edexcel

Edexcel GCE

Physics
Unit no. 6734

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Mark Scheme (Results)

Edexcel GCE
Physics
6734

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.

1	Explanation			
	There is a resultant (or net or unbalanced) force	✓		
	Plus any 3 of following:-			
	Direction of motion is changing	✓		
	Velocity is changing	✓		
	Velocity change implies acceleration	✓		
	Force produces acceleration by $F = ma$ (or N2)	✓		
	Force (or acceleration) is towards centre / there is a centripetal force (or acceleration) / no force (or acceleration) parallel to motion	✓		
	No work done, so speed is constant	✓	**Max 3**	
				4

2 (a) Time interval between wavefronts

1/50 or 0.02 s ✓

1

(b)(i) Time interval between slits

1/50 or 0.02 [No ue] ✓

1

(ii) Angular speed

Time for 1 revolution = 12 x previous answer / Angle between slits = $2\pi/12$ / Frequency = 50/12 ✓

26.2 [3 sf minimum] or ecf from wrong time in (i) ✓

[No ue]

2

e.g. $\omega = 2\pi/(12 \times 0.02\text{ s})$

$= 26.2\text{ rad s}^{-1}$

(iii) Velocity of A

Use of $v = r\omega$ ✓

3.9 m s^{-1} ✓

2

e.g. $v = 0.15\text{ m} \times 26\text{ rad s}^{-1}$

$= 3.9\text{ m s}^{-1}$

[No marks for using $v = 2\pi f x_0$]

(iv) Ratios

$\omega_A : \omega_B = 1 : 1$ or 1 ✓

$v_A : v_B = 3 : 2$ or 1.5 ✓

[Accept any correct numbers in either format]

2

8

3 (a) Experimental verification

QOWC ✓

Measure T using clock or motion sensor or video camera or digital camera [Don't accept light gates] ✓

for a range of masses (or various masses) ✓

Plot T vs $m^{1/2}$ / Plot T^2 vs m / Plot log T vs log m / calculate $T/m^{1/2}$ or T^2/m ✓

Str line through origin / Str line through origin / Str line gradient 0.5 / constant ✓

One precaution ✓

e.g. Use fiducial (or reference) mark
Repeat and average
No permanent deformation of spring
Small amplitude or displacement
Measure at least 10T

Max 5

(b) Natural frequency

Use of $T = 2\pi\sqrt{\frac{m}{k}}$ ✓

Use of $T = \frac{1}{f}$ ✓

3.8 (Hz) [2sf minimum No ue] ✓ **3**

e.g. $T = 2\pi\sqrt{(0.4 \text{ kg} / 230 \text{ N m}^{-1})}$
$= 0.262$ s
$f = 1 / 0.262$ s
$= 3.8$ Hz

(c) Explanations

Natural frequency:

Freq of free vibrations / freq of unforced vibrations / freq when it oscillates by itself (or of its own accord) / freq of oscillation if mass is displaced ✓

[Don't accept frequency at which it resonates, frequency at which it oscillates naturally, frequency if no external forces]

Resonance:

When vibration is forced (or driven) at natural frequency ✓

Amplitude (or displacement or oscillation) is large (or violent or increases) ✓

Amplitude is a maximum / large energy transfer ✓ **4**

[Accept 4 Hz for natural frequency]

12

4 (a)(i) Typical values

Slit separation: 0.1 to 1.0 mm ✓

Distance: 0.5 to 10 m ✓

2

(ii) Fringe separation

Correct measurement to give separation on grid ✓

i.e. 12 mm, or correct distance across stated number of fringes

Use of scale ✓

6 mm [Only award if first mark gained] ✓ **3**

OR (if they think "separation" means half x)

Correct measurement to give separation on grid ✓

i.e. 6 mm, or correct distance across stated number of fringes

Use of scale ✓

[2 marks max]

OR (if they use formula)

Use of $\lambda = xs/D$ ✓

[See 720 for λ, and any values for (D, s) except (9.6, 6)]

[1 mark max]

[No marks for using measurements off the apparatus diagram]

(b) Blue Fringes

5 equally spaced fringes centred at O [Ignore additional fringes] ✓

Fringe centres 8 mm apart on grid ✓

Bands and gaps equal width ✓ **3**

[Mark all points on diagram, ignoring working.]

[No marks if fringe pattern drawn is identical to the red one]

(c) Central fringe

White centre ✓

Red edge(s) / red furthest from centre ✓

2

10

5 (a) Solar Power

Use of $P = I\pi r^2$ [no component needed for this mark]	✓	
Use of cos 40 or sin 50 (with I or A)	✓	
2.2 [2 sf minimum. No ue]	✓	**3**

e.g. $P = 1.1 \times 10^3$ W m^{-2} $\times$ cos 40 $\times$ $\pi(29 \times 10^{-3}$ m$)^2$
$= 2.2$ W

(b) Energy

Use of $E = Pt$	✓	
1.8×10^4 J / 2.0×10^4J	✓	**2**

e.g. $E = 2.2$ W $\times$ (2.5 $\times$ 3600 s)
$= 2.0 \times 10^4$ J

5

6 (a) Graph

Straight line with positive gradient ✓

Starting the straight line on a labelled positive f_o ✓

[Curved graphs get 0/2. Straight line below axis loses mark 2 unless that bit is clearly a construction line.]

2

(b) Work function

From the y intercept ✓

[Accept if shown on graph]

OR Given by gradient × f_o (or $h \times f_0$) [Provided that f_0 is marked on their graph, or they say how to get it from the graph]

OR Read f and E_k off graph and substitute into $E_k = hf - \varphi$

[Curved graph can get this mark only by use of hf_0 or equation methods.]

1

(c) Gradient

Gradient equals Planck constant ✓

1

[Curved graph can't get this mark]

4

7 (a) Wavelength

eV to J ✓

Use of $\Delta E = hf$ ✓

Use of $c = f\lambda$ ✓

1.8×10^{-11} [2 sf minimum. No ue] ✓

4

e.g. $f =$
$(-1.8 \text{ keV} - (-69.6 \text{ keV})) \times (10^3 \times 1.6 \times 10^{-19} \text{ J keV}^{-1}) / 6.6 \times 10^{-34} \text{ J s}$
$= 1.64 \times 10^{19}$ Hz
$\lambda = 3.00 \times 10^8 \text{ m s}^{-1} / 1.64 \times 10^{19}$ Hz
$= 1.8 \times 10^{-11}$ m

(b) Type

X rays [Accept gamma rays] ✓

1

5

8 (a)(i) Hubble constant

Use of $v = Hd$ or gradient = H ✓

Converts y to s i.e. x (365 × 24 × 60 × 60) ✓

Correct x by 'c' ✓

[Seeing 9.46×10^{15} gets previous two marks]

1.7 to 1.8×10^{-18} (s^{-1}) ✓

[No marks for a bald answer] **4**

e.g. $H = 60 \times 10^{6}$ m s^{-1} /
(3.6×10^{7} ly × 365 × 24 ×3600 × 3×10^{8} m ly^{-1})
= 1.8×10^{-18} s^{-1}

(ii) Uncertainty

Distance / d ✓ **1**

(b) Age of Universe

States that $d = vt$ (any arrangement) ✓

Combines this with restated Hubble law (any arrangement) to give ✓

$t = \frac{1}{H}$ **2**

(c) Recessional Speed

Red shift = 76 nm / 469-393nm ✓

Use of $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$ ✓

5.8×10^{7} m s^{-1} ✓ **3**

e.g. $v = 76 \times 10^{-9}$ m × 3 $\times 10^{8}$ m s^{-1} / 393 $\times 10^{-9}$ m
= 5.8×10^{7} m s^{-1}

(d) Average mass-energy density

Closed : high density/above critical density ✓

Then gravitational pull (or force or attraction) sufficient to cause Big Crunch/pull everything back/stop expansion [NOT to hold the galaxies together] ✓

OR equivalent argument for Open

[Don't accept mass for density in mark 1 or just "gravity" in mark 2] **2**

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