GCSE
PHYSICS
8463/2F

Paper 2 Foundation Tier

Mark scheme

June 2023

Version: 1.0 Final

2 3 6 G 8 4 6 3 / 2 F / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make their judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Alternative words in the mark scheme are shown by a solidus eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name **two** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level.

The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

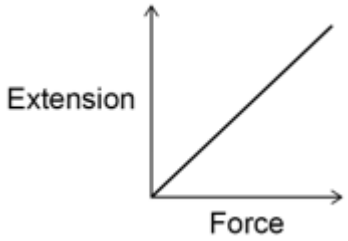
An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	1.5 cm		1	AO1 4.5.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **one** from: • clamp the stand to the desk • wear safety goggles / glasses • stand up / away from apparatus • limit the total mass used • have masses over the base of the stand		1	AO1 4.5.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$W = 0.050 \times 9.8$ $W = 0.49$ (N)	 do **not** accept 0.50 (N) alone	1 1	AO2 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4			1	AO1 4.5.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$k = \frac{2.0}{0.080}$ k = 25 (N/m)		1 1	AO2 4.5.3 RPA6

Total Question 1	**7**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	kinetic thermal	this order only	1 1	AO1 4.5.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(minimum braking) distance increases with increasing speed	allow positive correlation	1	AO2 4.5.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	increases		1	AO1 4.5.6.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	12.5 – 5.0 = 7.5 (m/s) $t = \frac{7.5}{0.25}$ t = 30 (s)	 this mark may be awarded if the change in velocity is incorrectly calculated allow a correctly calculated answer using a change in velocity incorrectly calculated	1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	*F* = 1600 × 0.25 *F* = 400 (N)		1 1	AO2 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	initial height of the ruler above the person's hand		1	AO3 4.5.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	there will be more variation in distances	allow reaction times for distances allow the three students tested are not typical	1	AO3 4.5.6.3.2

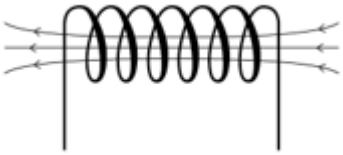
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	carry out the experiment listening to music then not listening to music (and compare the results)	 allow compare with original results	1 1	AO3 4.5.6.3.2

Total Question 2	**13**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	direction (of the magnetic field)		1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	increase the current in the wire		1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3			1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	**D A B C**	allow **1** mark for D B A C	2	AO2 4.7.2.1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	decrease the distance between the electromagnet and the iron arm		1	AO3 4.7.1.2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	period = $\frac{1}{6.25}$ period = 0.16 (s)		1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	**B**		1	AO1 4.6.1.1

Total Question 3	**9**

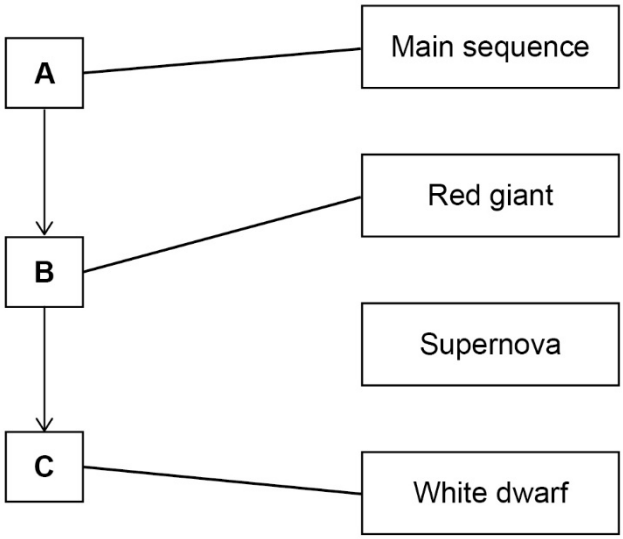
Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	the old model cannot explain new observations		1	AO1 4.8.1.1

Question	Answers	Mark	AO / Spec. Ref.
04.2	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3-4	AO1 AO3 4.8.1.1 4.8.1.3
	Level 1: Relevant features are identified and differences noted.	1-2	
	No relevant content.	0	
	Indicative content **Similarities** in both models: • the orbits of the Moon and / or planets are circular / elliptical • the Moon orbits the Earth • there is one star / Sun **Differences** In the current model: • the planets orbit the Sun, whereas in the old model the planets orbit the Earth • there are (two) more planets • there are also dwarf planets, whereas no dwarf planets are shown in the old model • other planets have moons, whereas other planets have no moons shown in the old model		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	it increases		1	AO3 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	three bars drawn correctly three bars correctly labelled	allow tolerance of half a small square	1 1	AO2 4.8.1.1

Question	Answers	Mark	AO / Spec. Ref.
04.5	**Stage** **Name of the stage**  2 marks for all lines correct 1 mark for 2 lines correct additional line from a box on the left negates the mark for that box	2	AO1 4.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	they are the best emitters of radiation		1	AO1 4.6.3.1

Total Question 4	**11**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	wavelength = Q		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	amplitude = $\frac{R}{2}$		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	radio waves		1	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	s = 300 000 000 × 0.000009 s = 2700 (m)		1 1	AO2 4.5.6.1.2

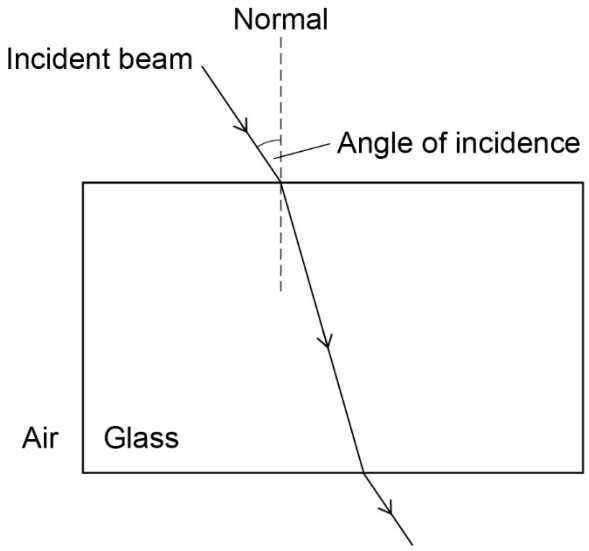
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	satellite communications **or** cooking /heating food	allow WiFi	1	AO1 4.6.2.4

Total Question 5	**6**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	it is harder to judge where the centre of the beam is		1	AO3 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	ray shown refracted to the right of the normal as it enters the glass block refraction towards the normal emergent ray parallel to incident ray	 do **not** accept a continuation of the incident ray through the glass block ignore arrows	1 1 1	AO1 4.6.2.2



Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	1 degree		1	AO2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	33 (°)		1	AO2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	absorbed		1	AO1 4.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	wave speed = frequency × wavelength **or** $v = f\lambda$	allow correct re-arrangement	1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	$3.0 \times 10^8 = 4.0 \times 10^{14} \times \lambda$ $\lambda = \frac{3.0 \times 10^8}{4.0 \times 10^{14}}$ $\lambda = 7.5 \times 10^{-7}$ (m)	 allow 0.000 000 75 (m)	1 1 1	AO2 4.6.1.2

Total Question 6	11

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	a satellite		1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	arrow drawn towards the centre of the Earth from the Hubble Space Telescope		1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	any correct change in distance with the correct change in time	e.g. 38 (km) and 5 (s)	1	AO2 4.5.6.1.4
	a correct substitution of a correct pair of values	e.g. $v = \frac{38}{5}$	1	
	a correctly calculated answer	e.g. v = 7.6 (km/s)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	galaxy **C**		1	AO3 4.8.2

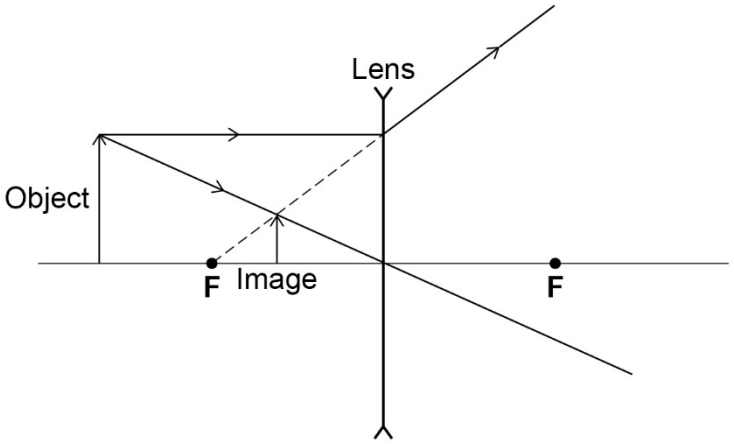
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	galaxy **C**		1	AO3 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	to check the observations are correct		1	AO1 4.8.2

Total Question 7	**8**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	principal focus		1	AO1 4.6.2.5

Question	Answers	Mark	AO / Spec. Ref.
08.2	ray through the centre of the lens image in correct position and with correct orientation  	1 1	AO2 4.6.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	upright virtual	allow right way up ignore not real ignore it is on the same side of the lens	1 1	AO3 4.6.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	$3.5 = \frac{\text{image height}}{1.6}$ image height = 3.5 × 1.6 image height = 5.6 (mm)		1 1 1	AO2 4.6.2.5

Total Question 8	**8**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	perpendicular		1	AO1 4.6.1.1

Question	Answers	Mark	AO / Spec. Ref.
09.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5-6	AO3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3-4	AO1
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2	AO1
	No relevant content	0	
	Indicative content **Method:** • heat the water / kettle • add an equal volume of (hot) water to each flask • insert a thermometer into each flask • record the initial temperature from both flasks OR • place an IR detector near each flask • the distance between the IR detector and the flask should be the same each time • record initial reading from IR detectors • (and) start a stop clock • record the temperatures / readings after 10 minutes from both flasks • calculate the change in temperatures / readings during the 10 minutes • compare the results to test the hypothesis to access level 3 the method must allow the correct consideration of a temperature decrease for both flasks or the correct comparison of IR detected from both flasks		4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	during the 1st minute		1	AO2
	there is the greatest temperature difference (between the hot water and the surroundings)	allow highest temperature or hottest MP 2 dependent on scoring MP1	1	AO1 4.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	the temperature (increase / change after 10 minutes)	allow the final temperature do not allow temperature decrease	1	AO1 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	black surfaces absorb more (infrared than white surfaces)	allow black surfaces have a greater temperature increase (than white surfaces)	1	AO3 4.6.2.2 4.6.3.1
	matt surfaces absorb more (infrared) than shiny surfaces of the same colour	allow matt surfaces have a greater temperature increase than shiny surfaces of the same colour if no other marks scored, allow 1 mark for matt black surface is the best absorber and shiny white surface is the worst absorber if no other marks scored, allow 1 mark for matt black has the greatest temperature increase and shiny white has the smallest temperature increase	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	pressure = $\frac{\text{force}}{\text{area}}$		1	AO1 4.5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.7	area of base = 0.0144 (m^2)	do not allow this or subsequent marks unless base area is used	1	AO2 4.5.5.1.1
	1500 = $\frac{F}{0.0144}$	this mark may be awarded if base area is incorrectly calculated	1	
	F = 1500 × 0.0144	this mark may be awarded if base area is incorrectly calculated	1	
	F = 21.6 (N)	this mark may be awarded if base area is incorrectly calculated allow 22 (N)	1	

Total Question 9	**17**

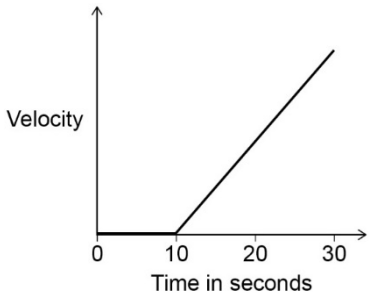
Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	7.1 (cm) 497 (m)	allow 7.0 to 7.3 (cm) allow 70 × their measurement of displacement	1 1	AO2 4.5.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	0 (N)		1	AO2 4.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	constant velocity	allow constant speed (in a straight line) do **not** accept stationary allow constant acceleration if a **mathematical error** in 02.2 gives a non-zero value for resultant force	1	AO1 4.5.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	any **one** from: • tension • normal contact (force) • upthrust	allow lift, thrust and water resistance allow normal reaction (force) ignore drag	1	AO1 4.5.1.2

Question	Answers		Mark	AO / Spec. Ref.
10.5	horizontal line drawn to 10s along the *x*-axis		1	AO3 4.5.6.1.4
	line with a positive gradient starting from 10 s	allow an upward curving line with increasing gradient starting from 10 s  	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.6	line of best fit drawn and extrapolated to 10 km	do **not** accept a straight line	1	AO2 4.5.5.2
	28 (kPa)	allow 26 to 32 (kPa) allow a value correctly extrapolated from their line allow 2 marks for a correct mathematically extrapolated value	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.7	the average density of the air above the aeroplane decreases		1	AO3 4.5.5.2

Total Question 10	**10**