2**

$^{27}_{13}$ OR correct values which balance the candidate's equation

(ii) Completion of 2nd equation

$^{0}_{1}$ ✓

Correct identification of positron / positive (+ ve) electron / β^{+} / antielectron ✓ **2**

[If incorrectly given $^{0}_{-1}$ allow electron / β^{-} ie 1 mark]

[Correct spelling only]

(b) Half-life

Average ✓

Time taken for the activity/intensity/count rate to drop by half OR time taken for half the atoms/nuclei to decay ✓

[NOT mass, count, particles, radioisotope, sample]

Isotope

Same: proton number / atomic number ✓
[Not same chemical properties]

Different: neutron number / nucleon number / mass number ✓ **Max 3**

[Not different physical properties/density]

(c) γ-ray emission

EITHER	OR	
(The loss of a helium nucleus/electron has left the remaining) nucleus in an excited state/with a surplus of energy	The nucleus emits its surplus energy (in the form of a quantum of γ-radiation) ✓	**1**

8

8. (a) Inelastic scattering

Kinetic energy is not conserved / (some) kinetic energy is 'lost' ✓ **1**

(b) Structure

There are point charges/quarks/smaller particles within the nucleon OR mass not uniform ✓ **1**

(c) Quantity conserved

Momentum / energy / charge / mass ✓ **1**

(d) No information

Electron was repelled (by the (outer) electron shell(s)) OR captured to make an ion. ✓ **1**

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