1. C

2. (a) light for which the electric field is oscillating in (only) one plane; 1

(b) (i) at a particular angle of incidence the reflected light is horizontally polarized;
and will be blocked by an analyser/polarizer with a vertical transmission axis;

or

at a particular angle of incidence when the reflected and refracted rays are at right angles the reflected light/rays will be horizontally polarized;
and will be blocked by an analyser/polarizer with a vertical transmission axis; 2

(ii) realization that \( n = \tan 50^\circ; \)
to give \( n = 1.19; \) 2

(c) (i) mention of superposition/interference;
interference is destructive and so there will be no light at P; 2
Award [0] for correct answer with no or wrong argument.

(ii) there will be light at P;
the two sources cannot interfere because their planes of polarization are at right angles;
Award [0] for correct answer with no or wrong argument.
Award [0] if answer mentions no light at P irrespective of anything else said. [9]

3. A

4. B

5. (a) in unpolarized light the electric field vector may vibrate in any plane (normal to the direction of propagation);
in polarized light the vector/electric field vibrates in one plane only;
To award [2 max] reference must be made to “electric field vector” at least once. Award [2 max] for any relevant correctly labelled diagram. 2

(b) \( \cos^2 \theta \) graph; \( \text{(judge shape by eye)} \)
max \( I_0 \) at 0° and 180° and zero at 90°; 2 [4]

6. C
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7. A

8. D

9. (a) polarized light is light in which the (electric) field vector vibrates in one plane only / OWLTE; 
the liquid crystal changes the plane in which (electric) field vector rotates; 2

(b) (i) nothing / whole area black; 
since the optical axes of P₁ and P₂ are at right angles / OWLTE; 2

(ii) since the liquid crystal rotates the plane of polarization light is now transmitted by P₂ / OWLTE; 
the electric field across the parts of the liquid crystal in the shape of the electrode on G no longer rotates the plane of polarization; 
the field of view of the observer will now contain a black area corresponding to the shape of the electrode on G / OWLTE; 3