

REFRACTION

- 1. D
- 2. A
- 3. B
- 4. A

5.

$$n = \sin i / \sin r$$

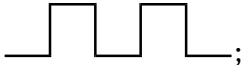
$$= \sin 45 / \sin 28 \text{ [2m] \{from air to glass\}}$$

$$= 1.51 \text{ [1m] Answer to 2d.p}$$

6.

- (a) red B1
- (b) (i) equal to B1
- (ii) less than B1
- (c) two correct refractions on Fig. 6.2 M1
no dispersion and ray ends close to P A1 [5]

7.

- (a) (i) total internal reflection; 1
- (ii) should show more reflections; 1
- (iii) An explanation to include:
 - more reflections/hits side more often: A.
 - greater distance to travel;
- (b) (i) ; (sharp on/off pulses)
- (ii) continuously variable (or diag)/voltage changing all the time/ can have any value (allow mark if shown on diagram); 1
- (c) (i) decreases/dims/less intense; 1
- (ii) limits range/travels less/ cannot go as far/amplitude less; 1

[8]

8.

- (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 $\sin i / \sin r$ C1
correct substitution from candidates values C1
value correct within agreed limits from candidate's values A1 3

[Total 7m]

9.

(a) (condone discontinuities at boundaries)

mirror:

equally spaced reflected waves, approx. same spacing as incident (by eye) B1

IGNORE reflected waves to left of arrowhead

correct angle to surface, by eye B1

block:

reduced wavelength in block B1

ACCEPT refracted waves to left of arrowhead

at sensible angle of refraction B1

CONDONE reflected waves shown as well as refracted

(b) (i) $3 \times 10^8 / \text{speed in glass} = 1.5$ C1

$2 \times 10^8 \text{ m/s}$ A1

(ii) $\sin 70^\circ / \sin r = 1.5$ C1

38.7895° to 2 or more sig figs A1

[8]