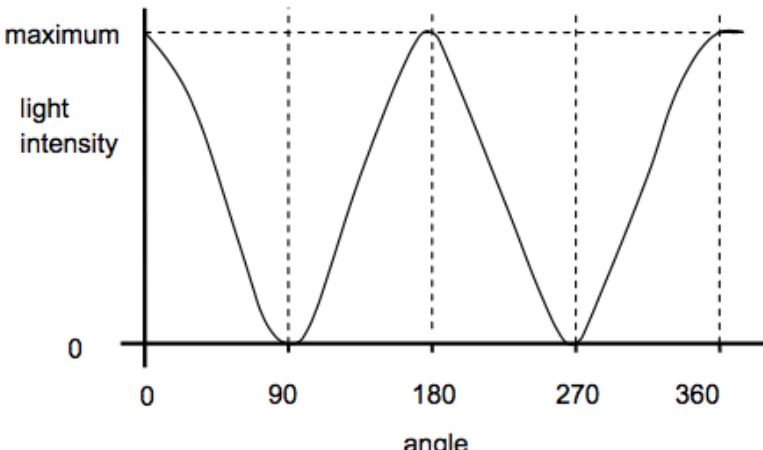


1)

a	<p>number of (complete) <u>waves</u> (passing a point) <u>in 1 second</u> OR number of waves / time (for the waves to pass a point) OR (complete number of) oscillations \ vibrations <u>per second</u> OR 1/T with T defined as time for 1 (complete) oscillation ✓</p>	1	<p>Allow: Cycles Allow: unit time</p>
b	<p><u>For two marks:</u> Oscillation of particles \ medium \ material etc, but not oscillation of wave is parallel to \ in same direction as the direction wave (travels) ✓✓</p> <p><u>For one mark:</u> Particles\material\medium <u>move(s)</u> \ disturbance \ displacement Parallel to \ in same direction as the direction wave travels OR (oscillations) parallel to direction of wave travel ✓</p> <p>The one mark answer with: Mention of <u>compressions</u> and <u>rarefactions</u></p>	2	<p>Allow Vibration Allow direction of energy transfer \ wave propagation</p>
	<p>OR (Longitudinal waves) cannot be polarised Gets two marks ✓</p>		
c	<p>($f = 1540 / 0.50 \times 10^{-3}$) = 3 100 000 (Hz) ✓ (3 080 000) 2sf ✓</p>	2	
d	<p>No more than two points from either list (max 3): <u>Description</u></p> <ul style="list-style-type: none"> • Mention of nodes <u>and</u> antinodes • Particles not moving at a node • Maximum displacement at antinode • Particles either side of node in antiphase / between two nodes in phase • Variation of amplitude between nodes <p><u>Explanation</u></p> <ul style="list-style-type: none"> • A stationary wave (forms) • two waves are of <u>equal frequency</u> or wavelength (and amplitude in the same medium) • reflected and transmitted waves \ waves travelling in opposite directions, pass through each other • superpose / interfere occurs • constructive interference at antinodes • destructive interference at nodes 	3	<p>Allow 'standing wave'</p>

3)

(a)	maximum displacement from equilibrium/mean position/mid-point/etc ✓	1
(b) (i)	any one from: surface of water/water waves/in ripple tank ✓ rope ✓ slinky clearly qualified as transverse ✓ secondary ('s') waves ✓	max 1
(b) (ii)	transverse wave: oscillation (of medium) is perpendicular to wave travel or transverse can be polarised or all longitudinal require a medium ✓	1
(c) (i)	vertical line on B $\pm 5^\circ$ ✓	1
(c) (ii)	 <p>maximum light intensity 0 0 90 180 270 360 angle</p> <p>max 0, 180, 360 + min 90, 270 ✓ and line reaches same minimum and maximum every time and reasonable shape ✓</p>	2
(d)	<p>appropriate use ✓ reason for Polaroid filter being used ✓</p> <p>eg</p> <p>Polaroid glasses/sunglasses/ windcreens to reduce glare</p> <p>camera reduce glare/enhance image</p> <p>(in a) microscope to identify minerals/rocks</p> <p>polarimeter to analyse chemicals/concentration or type of sugar</p> <p>stress analysis reveals areas of high/low stress/ other relevant detail</p> <p>LCD displays very low power/other relevant detail</p> <p>3D glasses enhance viewing experience, etc</p>	2
	Total	8

4)

a	<p>the maximum displacement (of the wave or medium) ✓ from the equilibrium position ✓ accept 'rest position', 'undisturbed position', 'mean position'</p>	2
b	<p>(vertically) downwards (¼ cycle to maximum negative displacement) ✓ then upwards (¼ cycle to equilibrium position and ¼ cycle to maximum positive displacement) ✓ down (¼ cycle) to equilibrium position/zero displacement and correct reference to either maximum positive or negative displacement or correct reference to fractions of the cycle ✓ candidate who correctly describes the motion of a knot 180 degrees out of phase with the one shown can gain maximum two marks (ie knot initially moving upwards)</p>	3
c	<p>max 3 from stationary wave formed ✓ by superposition or interference (of two progressive waves) ✓ knot is at a node ✓ waves (always) cancel where the knot is ✓ allow 'standing wave'</p>	max 3
Total		8

5)

(a)	<p>(i) 0.4(0) m ✓ (ii) speed (= frequency × wavelength) = $22 \times 0.4(0)$ ecf ✓ = $8.8 \text{ (ms}^{-1}\text{)}$ ✓ (iii) 90 or 450 ✓ ° or degrees ✓ or 0.5π or 2.5π or $5\pi/2$ ✓ rad(ians) or r or r ✓ no R, Rad, etc</p>	5
(b)	<p>displacement of Y will be a positive (or 'up') maximum at ¼ of a period (or cycle) (0.0114 s) ✓ returns to original position (at 0.5 of a period or cycle) (owtte) ✓</p>	2
Total		7

6)

a		(wave) B ✓ (the parts of the) spring oscillate / move back and forth in direction of / parallel to wave travel OR mention of <u>compressions and rarefactions</u> ✓ Second mark can only be scored if first mark is scored	2
b	i	(double ended arrow / line / brackets) from between two points in phase ✓	1
b	ii	wave A: arrow vertically upwards ✓ wave B: arrow horizontally to the left ✓	2
c		(transmitted radio waves are often) polarised ✓ aerial (rods) must be aligned in the same <u>plane</u> (of polarisation / electric field) of the wave ✓	2

7)

a	i	$\pi/2$ (radians) or 90 (degrees) ✓	1	No path differences Penalise contradictions No fractions of a cycle
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a	ii	$3\pi/2$ (rad) or 270 (degrees) ✓	1	No path differences Penalise contradictions No fractions of a cycle
b		(oscillation or motion) perpendicular to direction of wave (travel /velocity/energy transfer) ✓ (oscillates from equilibrium to maximum positive displacement, back to equilibrium, then to max negative displacement) <u>and back to equilibrium /starting position /rest position</u> ✓	2	do not allow 'up and down' for first mark allow 'up and down', or 'down then up', 'side to side', 'rise and fall' in place of oscillates Allow 'rest position', 'starting position', 'middle', 'centre line' ref to nodes/antinodes not allowed for 2 nd mark
c		(the wave is) <u>transverse</u> OR <u>not longitudinal</u> ✓ <u>only transverse</u> can be polarised OR longitudinal waves cannot be polarised OR oscillations are in one <u>plane</u> ✓	2	accept it is an S wave or secondary wave
d	i	number of waves/complete cycles/wavelengths (passing a point/produced) <u>per second</u> ✓	1	or 'unit time' allow: (number of) oscillations/vibrations/cycles per second allow $f=1/T$ only if T is correctly defined do not allow references to $f=c/\lambda$
d	ii	($v = f\lambda$ $\lambda = v/f =$) $4.5 \times 10^3 / 6.0$ ✓ $= 750$ (m) ✓	2	correct answer only gets 2 marks