GCE

Edexcel GCE

Physics (6731/01)

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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 PHY 1

1.

Graph	*Physical quantity represented by area under graph*		
(i)	Work (done) / (change in)energy (stored)	✓	
(ii)	Distance / displacement (change)	✓	
(iii)	Speed / velocity (change)	✓	
(iv)	Impulse / (change in) momentum	✓	**4**

For ii ignore total if written

For iii average velocity or average speed is wrong

2. (a) Principle of moments

For equilibrium / balance ✓

sum of moments clockwise = sum of moments anti-clockwise ✓
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) Weight of retort stand

Use of principle of moments ✓

i.e.$180 \times (10^{-3}\text{ m}) \times W = 228 \times (10^{-3}\text{ m}) \times 9\text{ (N)}$
[Allow 1 wrong distance]

11.4 (N) ✓ **2**
[At least 3 sig fig required. No u.e.] [In this question allow reverse calculation to gain full marks] [Bald answer scores 0]

(ii) Reading on newtonmeter and normal contact

Fully correct moment equation ✓

$F \times 448 \times (10^{-3}\text{ m}) = 11.4\text{ (N)} \times 40 \times (10^{-3}\text{ m})$
[allow $11\text{ N} \times 40 \times (10^{-3})$ m or ecf from bi]

= 1.0 N ✓

Normal contact force (11.4 N/11 N − 1 N) = 10.4 N or 10 N (upwards)[ecf] ✓

3

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3. (a) 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]

80 cm × 50 cm × 1.8 cm = 7200 cm^3

7200 cm^3 × 0.70 g m^{-3} = 5040 g

5040 g × 10^{-3} × 9.81 N/kg

= 49.4 (N)

[May see :
80 cm × 50 cm × 1.8 cm × 0.7 g m^{-3} × 10^{-3} × 9.81 N/kg = 49.4(N)]

(b)(i) Horizontal and vertical components

Horizontal component = (83 cos 37 N) = 66.3 N / 66 N ✓
Vertical component = (83 sin 37 N) = 49.95 N / 50 N ✓
[If both calculated wrongly, award 1 mark if the horizontal was identified as 83 cos 37 N and the vertical as 83 sin 37 N] **2**

(ii) Add to diagram

Direction of both components correctly shown on diagram ✓ **1**

(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.]

7

4. Expression for E_K and work done / base unit

(a)(i) Kinetic energy = ½ mu^2
Work done = Fd ✓
[must give expressions in terms of the symbols given in the question] **1**

(ii) Base units for kinetic energy = (kg (m $s^{-1})^2$) = kg m^2 s^{-2} ✓
Base units for work done = kgms^{-2} .m = kg m^2 s^{-2} ✓
[derivation of kg m^2 s^{-2} essential for 2nd mark to be given] **2**
[Ignore persistence of ½] [For 2nd mark ecf mgh for work from ai]

(b) Show that the braking distance is almost 14 m

[Bald answer scores 0; Reverse calculation max 2/3]

Either

Equating work done and kinetic energy[words or equations] ✓

Correct substitution into kinetic energy equation **and** correct substitution into work done equation ✓

Correct answer [13.8 (m)] to at least 3 sig fig. [No ue] ✓

$0.5 \times m \times (13.4 \text{ m s}^{-1})^2 = m \times 6.5 \text{ m s}^{-2} \times d$

$$\frac{0.5 \times m \times (13.4 \text{ ms}^{-1})^2}{m \times 6.5 \text{ ms}^{-2}} = 13.8 \text{ (m)}$$ **3**

[m may be cancelled in equating formulae step and not seen subsequently]

OR

Selecting $v^2 = u^2 + 2as$ OR 2 correct equations of motion ✓
Correct magnitudes of values substituted ✓
[i.e. $0 = (13.4 \text{ m s}^{-1})^2 + 2((-)6.5 \text{ m}^{-2})s$]
Correct calculation of answer [13.8 (m)] to at least 3 sig fig. [No ue] ✓

(c) Why braking distance has more than doubled

QOWC ✓

Either

(Because speed is doubled and deceleration is unchanged) time (to be brought to rest) is doubled/increased. ✓

(Since) distance = speed × time [mark consequent on first] or $s = ut + ½ at^2$ ✓

the distance is increased by a factor of (about) 4 ✓

4

Or

Recognition that (speed)^2 is the key factor ✓

Reference to $v^2 = u^2 + 2as$ or rearrangement thereof or kinetic energy [second mark consequent on first] ✓

(Hence) distance is increased by a factor of (almost) 4 ✓

Or

Do calculation using $v^2 = u^2 + 2as$ and use 26.8 m s^{-1} and 6.5 m s^{-2} ✓

Some working shown to get answer 55.2 m ✓

(Conclusion that) distance is increased by a factor of (almost) 4 ✓

[Note : unlikely that QWOC mark would be awarded with this method]

Or

Accurate labelled v-t graphs for both ✓

Explanation involving comparison of areas ✓

Distance is increased by a factor of (almost) 4 ✓

[In all cases give 4th mark if 4 is not mentioned but candidate shows more than doubled eg "Speed is doubled and the time increased, therefore multiplying these gives more than double."]

10

5. (a) <u>From what height?</u>

Use of $mg\Delta h$ **and** $\frac{1}{2}mv^2$ ✓
[ignore power of 10 errors]

mg $\Delta h = \frac{1}{2} mv^2$ ✓
[shown as formulae without substitution, or as numbers substituted into formulae]

Answer [0.8(2) m] ✓

[It is possible to get 0.8 m by a wrong method:
- If $v^2 = u^2 + 2as$ is used, award 0 marks
- If you see v^2/a then apply bod and up to 2/3 marks - the 2nd and 3rd marks. Note that v^2/g is correct and gains the first 2 marks, with the 3rd mark if 0.8 m is calculated] **3**

$80 \times (10^{-3})\text{ kg} \times 9.81\text{ N kg}^{-1} \times \Delta h = \frac{1}{2} \times 80 (\times 10^{-3})\text{ kg} \times (4\text{ m s}^{-1})^2$

$$h = \frac{0.5 \times 80 \times 10^{-3}\text{ kg} \times (4\text{ ms}^{-1})^2}{80 \times 10^{-3}\text{ kg} \times 9.81\text{ N kg}^{-1}}$$

= 0.8(2) m

(b)(i) <u>Law of conservation of linear momentum</u>

Provided no external[other/resultant/outside] force acts ✓
The total momentum (of a system) does not change / total momentum before(collision)= total momentum after (collision) ✓ **2**
[Total seen at least once] [Ignore all references to elastic and inelastic]
[Do not credit simple statement that momentum is conserved]

(ii) <u>Speed of trucks after collision</u>

Any correct calculation of momentum ✓

Use of conservation of momentum leading to the answer 1.3(3) m s^{-1} ✓

$80 \times (10^{-3})\text{ kg} \times 4\text{ m s}^{-1} = 240 \times (10^{-3})\text{ kg} \times u$, giving u = 1.3(3) m s^{-1}

2

(c) Time for trucks to stop

[Do not penalise candidates for using a total frictional force of 0.36 N. 3/3 possible]

Either

Correct use of power = $f \times$ v **and** $\frac{1}{2}mv^2$ ✓

[Do not penalise power of 10 errors or not dividing by 2 in f × V equation]

Use of energy divided by power ✓

Answer in range 2.6 s to 2.7 s ✓

[ecf their value for u]

$P = 0.12\text{ N} \times \frac{1.33}{2}\text{ m s}^{-1} = 0.08\text{ W}$

$KE = \frac{1}{2} \times (3) \times 80 \times (10^{-3})\text{ kg} \times (1.33\text{ m s}^{-1})^2 = 0.21\text{ J}$

$\frac{\text{Energy}}{\text{power}} = \frac{0.21\text{ J}}{0.08\text{ W}}$

t = 2.6(5) s

[accept 2.6 or 2.7 as rounding] **3**

OR

Use of $F = ma$ ✓

Use of **either** $v = u + at$ i.e. **or** $a = \frac{\Delta v}{t}$ ✓

Answer in range 2.6 s to 2.7 s ✓

$(–)0.12\text{ N} = (3) \times 80 \times (10^{-3})\text{ kg} \times a$ $(a = (–)0.5\text{ m s}^{-2})$

$0 = 1.33\text{ m s}^{-1} – 0.5\text{ m s}^{-2} \times t$ **or** $(-)0.5\text{ m s}^{-2} = \frac{(–)1.33\text{ m s}^{-1}}{t}$

$t = 2.6(6)$ s

OR

Select $Ft = \Delta p$ ✓

Substitution $(-)0.12t = (-3) \times 80 \times (10^{-3})\text{ kg} \times 1.33\text{ m s}^{-1}$ ✓

[Allow omission of any bracketed value]

Answer in range 2.6 s to 2.7 s ✓

10

6. (a)(i) Newton's First law of Motion

An object will remain (at rest or) uniform/constant velocity/speed/motion in a straight line unless (an external/impressed) force acts upon it / provided resultant force is zero. ✓

1

(ii) Everyday situation

Reference to air resistance / friction / drag etc. ✓

1

(iii) Equilibrium

The resultant force is zero / no net force /sum of forces is zero / forces are balanced / acceleration is zero ✓
[Accept moments in place of force] **1**

(b)(i) Identify the other force

Earth ✓
Gravitational [consequent on first mark] [Do not credit gravity.] ✓

2

(ii) Why normal contact forces are not a Newton's third law pair

Do not act along the same (straight) line / do not act from the same point ✓
They act on the same body ✓
They act in the same direction / they are not opposite forces ✓
They are of different magnitudes ✓ **max 2**

7

7. (a) Sources of background radiation

2 from:
Cosmic rays, rocks, soil, food, nuclear power/industry[buried waste as alternative], atmosphere, building material, medical uses, nuclear weapons testing (in the 60 s), Sun, radon gas ✓✓ **2**

[Do not credit more than 1 example in each category e.g.coffee and Brazil nuts is 1 mark not 2]

(b)(i) Measurement of background count rate

- Use GM tube or stop watch/ratemeter/datalogger ✓
- All sources must be in their (lead) containers / placed away from the experiment / place thick lead around tube ✓
- Measure count over measured period of time (and divide count by time) ✓
- Repeat and average / measure the count for at least 5 minutes ✓
- Subtract background (count rate) from readings ✓

max 4

(ii) Why it might be unnecessary to measure background count rate

Count rate for the radioactive material is much greater than the background count rate. ✓ **1**
[Comparison required with count rate of radioactive material]

7

8. (a)(i) Stable ?

Will not: decay / disintegrate / be radioactive / emit radiation / emit particles / break down ✓ **1**
[Do not accept will not emit energy]

(ii) Complete equation

${}^{1}_{1}\text{Y}$ ✓ **1**

(iii) Identify particles

X = neutron ✓
Y = proton ✓ **2**

(b)(i) Decay Constant

Use of $\lambda = \dfrac{0.69}{t_{1/2}}$ i.e. $= \dfrac{0.69}{5568 \times 3.2 \times 10^{7}\,\text{s}}$ ✓
[Do not penalise incorrect time conversion]

Correct answer [3.87×10^{-12} (s^{-1})] to at least 2 sig fig. [No ue] ✓ **2**
[Bald answer scores 0]

(ii) Number of nuclei

Use of A = λN eg $\dfrac{16}{60}$ = (–) 4×10^{-12} N ✓
[Ecf their value of λ] [Do not penalise incorrect time conversion]

Answer in range 6.6×10^{10} to 7.0×10^{10} ✓ **2**

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