Edexcel GCE

Physics

Unit no. 6731

June 2006

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Mark Scheme (Results)

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Physics

6731

Mark scheme notes June 2006

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] ✓ **1**
[Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

1. Mark scheme format

1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'
1.2 Bold lower case will be used for emphasis.
1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally cause the final calculation mark to be lost.
2.2 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.
2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given.
2.4 The same missing or incorrect unit will not be penalised more than once within one question but may be penalised again in another question.
2.5 Occasionally, it may be decided not to penalise a missing or incorrect unit e.g. the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.
2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. Significant figures

3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.
3.2 Use of an inappropriate number of significant figures will normally be penalised in the practical examinations or coursework.
3.3 Using g = 10 m s^{-2} will **not** be penalised.

4. Calculations

4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

4.2 If a 'show that' question is worth 2 marks then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.

4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

4.5 The mark scheme will show a correctly worked answer for illustration only.

4.6 Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H ✓

Substitution into density equation with a volume and density ✓

Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] ✓
[Allow 50.4(N) for answer if 10 N/kg used for g.]
[If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] **3**
[Bald answer scores 0, reverse calculation 2/3]

Example of answer:

$80 \text{ cm} \times 50 \text{ cm} \times 1.8 \text{ cm} = 7200 \text{ cm}^3$

$7200 \text{ cm}^3 \times 0.70 \text{ g cm}^{-3} = 5040 \text{ g}$

$5040 \times 10^{-3} \text{ kg} \times 9.81 \text{ N/kg}$

$= 49.4 \text{ N}$

5. Quality of Written Communication

5.1 Indicated by QoWC in mark scheme, placed as first mark.

5.2 Usually it is part of a max mark.

5.3 In SHAP marks for this are allocated in coursework only but this does not negate the need for candidates to express themselves clearly, using appropriate physics terms. Likewise in the Edexcel A papers.

6. Graphs

6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

6.4 Points should be plotted to within 1 mm.

- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

6.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

6731 Unit Test PHY1

1.

Graph	*Physical quantity represented by the gradient*		
(i)	(Constant) velocity [**Not** speed. **Not** velocity change.]	✓	
(ii)	(Constant) acceleration	✓	
(iii)	Force	✓	
(iv)	Power	✓	**4**

Ignore references to units eg velocity m s^{-1} or dimensions L T^{-1}

2. (a)Complete statement of Newton's Third Law of Motion

....exerts an equal force on (body) A ✓

(but) in the opposite direction (to the force that A exerts on B) ✓ **2**
['exerts an equal but opposite force on body A' would get both marks]

(b)Complete the table

1 mark for each of the three columns ✓✓✓ **3**

[Accept from earth for up. Accept towards ground or towards earth for down]

	Earth	Gravitational. [**Not** 'gravity'. **Not** gravitational field strength]	Up(wards) / ↑
	Ground		Down(wards) / ↓

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3. (a)Time to fall

Use of $s = ut + ½ at^2$ **or** use of 2 correct equations of motion ✓
or use of mgh = ½ mv^2 and other equation(s)
[allow g = 10 m s^{-2}] **2**

Answer to at least 2 sig fig [0.69 s. No ue] ✓

Example
2.3 m = 0 + ½ 9.8 m s^{-2} t^2
t = 0.68(5) s [0.67(8) if 10 m s^{-2} used]

[Reverse argument only accept if they have shown that height is 2.4 m]

(b)Time to rise

Select 2 correct equations ✓
Substitute physically correct values [not u = 0 or a + value for g] ✓
[allow g = 10 m s^{-2} throughout]
Answer: [t = 0.38 s] ✓ **3**

Example 1
$0 = u^2 + 2x - 9.81$ m s^{-2} 0.71 m
0 = 3.73 m s^{-1} + – 9.81 m $s^{-2}t$
t = 0.38 s [0.376 s if 10 m s^{-2}]

Example 2
0 = u + - 9.81 m s^{-2} t; u = 9.81t
0.71 m = 9.81$t.t$ + ½ -9.81 m s^{-2} t^2
t = 0.38 s
[**Note.** The following apparent solution will get 0/3. $s = ut + ½ at^2$; 0.71 m = 0 + ½ 9.81 m s^{-2} t^2; t = 0.38 s, unless the candidate makes it clear they are considering the time of fall from the wicket.]

(c)Velocity u

Use of $v = \frac{d}{t}$ ✓
[d must be 20 m, with any time value from the question eg 0.7 s]

Answer: [18.9 m s^{-1} or 18.2 m s^{-1} if 0.7 s + 0.4 s = 1.1 s is used. ecf value for time obtained in (b).] ✓ **2**

Example
$$v = \frac{20\ m}{0.68s + 0.38s}$$
= 18.86 m s^{-1} [18.18 m s^{-1} if 1.1 s used]

(d)Why horizontal velocity would not be constant

✓ **1**

Friction/drag/air resistance/inelastic collision at **bounce or impact**/ transfer or loss of ke (to thermal and sound) at **bounce or impact** (would continuously reduce the velocity/ kinetic energy).
[also allow ‘friction between ball and surface when it bounces (will reduce velocity/kinetic energy)’].
[Any reference to gravitational force loses this mark. A specific force must be mentioned, eg resistive forces is not enough.]

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4. (a)Newton's Second Law of Motion

(The) force (acting on a body) is proportional/equal to the rate of **change** of momentum ✓
and acts in the direction of the momentum change ✓
[accept symbols if all correctly defined for the first of these marks] **2**
[ignore any information that is given that is not contradictory]

b(i)Calculate the mass

Correct calculation for volume of air reaching tree per second ✓
[Do not penalise unit error or omission of unit]
Correct value for mass of air to at least 3 sig fig [246 kg. No ue.] ✓
[If $1.23 \times 10 \times 20 = 246$ kg is seen give both marks. Any order for the numbers] **2**

Example

$20\ \text{m s}^{-1} \times 10\ \text{m}^2 = 200\ \text{m}^3$

$1.23\ \text{kg m}^{-3} \times 200\ \text{m}^3 = 246\ \text{kg}$

b(ii)Calculate the momentum

Answer: [$(246\ \text{kg} \times 20\ \text{m s}^{-1} =)\ 4920\ \text{kg m s}^{-1}$.] ✓
[Accept $(250\ \text{kg} \times 20\ \text{m s}^{-1} =)\ 5000\ \text{kg m s}^{-1}$. Accept $4900\ \text{kg m s}^{-1}$. Ecf value for mass. Ignore signs in front of values.]

b(iii)Magnitude of the force
Answer: [F = 4920 N or 5000 N or 4900 N.] [Ecf value from b(ii). Ignore signs in front of values] ✓ **2**

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5 (a)Principle of moments

For equilibrium/balance	✓	
sum of clockwise moments = sum of anticlockwise moments **or** sum of moments about a point is zero.	✓	
[Sum or equivalent eg total/net/resultant [**Not all**] must be seen at least once]		**2**

b(i)Force T

Use of principle of moments [Allow one wrong distance]	✓	
Answer: [T = 1.25 N. Accept 1.3 N]	✓	**2**

$T \times 80$ cm = 1 N × 40 cm + 3 N × 20 cm
T = 1.25 N

b(ii)Force

Size: [(1 N + 3 M – 1.25 N =) 2.75 N. Ecf value of T]	✓	
Direction: [Up(wards) or same direction as T or arrow up, might be shown on diagram].	✓	**2**

b(iii)Bar tilted

Force T stays the same	✓	
As all moments/distances are decreased in the same ratio.	✓	**2**

b(iv)3 N moved

QoWC	✓	
(As distance increased) the moment of 3N (about pivot) increased **or** (total) clockwise moment is increased.	✓	
The moment of T is increased **or** anticlockwise moment must increase(to keep clockwise and anticlockwise moments equal).	✓	
Magnitude of T increases.	✓	
[Do not accept ↑ for increases]		**4**
[exclusively calculations 0/4]		**12**

6. <u>(i)Work done</u>

Use of work done = force × distance ✓
Answer given to at least 3 sig fig. [2396 J, 2393 J if 9.8 m s^{-2} is used, 2442 J if g = 10 m s^{-2} is used. No ue.] ✓ **2**

Work done = 110 kg × 9.81 m s^{-2} × 2.22 m
= 2395.6 J

<u>(ii)Power exerted</u>

Use of power = $\dfrac{\text{work done}}{\text{time}}$ or power = $F \times v$ ✓

Answer: [799 W. 800 W if 2400 J is used and 814 W if 2442 J is used. Ecf value from (i)] ✓ **2**

Power = $\dfrac{2396\,\text{J}}{3\,\text{s}}$
= 798.6 W

<u>(iii)Principle of Conservation of Energy</u>

Either
Energy can neither be created nor destroyed ✓✓
OR
Energy cannot be created/destroyed or <u>total</u> energy is not lost/gained ✓

(merely) transformed from one form to another or in a closed/isolated system. ✓ **2**
[Simple statement 'Energy is conserved' gets no marks]
[Information that is not contradictory ignore. ΔQ = ΔU +Δ W, with terms defined acceptable for 1st mark]

<u>(iv)How principle applied to...</u>

Lifting the bar: -
<u>Chemical</u> energy (in the body of the weightlifter) or <u>work done</u> (lifting bar) = (gain in) <u>g.p.e.</u> (of bar) ✓
[Reference to k.e. is acceptable]

The bar falling: -
Transfer from g.p.e. to k.e. ✓
(and that) g.p.e. lost = k.e. gained ✓ **3**

['g.p.e. converted to k.e.' would get one mark]
[References to sound and thermal energy are OK, but gpe to sound or thermal energy on its own gets no marks]

(v)<u>Speed of bar on reaching the floor</u>
Setting ½ mv^2 = $m\,g\,h$ or ½ mv^2 = work done or 2400 J [ecf their value] ✓
[Shown as formulae without substitution or as numbers substituted into formulae]
Correct values substituted ✓
[allow this mark if the 110 kg omitted – substitution gives v^2 = 43.55(6) $m^2\ s^{-2}$ or 44.4 $m^2\ s^{-2}$ if g = 10 m s^{-2} is used]
Answer: [6.6 m s^{-1}. 6.7 m s^{-1} if g = 10 m s^{-2} is used.] ✓

½ 110 kg x v^2 = 110 kg × 9.81 m s^{-2} × 2.22 m or = 2400 J / 2396 J
v = 6.6 m s^{-1} [6.66 m s^{-1} if 10 m s^{-2} used]

OR
Selects $v^2 = u^2 + 2as$ or selects 2 relevant equations ✓
Correct substitution into equation ✓
Answer [6.6 m s^{-1}] ✓ **3**

$v^2 = 0 + 2 \times 9.81\ m\ s^{-2} \times 2.22\ m$
$v = 6.6\ m\ s^{-1}$

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7. <u>(i)Plot a graph</u>

Check any 2 points. [Award if these correctly plotted in appropriate square] ✓
Curve of best fit. ✓ **2**

<u>(ii)Half life</u>

average time required ✓
for the count rate / activity / intensity to reach half the original value **or** time taken for half of the atoms / nuclei/nuclides to decay [NOT mass / particles / atom / (radio)isotope / count / sample/ cells/ nuclide] ✓

<u>(iii)Use the graph</u>

Value of half life [Allow answers in the range 3.1 – 3.3. Mark not to be awarded if a straight lined graph was plotted] ✓
Two or more sets of values used to find half life. [Could be shown on graph] ✓ **max 3 (ii &iii)**

<u>(iv)Similar to</u>
eg (The programme) obeys an exponential law or once a cell has 'decayed', it is not available to decay later **or** (the 'decay' is) random **or** it is impossible to predict which cell will 'decay' next. ✓ **1**

<u>(v)Different</u>

eg (Far) fewer cells available than atoms (in a sample of radioactive material) **or** it is a different 'scenario' eg. they are not atoms but cells on a grid generated by computer. ✓ **<u>1</u>**

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8. <u>(i)Isotopes</u>

(Atoms with) same proton number / atomic number ✓
[not same chemical properties]
Different numbers of neutrons or different nucleon / mass number ✓
[not different physical properties / density] **2**

<u>(ii)Unstable isotope of lead</u>

$^{212}_{82}Pb$ ✓ **1**

<u>(iii)Table</u>

All responses correct ✓✓✓
5 responses correct/ 1 wrong ✓✓
4 responses correct/ 2 wrong ✓

Decay path	*Change of A*	*Change of Z*	*Type of decay*
	−4/ reduced by 4	−2/ reduced by 2	α / helium nucleus
	0 No change / none	+1	β^- / electron [β decay insufficient]

[for change in *z*, 1 is not sufficient i.e. + is essential] **3**

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