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Rewarding Learning

General Certificate of Secondary Education
January 2019

Science: Physics

Unit 2

Higher Tier

[GPH22]

THURSDAY 24 JANUARY, MORNING

MARK
SCHEME

General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is 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 that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

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, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of 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.
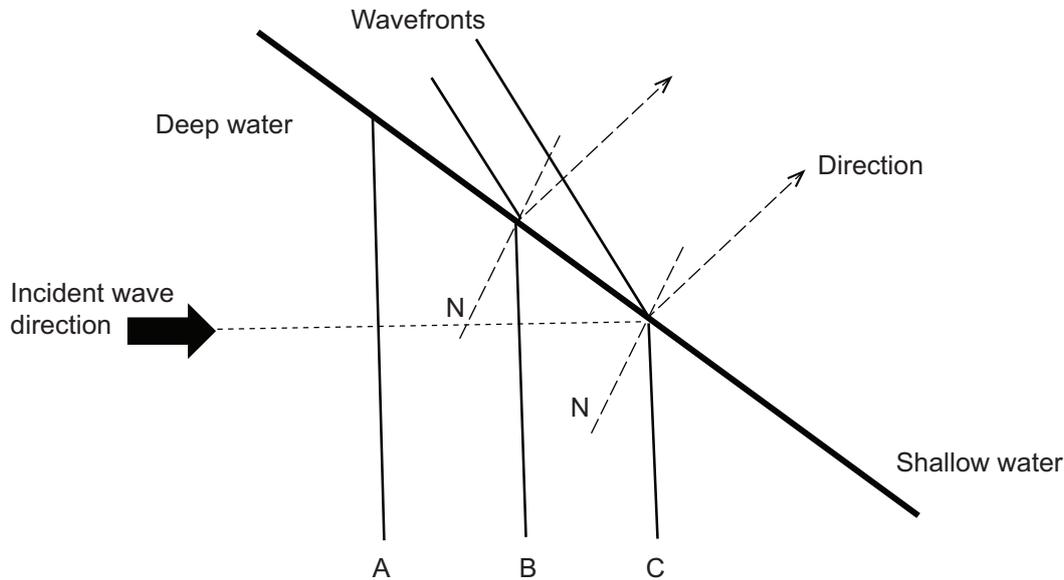
Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark Schemes for 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.

1

	AVAILABLE MARKS

Wavefronts

Deep water

Incident wave direction ➡ - - - - - - - - N - - - - - - - -

Direction

N

N

Shallow water

A   B   C

(a) **(i)** Speed decreases   Wavelength decreases
Frequency no change [3]

(ii) Both wavefronts bent towards normal [1]
Two waves parallel [1]

(iii) Frequency = 4 [1]
Unit Hz [1]

(iv) $v = f\lambda$ [1]
$= 4 \times 2.5$ [1]
$= 10$ (cm/s) ecf from **(iii)** only [1]

(b) **(i)** Vibrations [1]
Parallel to wave direction [1]

(ii) Frequency is above threshold of hearing [1]
This stated as 20 kHz [1]

(iii) Reflection from the bottom [1]

(iv) Distance = $\dfrac{\text{Speed} \times \text{time}}{2}$ [1]

$= \dfrac{3000 \times 7 \times 0.00005}{2}$ [2]

$= 0.525$ (m) [1]

(v) Peak between two peaks shown [1]   20

12007.01 **F**   **3**

2 **(a)** Indicative content:
Breaking of white light into component colours
Different colours travel at different speeds in the glass
Apparatus   Triangular prism and ray box with labels
Switch on the ray box
Direct light at the prism
A coloured band/spectrum
Red to violet

Response	Mark
Candidates describe in detail **at least 5** of the above points using good SPG. The form and style are of a high standard and specialist terms are used appropriately.	[5]–[6]
Candidates describe in detail **3 or 4** of the above points using satisfactory SPG. The form and style are of a satisfactory standard and they have made some use of specialist terms.	[3]–[4]
Candidates describe **1 or 2** of the above points. The SPG is limited. The form and style are of a limited standard and there is no use of specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(b) **(i)** At critical angle in glass, angle of refraction in air is $90°$ or greater than critical angle T.I.R. occurs [1]

(ii) Ray into air along EC [1]

(iii) Angle of incidence is $0°$ [1]

(c) **(i)** Total internal reflection [1]

(ii) 1. Endoscopy/Laparoscopy/key-hole surgery [1]

(d) **(i)** They can all travel in a vacuum [1]
They all travel at the same speed in a vacuum [1]

(ii) UV   Causes skin cancer   [2]
IR   [1]
          Cancer treatment   [1]
          Medical imaging

(iii) Radio [1]

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					AVAILABLE MARKS
3	**(a)**	**(i)**	Ray from O straight through optical centre	[1]	
			Both virtual rays traced back to show intersection	[1]	
			Image drawn and clearly labelled	[1]	
		(ii)	F clearly marked where drawn ray cuts the P.A.	[1]	
		(iii)	Focal length = 60 mm	[1]	
		(iv)	Erect	[1]	
			Virtual	[1]	
		(v)	Magnification = $\dfrac{4.5}{3}$	[1]	
			= 1.5 ± 0.1 No ecf from ray diagram	[1]	
		(vi)	Magnifying glass or simple microscope	[1]	
	(b)	**(i)**	Sharp/well focussed image seen on screen	[1]	
		(ii)	Image is real	[1]	
			Image is focussed on the screen or rays pass through it	[1]	
		(iii)	Scale covers at least half horizontal axis	[1]	
			Correctly plotted 5 to 6 points [2]; 3 to 4 points [1]	[2]	
			Good curve drawn with clear minimum	[1]	
		(iv)	**Quality graph mark** minimum on graph identified at (40, 80)	[1]	
			Focal length = 20 cm	[1]	
	(c)		Both rays diverging after exiting the lens	[1]	20

4 **(a)** **(i)** Total R = 8 (Ω) [1]

$$I = \frac{V}{R}$$ [1]

$$I = \frac{12}{8} \text{ or } \frac{6}{4}$$ [1]

I = 1.5 (A) [1]

(ii) V = I × R [1]
V = 1.5 x 4 = 6 (V) [1]

or

V splits equally across the two resistors = 6 V or $\frac{12}{2}$ = 6V

(b) **(i)** **parallel section** $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

award [1] if no further working [1]

$$\frac{1}{R_T} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{1}{4} + \frac{1}{2} \text{ or } R_T = \frac{4 \times 2}{4 + 2}$$ [1]

R_T = 1.33 (Ω) [1]

Complete resistance = 4 + 1.33 = 5.33 (Ω) [1]

(ii) $I = \left(\frac{V}{R}\right) = \frac{12}{5.33}$ = 2.25 A – allow ecf for resistance from **(b)(i)** [1]

V = (I × R) = 4 × 2.25 [1]
= 9 V [1]
or

V splits in ratio of resistors V = $\frac{12}{5.33}$ × 4 – worth 2 marks

V = 9 (V)

(c) Graph A Filament bulb [1]
Graph B Metal (at constant temperature) [1]
Graph C Diode [1]

(d) **(i)** Suitable scale for R axis to cover at least half [1]
Plot of points 2–3 points [1]   4–5 points [2] [2]
Line of best fit – inverse curve [1]

(ii) Inverse (proportion) [1]

(iii) $R_T = \frac{\text{Constant}}{N}$ **or** $R_T = \frac{10}{N}$ **or** $R_T N = 10$ [1]   22

| | | AVAILABLE MARKS |

5 **(a)** Indicative content
Needle deflects
No deflection or needle at zero
Needle deflects in opposite direction – worth 2 marks
Larger deflection
Rotate the magnet or move back and forth

Response	Mark
Candidates describe in detail **at least 5** of the above points using good spelling, punctuation and grammar. The form and style are of a high standard and specialist terms are used appropriately.	[5]–[6]
Candidates describe in detail **3 or 4** of the above points using satisfactory spelling, punctuation and grammar. The form and style are of a satisfactory standard and they have made some use of specialist terms.	[3]–[4]
Candidates describe **1 or 2** of the above points. The spelling, punctuation and grammar is limited. The form and style are of a limited standard and there is no use of specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(b) **(i)** 240 V linked with 200 turns [1]
240 V linked with 20 turns [1]

(second line reads: 24 V linked with 20 turns) [1]

(ii) a.c. for both [2]

(iii) To reduce the current in the cables [1]
Reducing power/energy loss [1]

(c) **(i)** Current marked into the page [1]

(ii) Force to the right [2]

(iii) The current reverse direction (frequency) [1]
The force reverse direction [1]

(d) **(i)** Increase the number of turns on the coil [1]

(ii) Top – NORTH
Bottom – SOUTH [1]

(iii) The magnetic field is weakened [1]

20

				AVAILABLE MARKS
6	**(a)**	**(i)**	Cosmic microwave background radiation accept CMBR [1]	
		(ii)	Evidence of the Big Bang [1]	
		(iii)	Red shift of light (from distant galaxies) [1]	
	(b)	**(i)**	Pulls the gas cloud (hydrogen) together [1]	
		(ii)	(Inward force of gravity) balances outward gas/radiation pressure [1]	
		(iii)	Provides the centripetal force [1]	

(c) 2 3 4 1   [2]
First and last correct award [1]

(d) **(i)**
1 = crust	solid	[1]
2 = mantle	both	[1]
3 = outer core	liquid	[1]
4 = inner core	solid	[1]

  (ii) Earth's crust consists of moving plates   [1]
  They stick   [1]
  Sudden movement/lurch causes a quake   [1]   **15**

                                                              Total   **115**