Light

Mark Scheme 9

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Properties of Waves including Light and Sound
Sub-Topic	Light
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 9

Time Allowed: 79 minutes

Score: /66

Percentage: /100

1　**(a**　**(i)**　$2.0 – 4.0 \times 10^8$ m/s *Unit penalty applies　　　　　　　　　　　　B1

　　(ii)　(f =) v/λ **or** $3.0 \times 10^8/4.0 \times 10^{-7}$　　　ecf from **6(a)(i)**　　C1
　　　　　7.5×10^{14} Hz *Unit penalty applies　　ecf from **6(a)(i)**　　A1

　(b)　**(i)**　55° *Unit penalty applies　　　　　　　　　　　　　　　　　　　　B1

　　(ii)　sin i/sin r = n **or** sin 55°/1.5 **or** 0.54610　　ecf from **6(b)(i)**　　C1
　　　　　33° *Unit penalty applies　　　　　　　ecf from **6(b)(i)**　　A1　**[6]**

　　*Apply unit penalty once onl

2　**(a)**　idea of fine ray/beam shone into (glass) block / pins appropriately placed
　　　shown in diagram or described　　　　　　　　　　　　　　　　　　　　　B1
　　　angles *i* & *r* or *C* measured OR correct *i* & *r* or *C* marked on diagram　　B1
　　　sin*i*/sin*r* OR sin*r*/sin*i* OR 1/sin*C* OR sin*C*　　　　　　　　　　　　B1
　　　n = speed in air/speed in glass OR *c*/*v* = sin*i*/sin*r* OR *n* = 1/sin*C* OR *c*/*v* = 1/sin*C*　　B1

　(b)　**(i)**　*v* = *f*λ　OR　$240/1.9 \times 10^5$ OR *T*=*d*/*s* AND *f*=1/*T*　　　　　B1
　　　　　0.00126 Hz OR 0.0013 Hz　　NOT 0.0012 Hz
　　　　　ignore more than 3 s.f.　accept s^{-1}　　　　　　　　　　　　　　A1

　　(ii)　distance = speed × time　in any form accept *s* = 2*d*/*t*　　　　　C1
　　　　　(time for tremor =)　240 (s) or 4 mins　　also gives first C1　　　C1
　　　　　(time for tsunami =)　2500 (s) or 41 mins 40 s　also gives first C1　C1
　　　　　(warning time =)　2260 (s) or 37 mins 40 s　　　　　　　　　　A1　[10]

3 **(a** idea of light travelling (much) faster than sound — B1

(b) **(i)** 4.0 (min) — B1

(ii) always a (measurable) time difference / never zero time difference
Ignore time would be less — B1

(iii) distance/time in any form, symbols, words, numbers OR 1200/3.6 — C1
333.3 m/s to 2 or more sig figs — A1

(iv) idea of light travelling instantaneously OR no wind
OR idea of lightning at ground level OR no obstruction to sound
Ignore echoes — B1

(c)

	light waves	sound waves
longitudinal		✓
transverse	✓	
electromagnetic	✓	
mechanical		✓

−1 e.e.o.o. i.e. 1 mark subtracted from <u>3</u> for each error or omission — B3 — [9]

4 **(a)** **(i)** R in correct position, by eye — B1

(ii) 3 reflected waves correctly meeting mirror)
3 reflected wave equidistant, by eye) -1 e.e.o.o — B2
3 reflected waves centred on candidate's R)

(b) 1st ray + reflection correct by eye — B1
2nd ray + reflection correct by eye — B1
reflected rays projected back, to meet behind mirror
OR labelled I **and** in correct position — B1

[Total: 6]

5 **(a)** expect two internal reflections at sensible angles   1   1

  (b)   angle of incidence at Y greater than critical angle   1
             total internal reflection occurs   1   2

  (c) (i) frequency = velocity/wavelength or $1.9 \times 10^{8}/3.2 \times 10^{-7}$ 1
                = 5.9×10^{14}Hz   1

    (ii) refractive index = 3/1.9 or 1.9/3   1
                 = 1.58 (no e.c.f.)   1   4
                                                  (7)

6 **(a) (i)** incident ray, refracted ray and normal drawn   **C1**
             all correct and meeting at a point   **A1**
     (ii) angle of incidence and refraction correctly identified   **B1**
    (iii) values correct within agreed limits   **B1**   4

  (b)   use of sini/sinr   **C1**
          correct substitution from candidates values   **C1**
          value correct within agreed limits from candidate's
          values   **A1**   3
                                                    [7]

7 **(a)**   value 3 x 10 m/s   **A1**   1

  (b)   speed of light (much) greater than speed of sound or
          value for sound   **A1**   1

  (c) (i) source and receiver arrangement   **C1**
            with detail and labels   **A1**
     (ii) distance between source and receiver   **B1**
            time between flash and bang   **B1**
    (iii) speed = distance/time   **B1**   max 4
                                                    [6]

8 **(a)**   two dots, marked F, each 5.0 cm from the lens   **A2**

   (b)   each correct ray one mark   **M2**

   (c)   correct image, labeled I   **A1**

   (d)   rays pass along the axis undeviated/object distance same for all object/rays meet at   **B1**
              same distance on image/image distance same for all image

   (e)   magnifying glass/eyepiece of telescope or microscope   **B1**

                                                                                                                          [7]

9 a(i) 43 ±1°   1   A1
   (ii) angle r for this ray is 90°   B1
     → angle c is angle i (in denser medium) ~~(giving angle r = 90°)~~   2   B1   3

   b(i) 3 × 10⁹ m/s *   1   A1
   (ii) speed in air/speed in medium   M1
        = 1.5   (no up for °)   2   A1
   (iii) angle i = 0°/ along normal / at 90° to surface   1   B1
   (iv) increased/more/larger   1   B1   5
                                                                                                                 QT   8