Rewarding Learning

General Certificate of Secondary Education
2019

Science: Physics

Unit 2

Higher Tier

[GPY22]

FRIDAY 14 JUNE, MORNING

MARK SCHEME

General Marking Instructions

Introduction
Mark schemes are intended to ensure that the GCSE examinations are marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives
Below are the assessment objectives for GCSE Physics

Candidates must:

AO1 Demonstrate knowledge and understanding of scientific ideas, scientific techniques and procedures;

AO2 Apply knowledge and understanding of scientific ideas, scientific enquiry, techniques and procedures; and

AO3 Analyse information and ideas to interpret and evaluate; make judgements and draw conclusions; develop and improve experimental procedures.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Marking Calculations
In marking answers involving calculations, examiners should apply the 'own figure rule' so that candidates are not penalised more than once for a computational error.

Types of mark schemes
Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Levels of response
Tasks and questions requiring candidates to respond in extended writing are marked in terms of levels of response. In deciding which level of response to award, examiners should look for the 'best fit' bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement. The following guidance is provided to assist examiners.

- ***Threshold performance:*** Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.
- ***Intermediate performance:*** Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.
- ***High performance:*** Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

Quality of written communication
Quality of written communication (QWC) is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in extended written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

Level A: Quality of written communication is excellent.
Level B: Quality of written communication is good.
Level C: Quality of written communication is basic.

In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

Level A (Excellent): The candidate successfully selects and uses the most appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is widespread and accurate use of appropriate specialist vocabulary. Presentation and spelling, punctuation and grammar (SPG) are of a sufficiently high standard to make meaning clear.

Level B (Good): The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is some use of appropriate specialist vocabulary. Presentation and spelling, punctuation and grammar (SPG) are sufficiently competent to make meaning clear.

Level C (Basic): The candidate makes only a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation and spelling, punctuation and grammar (SPG) may be such that intended meaning is not clear.

AVAILABLE MARKS

1 (a) (i) Right angles up and down
90° up and down
perpendicular [1]

(ii) Longitudinal wave [1]
vibrations/oscillations [1]
parallel/antiparallel to wave direction [1]
same direction [4]

(b) (i) $2\frac{1}{2}$ waves in 10 ms [1]

(ii) = 2.5 × 1000/10 or $\frac{2.5}{0.01}$ [1]
= 250 [1]
Hz allow ecf from **(i)** [1] [3]

(iii) v = fλ or λ = v/f [1]
λ = 330/250 [1]
= 1.32 (m) [1] [3]
Allow ecf for frequency from **(ii)**

(c) (i) The sound is reflected/bounces/deflected/echoes [1]
From the ceiling [1] [2]

(ii) Time = $\frac{\square istance}{\square peed}$ [1]
Time to reach A = 0.025 [1]
Time to reach B = 0.075 [1]
Time interval = 0.05 [2]

or

Time = $\frac{\square istance}{\square peed}$ [1]
Time interval = $\frac{1\square.5}{330}$ [2]
= 0.05 [2] [5]

(d) (i) Infrared [1]

(ii) Ultraviolet [1]

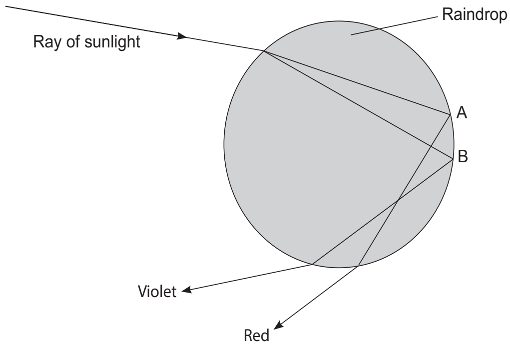
(iii) **Visible** (light) visual [1]

(iv) Microwaves, radio, micro [1]

(e) Radar [1]

(f) Any **two** from:
They travel at the speed of light 3×10^8
They can travel through vacuum
They travel at the same speed **in vacuum**
They travel at the speed of light in vacuum [2] 25

2	**(a)**	**(i)**	One ray from tip of object to the plane mirror + reflected to eye	[1]	
			ray drawn to eye must appear to come from tip of image – by judgement	[1]	
			Arrow in incident **or** reflected ray	[1]	[3]
		(ii)	Laterally inverted – left appears as right or vice versa		[1]
	(b)	**(i)**	Red and violet rays labelled as shown		[1]



		(ii)	Violet is refracted/deviated/bent/slowed more (on entry) or Red refracted less		[1]
			Also, accept an answer related to speed or different colours of light travel at different speeds		
		(iii)	Violet slowed more than red		[1]
			must be a comparison of speeds		
		(iv)	1. Light must travel from higher density/ref index to lower one	[1]	
			or travelling from water/glass to air		
			2. Angle of incidence must be GREATER than critical angle	[1]	[2]
	(c)	**(i)**	Ray from top of object parallel to axis passes through lens to top of image	[1]	
			Focus marked	[1]	
			arrow	[1]	[3]
		(ii)	Measured as 2 cm (1.8 → 2.2)		[1]
		(iii)	(Slide/movie) projector		[1]
	(d)	**(i)**	Cannot see distant object clearly/in focus or appears blurred		[1]
		(ii)	Rays diverge from lens to the eye	[1]	
			Rays converge in the eye	[1]	
			and meet on the retina	[1]	
			Concave (diverging) lens	[1]	[4]

AVAILABLE MARKS

(e) Indicative content:

Apparatus

Ray box (glass block assumed) light box

Path of a ray

Outline of the glass block marked or boundary between air–glass and glass–air marked
Path of incident ray marked (with dots or crosses and joined up)
Path of the emergent ray marked (with dot or cross where it emerges from glass)
(Glass removed and) incident point and emergent point joined/ or draw refracted ray/draw ray inside block

Measurement of angles

***Draw** normal at boundary*
Measure angles (of incidence and refraction) with a protractor
Angles measured from the normal

Investigation

Change the angle of incidence (measure the angle of refraction)/ repeat for different angles

Graph/Relationship

- *Plot angle of incidence against angle of refraction*
- *Tells us that angle of refraction increases as the angle of incidence increases*
- *But they are not proportional*

Response	Mark
Candidate describes in detail using good spelling, punctuation and grammar **5 or more** points shown above. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidate describes in detail using good spelling, punctuation and grammar **3 or 4** points shown above. The form and style are of a high standard and specialist terms are used appropriately at all times.	[3]–[4]
Candidates make some reference to **1 or 2 of the main points** shown above using satisfactory spelling, punctuation and grammar. The form and style are of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

AVAILABLE MARKS

25

AVAILABLE MARKS

3 **(a)** 6 V [1]
3.0 V [1]
0 V [1] [3]

(b) 2.0 Ω [1]
9.0 Ω [1]
$\frac{1}{\square} \square \frac{1}{2} \square \frac{1}{3} \square \frac{1}{6}$ [1]
R = 1 Ω [1] [4]

(c) **(i)** Ammeter in series with lamp **and** correct symbol [1]
Voltmeter in parallel with lamp **and** correct symbol [1] [2]

(ii) **Both** axes labelled [1] with both units [1] transposed [–1] [2]
All points correct [2]
If 4 points correct give [1]
Suitable scale at least half the grid [1] [5]

(iii) Best fit curve [1]

(iv) $R = \frac{V}{I}$ [1]
Identification of voltage – from **their** graph [1]
The resistance when current is 0.25 is 5.4 ± 0.2 Ω [1] [3]

(d) **(i)** Circuit number 2 [1]
Lamps in parallel or each receives 12V [1] [2]
don't accept because voltage isn't shared

(ii) P = I × V **or** 24 = I × 12 or equivalent [1]
I = 2A [1]
R = 12/2 = 6 (Ω) [1] [3] 23
no V = IR

Alternative solution to (ii)
P = V^2/R **or** 24 = 12 × 12/R [1]
R = 144/24 [1]
R = 6 (Ω) [1]

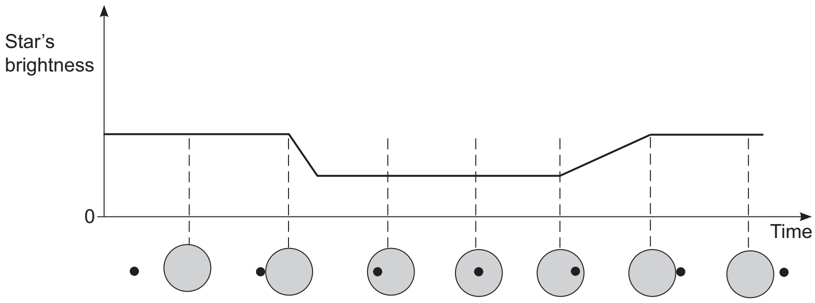
4 **(a)** **(i)** Electromagnetic induction [1]
accept EM or mutual **induction**

(ii) (soft) iron [1]

(iii) Vs/Vp = Ns/Vs (or equivalent) [1]
Vs = (5/750) × 240 (or equivalent) [1]
Vs = 1.6 (V) [1] [3]

(**iv)** The useful output energy = total input energy **or**
No energy is wasted **or** [1]
(**Electrical**) energy input = (**electrical**) energy output

						AVAILABLE MARKS
	(b)	**(i)**	(At the power station a step-up transformer) increases or steps up the voltage	[1]		
			(and at homes a step-down transformer) steps down/reduces the voltage	[1]		
			Increasing the voltage reduces energy losses or heat loss	[1]		
			any mention of resistance = [0] here			
			Lowering the voltage makes it safe to use or allows appliances to work	[1]	[4]	
			Do not credit reducing resistance			
		(ii)	Coil (of wire) and magnet	[1]		
			That rotates between the poles of a magnet	[1]	[2]	12
			mention of relative motion for second mark			
			a coil moving in a magnetic field [2]			
5	**(a)**	**(i)**	Dip	[1]		
			Constant level (do not accept zero)	[1]	[2]	



	(ii)	Oxygen		[1]	
	(iii)	(**Spectra**) or light passing **through** or from the	[1]		
		(planet's) atmosphere	[1]	[2]	
	(iv)	Speed of spacecraft too slow, the journey would take a very long time longer than human life. No credit for fuel/food or distance		[1]	
(b)	**(i)**	cosmic **microwave** background radiation		[1]	
	(ii)	The Big Bang		[1]	
	(iii)	The Red Shift (of light from other galaxies)		[1]	

(c) **Indicative content:**

Mass

*A star **more massive** (than our Sun)*

Type of star

Red supergiant

What happens during the supernova

An explosion occurs

Outer layers (of gas) are ejected/blown off

How it is detected

The brightness of the star increases

For a short time

AVAILABLE MARKS

After the supernova

(Rest of the) star collapses
(The star) becomes a neutron star
(If very massive) a black hole is formed

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Candidates make some reference to **1 or 2 of the main points** shown above using satisfactory spelling, punctuation and grammar. The form and style are of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6] 15

Total **100**