Edexcel Pearson IAL

Marking activity

Questions and Markschemes

Question 1 – 4 are examples of questions where linkage will be assessed. These questions were on the GCE AL physics papers June 2017 and marks were awarded on the following basis.

This question assesses a student's ability to show a coherent and logical structured answer with linkage and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.
The following table shows how the marks should be awarded for indicative content.

Number of indicative points seen in answer	Number of marks awarded for indicative points
6	4
5-4	3
3-2	2
1	1
0	0

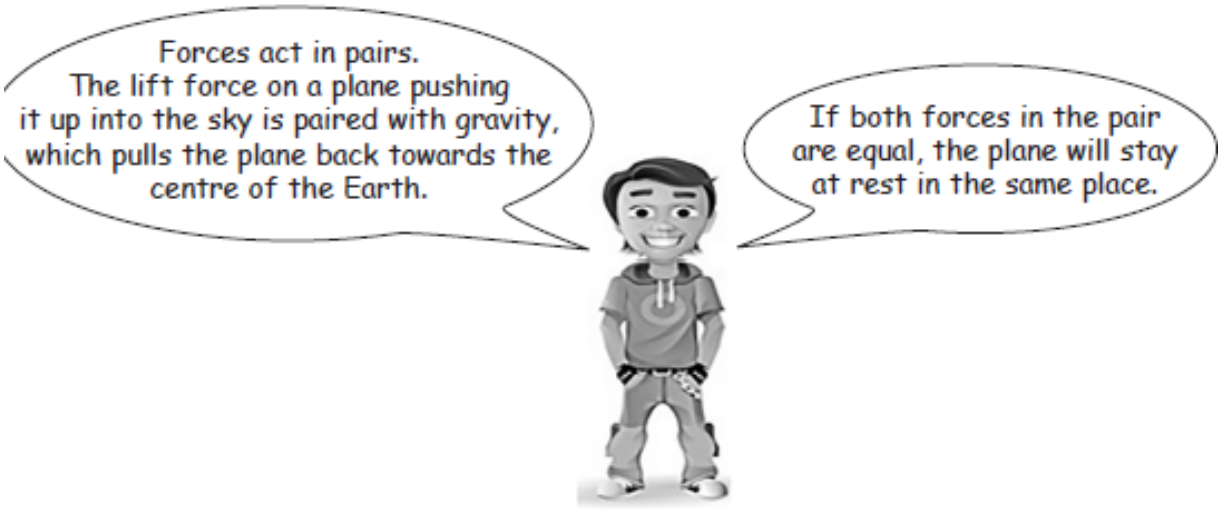
The following table shows how the marks should be awarded for structure and lines of reasoning

	Number of marks awarded for structure and lines of reasoning
Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkage between points and is unstructured	0

Each question will have some indication which relates the indicative points to the linkage marks.

Question 1

The following extract comes from a section on forces, on a website written for children.



Criticise this extract.

(6)

Markscheme for Q1

Indicative content:

- Newton's 3rd law pair of forces must be of the same type
  Or Newton's 3rd law pair of forces must act on different bodies
- The two forces mentioned are not a 3rd Law pair
  Or gravity is not a good description of force
- The lift on the plane should be paired with the push of the plane on the air
  Or the gravitational force of Earth on plane should be paired with the gravitational force of plane on Earth.
- If the vertical resultant force is zero the plane will not accelerate vertically
- So the plane could be 'at rest' or moving with uniform velocity in the vertical direction
- There must be some horizontal motion so plane can't be in same place

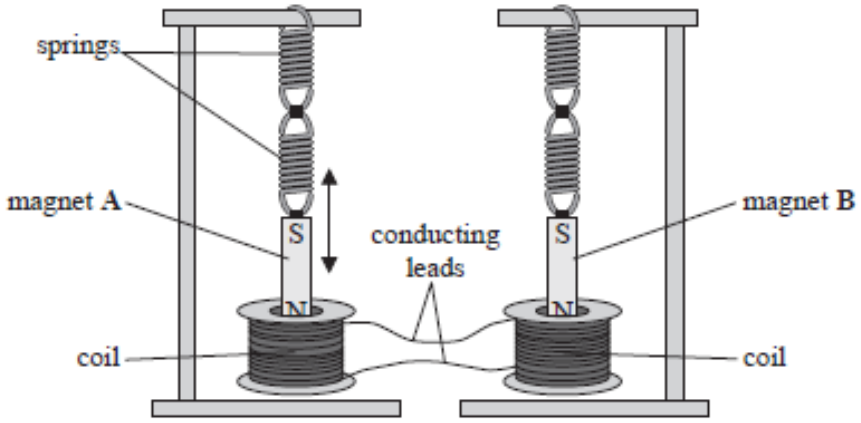
Linkage Marks

IC points 1 – 3
Two of these points could score one linkage mark

IC points 4 – 6
Two of these points could score one linkage mark

Question 2

*(d) Identical bar magnets are suspended from identical springs, with the North pole of each magnet inside a coil of wire as shown. The two coils are connected together with conducting leads.



Magnet A is displaced so that it oscillates vertically. The North pole of magnet A moves into and out of the coil of wire with simple harmonic motion. As this motion continues, magnet B starts to oscillate. The amplitude of oscillation of magnet B increases over time.

Explain why magnet B starts to oscillate with an increasing amplitude.

(6)

Markscheme for Q2

Indicative content:

- As magnet A moves, its coil experiences a change of magnetic flux (linkage)
- The change in magnetic flux linkage induces an emf in the coil
- The (induced) emf causes a current in both coils
- The current in the second coil causes a force to act on magnet B, driving magnet B into oscillation
- Because both mass-spring systems have the same period/frequency
- Resonance occurs (and magnet B oscillates with increasing amplitude)

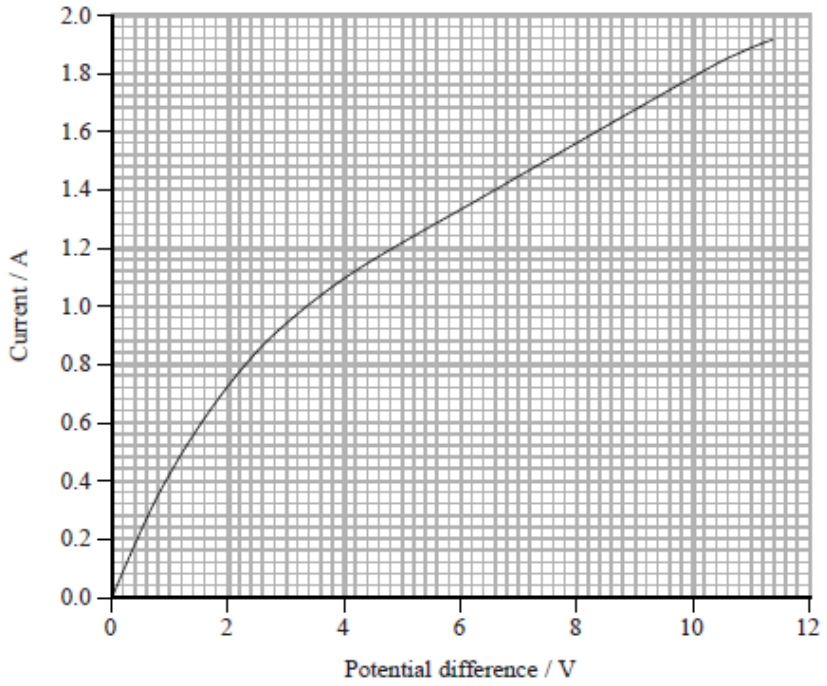
Linkage Marks

IC points 1 – 4
Three of these points could score one linkage mark

IC points 5 & 6 could score one linkage mark

Question 3

The graph shows how the current through a filament bulb varies with the potential difference across the bulb.



*(c) Explain the variation of resistance with potential difference for the filament bulb in terms of particle behaviour.

(6)

Markscheme for Q3

Indicative content

- (As *V* increases) acceleration/velocity/energy of electrons increases
- greater energy transfer in collisions with lattice / ions
- increasing the temperature of metal/filament/ions
- amplitude of vibrations of lattice/ ions increases
- collision (rate) between lattice /ions and electrons increases
  Or shorter distance between collisions
  Or greater chance of collision
- due to the increase in resistance, current doesn't increase in proportion to potential difference
  Or due to the increase in resistance the ratio of I/V decreases

Linkage marks

Number of indicative content points awarded	Possible linkage marks
0, 1	0
2, 3	1
4, 5, 6	2

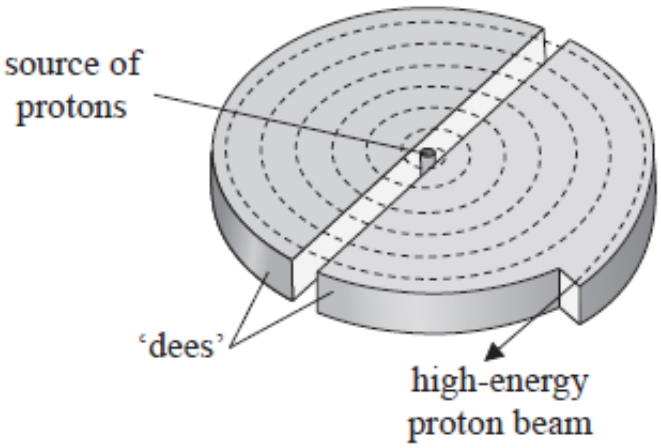
MP1 don't award for 'increased rate of flow'

MP2 to award mark there must be the idea of increased/greater energy transfer between electrons and ions

Question 4

Proton beam therapy is being introduced in the UK as a new cancer treatment.

A beam of protons is accelerated by a cyclotron to an energy of 23 MeV and is then focused onto a tumour.



*(a) Explain how the cyclotron produces the high-energy proton beam.

(6)

Markscheme for Q4

Indicative content

- There is an alternating p.d./E-field
- P.d./E-field accelerates protons between the dees
- Magnetic field is perpendicular to plane of dees
- Proton path is curved by the magnetic field.
- As velocity of protons increases, the radius of path increases
- The time for which a proton is in a dee remains constant
  Or the frequency of p.d./E-field is constant

Number of IC points	**Possible linkage marks**
0, 1, 2	0
3, 4	1
5, 6	2

IC2 accept 'in the gap' for between dees. Accept increases E_k for accelerates

IC3 accept vertical or upwards for perpendicular to plane.

IC5 accept reference to $r = p/BQ$

Questions 5 – 7 are questions are examples of questions which assess AO3.

Often the question does not state what calculation has to be done and often there are a number of possible methods.

Question 5

A motorist received a speeding penalty notice, from the police, for a short journey along 120 m of road.

(a) The car's specification states that the minimum time for the car to accelerate from 0 to 60 miles per hour is 9.5 seconds.

Show that the maximum value for the average acceleration of the car over 9.5 s is about 3 $m s^{-2}$.

1 mile = 1600 m

(2)

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(b) The police recorded a maximum speed for the car of 20 $m s^{-1}$.

The motorist knows that the speed at the start and at the end of the 120 m journey was zero

Assume that the car had:

- constant positive acceleration, equal to the value in part (a), for the first 60 m of the journey
- constant negative acceleration of the same magnitude for the final 60 m of the journey.

Determine whether the motorist should challenge the penalty notice.

(3)

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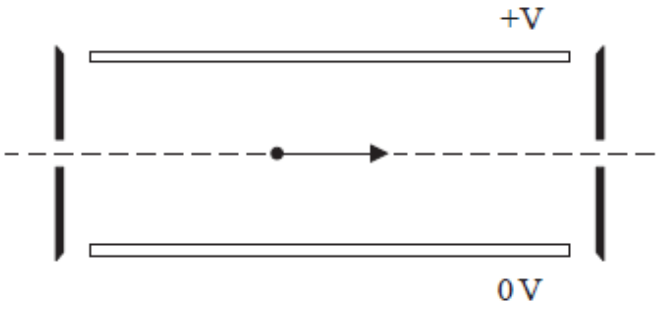
Markscheme for Q5

Acceptable Answer		Additional guidance
• Use of $v = u + at$ • Max acceleration from 0-60 time = 2.8 (m s^{-2})	(1) (1)	Example of calculation $\frac{(60 \times 1600)\ \text{m}}{(60 \times 60)\ \text{s}} = 0 + a \times 9.5\ \text{s}$ Max acceleration = 2.8 m s^{-2}
• Use of $v^2 = u^2 + 2as$ • Max speed with manufacturer's acceleration = 18 m s^{-1} **Or** acceleration shown by police = 3.3 m s^{-2} • Decision **and** evidence required consistent with calculated values	(1) (1) (1)	Examples for MP3: e.g. 18.3 m s^{-1} is lower than 20 m s^{-1} so should be challenged e.g. 18.3 m s^{-1} is lower than the maximum speed so should be challenged e.g. The police are suggesting a greater acceleration than the manufacturers, so it should be challenged e.g. The maximum speed achievable is less than that suggested by the police, so it should be challenged MP2: maximum manufacturer's speed with show that value of acceleration = 19.0 m s^{-1} Example of calculation $v^2 = 0^2 + 2 \times 2.8\ \text{m s}^{-2} \times 60\ \text{m}$ $v = 18.3\ \text{m s}^{-1}$

Question 6

(c) In most mass spectrometers the ions are passed through a velocity selector, after being accelerated, to produce a beam of ions of a particular velocity.
The velocity selector consists of a pair of parallel plates, across which a potential difference (p.d.) is applied to create an electric field.



In one mass spectrometer the plates are 2.5 cm apart and a p.d. of 135 V is applied.

A magnetic field is also applied to produce a force on the ions in the opposite direction to the force from the electric field. For one particular speed the ions travel in a straight line and emerge from the selector.

(i) Add to the diagram to indicate the directions of the electric field and the magnetic field.

(2)

(ii) The magnetic flux density applied to the velocity selector is 24.5 mT.

Deduce whether this magnetic flux density is suitable to produce a beam of chlorine-35 ions of speed 2.2×10^5 m s^{-1}.

(4)

Markscheme for Q6

• Electric field vertically downwards (from top plate to bottom plate) • Magnetic field into paper	(1) (1)	
• Use of $E = \frac{V}{d}$ • Use of $F_E = EQ$ • Use of $F_M = BQv$ • Show that these forces are equal (if v is 2.2×10^5 m s^{-1}) and hence state that B is suitable	(1) (1) (1) (1)	Do not award MP4 if incorrect ion charge used Example of calculation: $E = \frac{V}{d} = \frac{135\,\text{V}}{2.5\times10^{-2}\,\text{m}} = 5400\,\text{V m}^{-1}$ $F = EQ = 5400\,\text{V m}^{-1} \times 1.6\times10^{-19}\,\text{C} = 8.6\times10^{-16}\,\text{N}$ $F = BQv = 24.5\times10^{-3}\,\text{T} \times 1.6\times10^{-19}\,\text{C} \times 2.2\times10^{5}\,\text{ms}^{-1}$ $= 8.6\times10^{-16}\,\text{N}$

Question 7

(ii) Show that the activity of this sample is about 5 Bq.

half-life of potassium-40 = 1.25×10^9 years

(3)

(iii) With no sample in front of the Geiger-Müller tube, a count rate of 15 counts per minute is recorded. When the potassium chloride test sample is placed next to the Geiger-Müller tube 176 counts are recorded in a period of 10 minutes.

A detector is considered efficient if it detects at least 7.5% of beta emissions from the source.

Determine whether this Geiger-Müller tube can be considered efficient.

(3)

Markscheme for Q7

• use of ln 2 = $\lambda t_{1/2}$ • use of activity = λN (ecf from (b)(i)) • activity = 5.1 (Bq) (use of show that value gives 5.3 Bq)	(1) (1) (1)	ln 2 = $\lambda \times 1.25 \times 10^9$ years = $\lambda \times (1.25 \times 10^9 \times 365 \times 24 \times 60 \times 60)$ s $\lambda = 1.76 \times 10^{-17}$ s^{-1} $A = 1.76 \times 10^{-17}$ s$^{-1} \times 2.9 \times 10^{17}$ = 5.1 Bq
• use of count rate = (counts – background counts) / time • calculates percentage of activity from (b)(ii) **Or** applies 7.5% to activity from (b)(ii) • Comparative statement consistent with their values	(1) (1) (1)	**MP3** can only be awarded if Activity from (ii) is used. A clear comparison with the corresponding value must be made e.g. percentage = 0.8 % which is < 7.5 % so not efficient **Or** detects 176 but should detect 379 counts in 10 min, so not efficient **Or** should detect a rate of at least 0.63 Bq, so not efficient Example of calculation Recorded count rate = (176 - 150) ÷ 600 s = 0.04 Bq 0.04 Bq × 100 ÷ 5.1 Bq = 0.78 % (ecf from (b)(ii) for MP3)