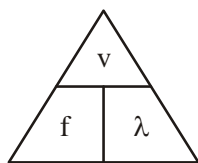


Waves and their uses

1.	(a)	4	1
	(b)	3	1
	(c)	3	2
		<p><i>correct answer with no working = 2</i>  <i>allow 1 mark for <math>f = \text{number} \div \text{time}</math> or correct working i.e., <math>12 \div 4</math></i>  <i>N.B. correct answer from incorrectly recalled relationship / substitution = 0</i></p>	
		Hz / hertz	1
		<p><i>accept HZ, hz, hZ</i>  <i>allow waves / cycles per second</i>  <i>allow wps, w/s, cps, c/s</i></p>	
			[5]
2.	(a)	the <u>normal</u>	1
	(b)	v	1
	(c)	any <b>one</b> from:	1
		<ul style="list-style-type: none"> <li>• light has moved from glass to air / from air to glass <i>accept light has changed medium</i></li> <li>• speed of light has changed <i>beware of contradictions for this marking point eg light has moved from glass to air and slowed down gets zero</i></li> <li>• angle of incidence is less than the critical angle <i>or (angle) <math>i &lt; (\text{angle}) c</math></i> <i>or (angle) <math>y</math> is less than the critical angle</i></li> <li>• change in density (of medium) <i>eg glass is more (optically) dense than air</i></li> </ul>	
	(d)	(i) ratio of v to y does not give the same answer (in every case)	2
		<b>or</b> value of v doubles value of y does not double	
		<b>or</b> increments for v are the same but increments for y are not the same <i>allow for 1 mark a calculation but no conclusion</i> <i>eg <math>30 \rightarrow 60</math></i> <i><math>19 \rightarrow 35</math> (38)</i>	
		(ii) as (angle) v increases, angle y increases	1
		<i>accept as the angle of incidence increases, the angle of refraction increases or there is a (strong) positive(non-linear) relationship between the variables or ratio of sines is constant</i> <i>do <b>not</b> accept angle y is not directly proportional to angle v</i>	
		(iii) no evidence outside this range	1
		<b>OWTTE</b>	
		<b>or</b> when angle y is greater than the critical angle total internal reflection occurs	
			[7]

3. (a) (i) 9 1  
 (ii) (cells) contain water 1  
 (iii) genetic damage 1  
 cancer 1  
*accept any named cancer*  
*accept tumour*  
 (iv) no proven link 1  
 (b) (i) wave speed = frequency x wavelength 1  
*accept  $v = f \times \lambda$*   
*accept*



*provided subsequent method correct*

- (ii) 300 000 000 2  
*allow 1 mark for correct substitution*  
*an answer of 300 gains 1 mark only*

[8]

4. (i) Speed = wavelength x frequency 3  
 $3.108 = 1.5 \cdot 10_6 \times \text{wavelength}$   
 Wavelength = 200m  
*for 1 mark each*

- (ii) 8 1

[4]

5. (a) big bang theory – universe started at one point (then expanded) 1  
 steady state theory – universe has no origin / has always existed 1  
*accept an answer in terms of mass*  
*eg steady state theory mass is created*  
 (b) (i) wavelength (of light) increases 1  
*accept answers in terms of frequency decrease*  
*accept wavelength stretched but **not** wave stretched*  
**or** wavelength / light moves to red end of spectrum  
*do **not** accept galaxy moves to the red end of the spectrum*  
*do **not** accept light becomes red / redder*  
 (ii) red-shift is evidence / supports idea of expanding universe 1  
*accept prove for support*  
 both theories use the idea/accept/explain why the universe is expanding 1  
 (c) to find evidence to support one or both theories 1  
*accept prove for support*  
*accept to gain more knowledge about the universe*

- or** to find evidence to disprove one or both theories

	(d) answer involves (religious) belief <i>accept it cannot be tested</i>	1	
	<b>or</b> no / insufficient evidence		[7]
6.	(a) wavelength increases <i>accept the crests are further apart</i> <i>ignore waves are further apart</i>	1	
	frequency decreases <i>accept pitch decreases</i> <i>ignore references to amplitude</i>	1	
	(b) stars/galaxies/sources emit all/different types of electromagnetic waves/radiation <i>accept two or more named electromagnetic waves</i> <i>accept answers in terms of frequencies / wavelengths</i>	1	
	(c) (i) wavelength (of light) increases <i>accept frequency decreases</i>	1	
	<b>or</b> light moves to red end of spectrum <i>accept redder but do <b>not</b> accept red alone</i>		
	(ii) it is the star (detected) <u>furthest</u> from the Earth <i>accept galaxy for stars</i>	1	
	<b>or</b> it is moving <u>away</u> the <u>fastest</u> <i>ignore reference to universe expanding</i>		
	(d) (i) all matter compressed to/starts at/comes from a single point <i>do <b>not</b> accept increasing gravitational pull</i> <i>accept everything / the universe for all matter</i>	1	
	(massive) <u>explosion</u> sends matter outwards <i>accept <u>explosion</u> causes universe to expand</i> <i>ignore explosion creates the universe <b>or</b> further reference to star / Earth formation</i>	1	
	(ii) check validity / reliability of the evidence	1	
	<b>or</b> change the theory to match the new evidence <i>accept comparison of new and old evidence</i>		[8]