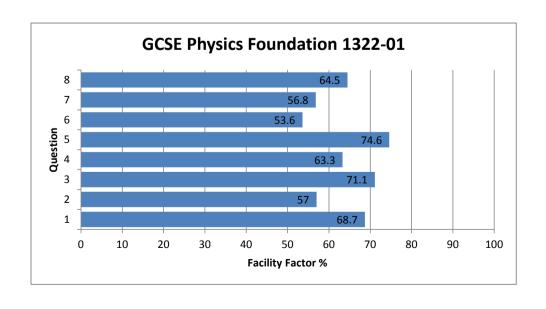


## WJEC 2014 Online Exam Review

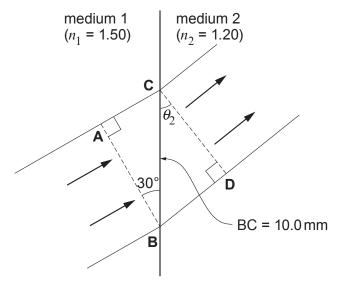
## **GCSE Physics Foundation 1322-01**

All Candidates' performance across questions

?	?	?	?	?	?	?	
Question Title	N	Mean	S D	Max Mark	F F	Attempt %	
1	2822	6.2	2.4	9	68.7	99.8	
2	2800	4.6	2.4	8	57	99	
3	2811	6.4	2.4	9	71.1	99.4	
4	2796	8.9	4.6	14	63.3	98.9	$\leftarrow$
5	2807	6	2	8	74.6	99.3	
6	2812	5.9	3.4	11	53.6	99.4	$\leftarrow$
7	2809	6.8	3.2	12	56.8	99.3	$\leftarrow$
8	2781	5.8	2.5	9	64.5	98.3	



**4.** (a) A beam of light passes from medium 1, of refractive index  $n_1$  = 1.50, into medium 2, of refractive index  $n_2$  = 1.20.



- (i) Calculate the speeds of light in the two media. [1]
  medium 1
  medium 2
- (ii) Show clearly that the end,  $\bf A$ , of wavefront  $\bf AB$  will take  $2.5 \times 10^{-11} \rm s$  to reach the boundary at  $\bf C$ . [Note that distance BC =  $10.0 \, \rm mm$ .] [2]

(iii) While **A** is travelling to **C**, the end, **B**, of wavefront **AB** travels to **D**, through medium **2**. Calculate the distance **BD** and hence the angle  $\theta_2$ . [2]

(iv) Check your value of  $\theta_2$  using a refraction equation involving  $n_1$  and  $n_2$ . [2]

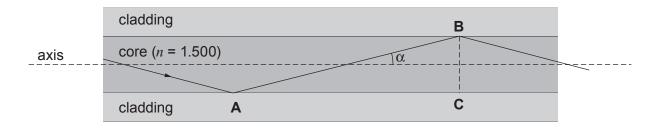
© WJEC CBAC Ltd. (1322-01) Turn over.

(b) A diagram of an optical fibre is given.

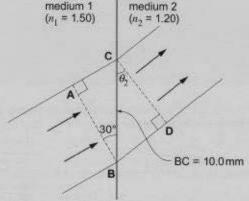
	cladding	
axis	core (n = 1.500)	
	cladding	

(i)	Show clearly that a light pulse travelling along the axis of the fibre takes a	8.0μs to
	travel through 1.6 km of fibre.	[2]

(ii) The greatest angle,  $\alpha$ , **to the axis** at which light can travel through the core without escaping is 14°. Calculate the refractive index of the cladding. [3]




(iii)	Calculate the <b>difference</b> in times taken for a pulse to travel through 1.6 km of fi by the routes in $(b)(i)$ and $(b)(ii)$ .	ibre [2]



Calculate the speeds of light in the two media. [1] 100 = V2 = 2x/0° medium 1 V = 1/2 medium 2

(ii) Show clearly that the end, A, of wavefront AB will take 2.5 × 10<sup>-11</sup>s to reach the boundary at C. [Note that distance BC = 10.0 mm.] [2]

= AC AC = 10×10° (sinsa) = 5×10-3 time = distance time = 5×10-3 = 2.5×10

(iii) While A is travelling to C, the end, B, of wavefront AB travels to D, through medium
 2. Calculate the distance BD and hence the angle θ<sub>2</sub>.

92 = (38.68°) BD = 10×10-3(sin38.68)

(iv) Check your value of  $\theta_2$  using a refraction equation involving  $n_1$  and  $n_2$ . [2]

(b) A diagram of an optical fibre is given.

cladding
axis core (x = 1.500)
cladding

 Show clearly that a light pulse travelling along the axis of the fibre takes 8.0 µs to travel through 1.6 km of fibre.

Speed = distance time = distance Speed = Speed

(ii) The greatest angle, α, to the axis at which light can travel through the core without escaping is 14°. Calculate the refractive index of the cladding. [3]

cladding B

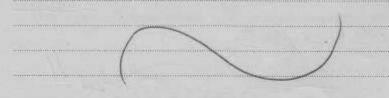
core (n = 1.500)

cladding A

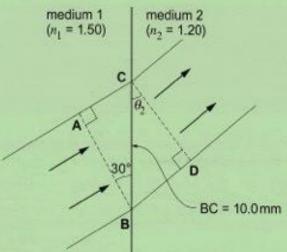
C

NsinO, = N, sinO, 115 sin90 = N, sin14 ×× Nz=115 Nz≈6.7

(iii) Calculate the **difference** in times taken for a pulse to travel through 1.6 km of fibre by the routes in (b)(i) and (b)(ii). [2]



(a) A beam of light passes from medium 1, of refractive index n<sub>1</sub> = 1.50, into medium 2, of refractive index n<sub>2</sub> = 1.20.



(ii) Show clearly that the end, A, of wavefront AB will take 2.5 × 10<sup>-11</sup>s to reach the boundary at C. [Note that distance BC = 10.0 mm.]

10x10-3 - AC AC = 10x10-3(sin30) = 5x10-3 // Sin90 sin30 sin90 Speed = distance time = distance time = 5x10-3 = 215x10-11

(iii) While A is travelling to C, the end, B, of wavefront AB travels to D, through medium
 2. Calculate the distance BD and hence the angle θ<sub>2</sub>.

115 sin30 = 112 sin 02 SNBUR 1 Sin-1 (115 sin20) -02 02 = 38.68° BD = 10×10-3(sin38.68)

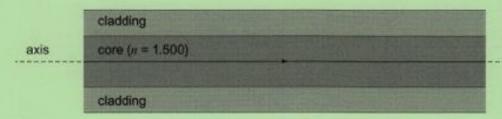
(iv) Check your value of  $\theta_2$  using a refraction equation involving  $n_1$  and  $n_2$ .

 $\begin{array}{l}
\Lambda_{1}S_{1}\Lambda\Theta_{1}=\Lambda_{2}S_{1}\Lambda\Theta_{2} \\
I_{1}S_{2}S_{1}\Lambda3O=12S_{1}\Lambda\Theta_{2} \\
S_{1}\Lambda^{-1}\left(\frac{I_{1}S_{2}S_{1}\Lambda3O}{I_{1}I_{2}}\right)=\Theta_{2}=8648^{\circ} \quad \text{bod} \quad \square
\end{array}$ 

Turn over.

(b) A diagram of an optical fibre is given.

Examiner only



 Show clearly that a light pulse travelling along the axis of the fibre takes 8.0 μs to travel through 1.6 km of fibre.

Speed = distance time = distance

Speed = Speed

The greatest angle, α, **to the axis** at which light can travel through the core without escaping is 14°. Calculate the refractive index of the cladding. [3]

axis core (n = 1.500)

cladding A

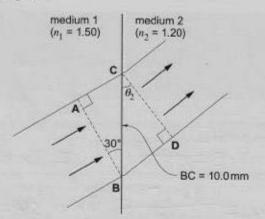
C

 $N_{2} = N_{1} \sin \Theta_{2}$   $N_{3} = N_{5} \sin \Theta_{1}$   $N_{4} = N_{5} = N_{5} \sin \Theta_{1}$  $N_{5} = N_{5} = N_{5} \cos \Theta_{1}$ 



(iii) Calculate the **difference** in times taken for a pulse to travel through 1.6 km of fibre by the routes in (b)(i) and (b)(ii). [2]

A beam of light passes from medium 1, of refractive index  $n_i = 1.50$ , into medium 2, of examiner only refractive index  $n_2 = 1.20$ .



Calculate the speeds of light in the two media. 1.50 = 3x108 C= 2x108mc-1

medium 2 1 - 20 = 3 × 108

Show clearly that the end, A, of wavefront AB will take  $2.5 \times 10^{-11}$ s to reach the boundary at C. [Note that distance BC = 10.0 mm.]

[2]

Peed =  $\frac{Distance}{Time}$   $\frac{5\times10^{11}}{2}$  =  $7.5\times10^{11}$ ?

(iii) While A is travelling to C, the end, B, of wavefront AB travels to D, through medium Calculate the distance BD and hence the angle θ<sub>s</sub>. [2]



(iv) Check your value of  $\theta_2$  using a refraction equation involving  $n_1$  and  $n_2$ .

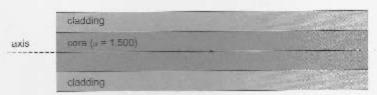
n, sin O, = no Sin O,

50)(Sin 30)=(1.70)(Sin 02)

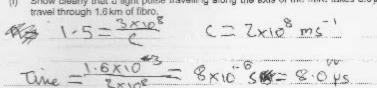
Turn over.

[2]

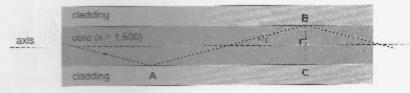
A diagram of an optical fibre is given.



Show clearly that a light pulse travelling along the exis of the fibre takes 8.0 us to



The greatest angle,  $\alpha$ , to the axis at which light can travel through the core without escaping is 14°. Calculate the refractive index of the cladding.

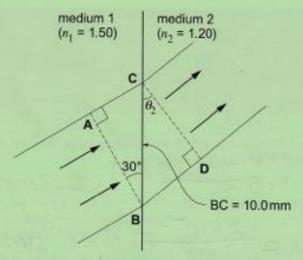




Calculate the difference in times taken for a pulse to travel through 1.6 km of fibre by the routes in (b)(i) and (b)(ii).

vace = 0-25 ps

A beam of light passes from medium 1, of refractive index  $n_1 = 1.50$ , into medium 2, of entry refractive index  $n_2 = 1.20$ .



Calculate the speeds of light in the two media.

1.50 = 3x108 C=2x108nc-1

medium 2 1-20 = 3 x 103

Show clearly that the end, A, of wavefront AB will take  $2.5 \times 10^{-11}$ s to reach the boundary at C. [Note that distance BC = 10.0 mm.]

[2]  $\frac{Distance}{Time} = \frac{5 \times 10^{11}}{2} = 7.5 \times 10^{11}$ 

While A is travelling to C, the end, B, of wavefront AB travels to D, through medium Calculate the distance BD and hence the angle θ<sub>2</sub>. [2]

(iv) Check your value of  $\theta_2$  using a refraction equation involving  $n_1$  and  $n_2$ . [2]

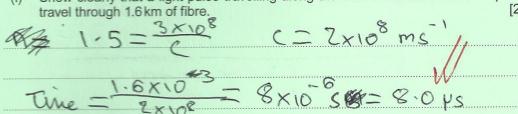
n, sin O, = no Sin O,

Turn over.

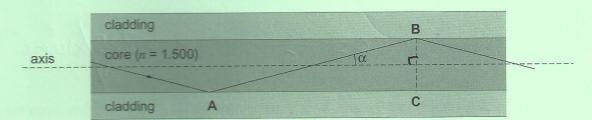
A diagram of an optical fibre is given.

cladding core (n = 1.500)axis cladding

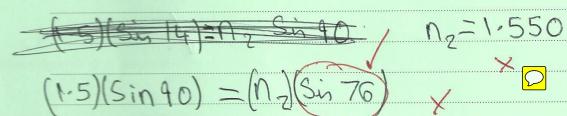
Show clearly that a light pulse travelling along the axis of the fibre takes  $8.0\,\mu s$  to



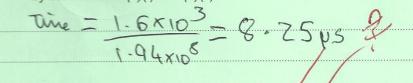
The greatest angle,  $\alpha$ , to the axis at which light can travel through the core without escaping is 14°. Calculate the refractive index of the cladding.

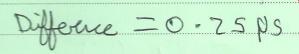


n, Sind, = n, Sin Do

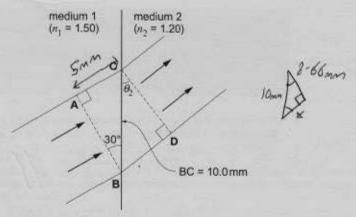


Calculate the difference in times taken for a pulse to travel through 1.6 km of fibre by the routes in (b)(i) and (b)(ii).





- A beam of light passes from medium 1, of refractive index  $n_1 = 1.50$ , into medium 2, of  $n_2 = 1.50$ refractive index  $n_2 = 1.20$ .



Calculate the speeds of light in the two media.

[1]

medium 2 3x 10 8

Show clearly that the end, A, of wavefront AB will take 2.5 × 10-11 s to reach the boundary at C. [Note that distance BC = 10.0 mm.]

While **A** is travelling to **C**, the end, **B**, of wavefront **AB** travels to **D**, through medium **2**. Calculate the distance **BD** and hence the angle  $\theta_2$ .

=14.3 mm

(iv) Check your value of θ, using a refraction equation involving n, and n,. [2]

n, Sin 0, = n2 Sin 07 1.55 - 30 = 1.25 - 0

0-75=1.2500

(b) A diagram of an optical fibre is given.

cladding

axis core (n = 1.500)

cladding

 Show clearly that a light pulse travelling along the axis of the fibre takes 8.0 μs to travel through 1.6 km of fibre.

 $5 = \frac{d}{t}$   $t = \frac{d}{s} = \frac{1.6 \times 10^3 - 8 \times 10^{-6} \text{s}}{2 \times 10^8}$   $8 \times 10^{-6} \text{s}$  or

 (ii) The greatest angle α, to the axis at which light can travel through the core without escaping is 14°. Calculate the refractive index of the cladding.

cladding B
core (n = 1.500)
cladding A C

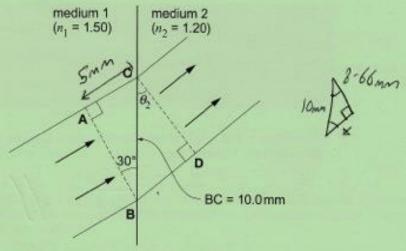
 $\frac{n_2}{n_1} = \sin \theta \frac{n_2}{1.5} = \sin 14$   $n_2 = \sin \theta = \sin 14$   $n_2 = \sin \theta = \sin 14$ 

(iii) Calculate the **difference** in times taken for a pulse to travel through 1.6 km of fibre by the routes in (b)(i) and (b)(ii). [2]

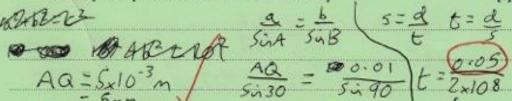
by the routes in (b)(i) and (b)(ii).  $C = \frac{d}{s} = \frac{1.55 \times 10^{3}}{2 \times 10^{8}} = 7.76 \times 10^{-6}$ 

78805 8-508 = 2.4×10-75

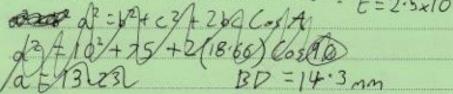
(a) A beam of light passes from medium 1, of refractive index n<sub>1</sub> = 1.50, into medium 2, of refractive index n<sub>2</sub> = 1.20.



- (i) Calculate the speeds of light in the two media. [1]  $\frac{3\times10^8}{1\cdot5} = 2\times10^8 \, \text{ms}^{-1}$   $\frac{3\times10^9}{1\cdot5} = 2\cdot5\times10^9 \, \text{ms}^{-1}$
- (ii) Show clearly that the end, A, of wavefront AB will take 2.5 × 10<sup>-11</sup>s to reach the boundary at C. [Note that distance BC = 10.0mm.]



(iii) While A is travelling to C, the end, B, of wavefront AB travels to D, through medium
 2. Calculate the distance BD and hence the angle θ<sub>2</sub>.



(iv) Check your value of  $\theta_2$  using a refraction equation involving  $n_1$  and  $n_2$ .

(1322-01)

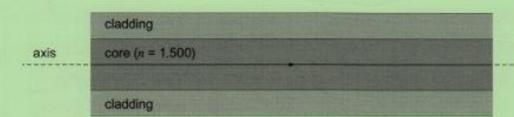
ID WHEC CHAC Ltd.

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$
  
 $1.55 = 30 = 1.25 = 0$   
 $0.75 = 1.25 = 0$   
 $0 = 38.7^{\circ}$ 

[2]

A diagram of an optical fibre is given.

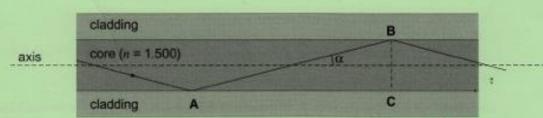
Examiner only



 Show clearly that a light pulse travelling along the axis of the fibre takes 8.0 μs to travel through 1.6 km of fibre.

 $5 = \frac{d}{t}$   $t = \frac{d}{5} = \frac{1.6 \times 10^3 - 8 \times 10^{-6} \text{s}}{2 \times 10^8}$   $1 \times 10^{-6} \text{s}$  or

(ii) The greatest angle, α, to the axis at which light can travel through the core without escaping is 14°. Calculate the refractive index of the cladding. [3]

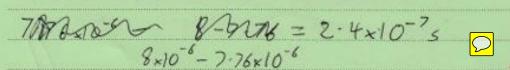


 $\frac{n_2}{n_1} = \sin \theta \quad \frac{n_2}{1.5} \text{ MB} = \sin 14 \quad \sqrt{\frac{n_2}{1.5} \text{ MB}} = \sin 14 \quad \sqrt{\frac{n_2}{1.5$ 



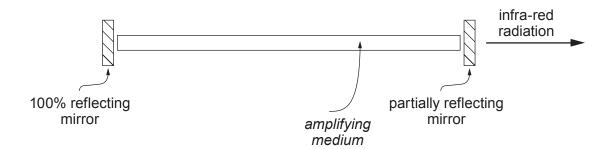
(iii) Calculate the difference in times taken for a pulse to travel through 1.6 km of fibre by the routes in (b)(i) and (b)(ii).

by the routes in (b)(i) and (b)(ii).  $E = \frac{d}{s} = \frac{1.55 \times 10^{3} \times 7.76 \times 10^{-6}}{2 \times 10^{8}}$ 



6.	(a)	A las	ser emits 25W of coherent infra-red radiation of wavelength 1064nm.
		(i)	Explain what 'coherent' means in this sentence. [2
		(ii)	Calculate the photon energy.
		(iii)	Calculate the number of these photons leaving the laser per second. [1
		(iv)	A simplified energy level diagram for this (four level) laser is given.
			level P
			level L 0.42 × 10 <sup>-19</sup> J
		g	round state 0
			(I) <b>Show, with an arrow,</b> on the diagram the transition associated with emissio of the infra-red radiation.
			(II) In the box provided in the diagram above, <b>write</b> the energy of level U. [1

(b) 'Light' amplification occurs as the radiation passes through the amplifying medium in the laser cavity.



	Explain how light amplification occurs. Start by explaining what is meant by <i>emission</i> , referring to the diagram in <i>(a)</i> (iv).	stimulated [4]
•••••		
•••••		
•••••		
•••••		

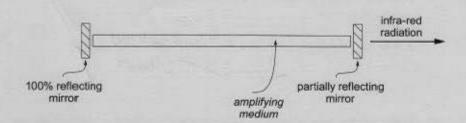
[2]

- 6. (a) A laser emits 25W of coherent infra-red radiation of wavelength 1064nm.
  - (i) Explain what 'coherent' means in this sentence.

    In phase with the same optimile, frequency and wavelength
  - (ii) Calculate the photon energy. [2]  $C = \int_{0.5}^{10} \int_{0.5}^{10}$
  - (iii) Calculate the number of these photons leaving the laser per second. [1]  $25\omega = 257/s \qquad 25/1.57 \times 10^{-19} = 1.34 \times 10^{20}$
  - (iv) A simplified energy level diagram for this (four level) laser is given.

- (I) Show, with an arrow, on the diagram the transition associated with emission of the infra-red radiation. [1]
- (II) In the box provided in the diagram above, write the energy of level U. [1]

(b) 'Light' amplification occurs as the radiation passes through the amplifying medium in the laser cavity.



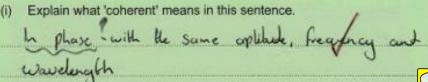
Explain how light amplification occurs. Start by explaining what is meant by stimulated emission, referring to the diagram in (a)(iv). [4]

Stimulated emission is where an incident photon amosts an elabor to full from a population that her unsergone population inversion, this means more photons we willed their above bed, who the photons will be mirrors they reflect and cause more shoulded emission. Some of this light escapes the front mirror and most is retterly among more anission and this amplification.

6. (a) A laser emits 25W of coherent infra-red radiation of wavelength 1064 nm.

[2]

Examiner



(ii) Calculate the photon energy.

[2]

[1]

C= fl 3x10 = f (1064\_\_) f= 2.8 x10 4 (6.63 x10 34)(2.8 x10 4) = 1.87 x10 14 5

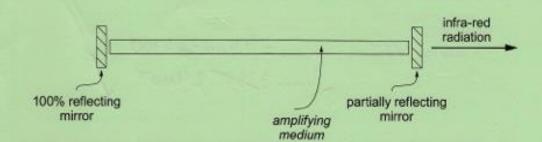
(iii) Calculate the number of these photons leaving the laser per second.

25w = 25jis 25/1.87x10-19 = 1.34x1020

(iv) A simplified energy level diagram for this (four level) laser is given.

- (I) Show, with an arrow, on the diagram the transition associated with emission of the infra-red radiation. [1]
- (II) In the box provided in the diagram above, write the energy of level U. [1]

(b) 'Light' amplification occurs as the radiation passes through the amplifying medium in the laser cavity.



Explain how light amplification occurs. Start by explaining what is meant by stimulated emission, referring to the diagram in (a)(iv). [4]

Stimulated exission is where an inchest photon angles an elabor to fall from a population that have undergone population invession, this means more photons we willed their absorbed, when the photons will be nirrors they reflect and cause more shoulded emission. Some of this light escapes the front mirror and most is rettled, causing more emission and thus amplification.

6.	(a)	A laser emits 25 W	of coherent infra	<ul> <li>red radiation of wavele</li> </ul>	enath 1064 nm.

(i) Explain what 'coherent' means in this sentence. [2]

Coherevit is a wave with'.

I same frequency

I constant phase different?

(ii) Calculate the photon energy.

[2]

9832KJ

Ephoton = hc = (6.63 × 10-34) (3× 108) = 1.87×10)

(iii) Calculate the number of these photons leaving the laser per second.

[3]

 $\frac{25}{1.87\times10^{19}} = 1.34\times10^{20} \text{ electron}$ persecon

= 1.34 x 1020 d

(iv) A simplified energy level diagram for this (four level) laser is given.

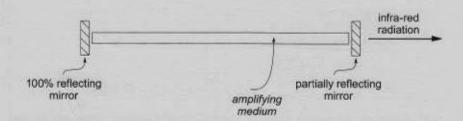
level U 2 . 2 9 x 10 19 J

ground state — \_\_\_\_\_\_

- (I) Show, with an arrow, on the diagram the transition associated with emission of the infra-red radiation. [1]
- (II) In the box provided in the diagram above, write the energy of level U. [1]  $0.42 \times 10^{-19} + 1.87 \times 10^{-19}$

1

(b) "Light" amplification occurs as the radiation passes through the amplifying medium in the laser cavity.



Explain how light amplification occurs. Start by explaining what is meant by stimulated emission, referring to the diagram in (a)(iv). [4]

stimulated emission.

Ly when a incident projoh with energy of

2020 AND LU - LL) passes, electron

in LU drops as were a level relassing
a prioron with the same Greguency os

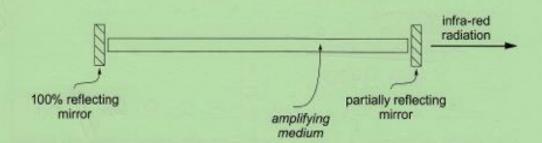
the incident photophein Phase and

coherent)

a photon is reflected back causing stimulated emission, the 2 photons are then reflected back so 4 photons are then reflected back so 4 photons are now produced and

6.	(a)	A laser emits 25 W of coherent infra-red radiation of wavelength 1064 nm.	Examiner only
٥.	(4)	(i) Explain what 'coherent' means in this sentence. [2]	1
		coherent is a wave with.	
		9 same grequency	
		& constant phase different	0
		(ii) Calculate the photon energy. p = 34 [2]	1
		92324	_
		Ephoton = hc	
		$=(6.63 \times 10^{-34})(3 \times 10^{8})=1.87 \times 10^{-19}$	
		25 36 121 20	
		$\frac{25}{1.87\times10^{19}} \simeq 1.34\times10^{-1} \text{ electrons}$ $\frac{25}{1.87\times10^{19}} \simeq 1.34\times10^{-1} \text{ electrons}$	
		1.87×10 <sup>14</sup> persecond	1
		= 1.34x1020 dg-1	
		(iv) A simplified energy level diagram for this (four level) laser is given.	
		level P	
		level U 2.29 x10 <sup>-19</sup>	
		V~~~	
136		Charles and the second	
		level L 0.42 × 10 <sup>-19</sup> J	31
			1
		ground state 0	
			1
		<ol> <li>Show, with an arrow, on the diagram the transition associated with emission of the infra-red radiation.</li> </ol>	
		(II) In the box provided in the diagram above, write the energy of level U. [1]	-
		0.42×10-19 + 1.87×10-19	

(b) 'Light' amplification occurs as the radiation passes through the amplifying medium in the laser cavity.



Explain how light amplification occurs. Start by explaining what is meant by stimulated emission, referring to the diagram in (a)(iv). [4]

Shim utalized emission.

Le when a incident projon with energ of

2020 Atte Lu - LL) passes, electron

in Lu drops down a level relassing
a photon with the same Grequency os

the incident photon fin phase and

conerent)

Light Amplification occurs when the a photon is reglected back causing stimulated emission, the 2 photons are then reflected back so it are then reflected back so it photons are now produced and photons are now produced and

6.	(a)	A laser emits 25W of coherent infra-red radiation of wavelength	1064 nm.

(i) Explain what 'coherent' means in this sentence. [2]

The light is in a fixed those

Teluhunship and has the some amphibial,

(ii) Calculate the photon energy. [2]  $E = hy \qquad C = fx$   $E = hy \qquad C = fx$  C = fx C = fx

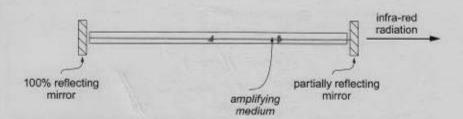
(iii) Calculate the number of these photons leaving the laser per second. [1]  $P = \frac{\Delta E}{E} \qquad E = 25$   $OE = PE \qquad h = 1.3 + \times 10^{20} / \text{ photons}$   $= 25(i) \qquad \times 1 \times 10^{20} \text{ photons}$ 

(iv) A simplified energy level diagram for this (four level) laser is given.

level L \_\_\_\_\_\_\_ 0.42 × 10<sup>-19</sup> J ground state \_\_\_\_\_\_ 0

- Show, with an arrow, on the diagram the transition associated with emission of the infra-red radiation.
- (II) In the box provided in the diagram above, write the energy of level U. [1]

(b) "Light' amplification occurs as the radiation passes through the amplifying medium in the laser cavity.



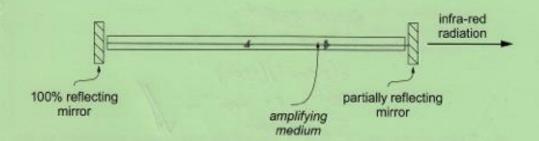
Explain how light amplification occurs. Start by explaining what is meant by stimulated emission, referring to the diagram in (a)(iv). [4]

Shimshild emission is whom possing this of the right energy long electrons to more from an executant state book found to ground state emiting an informall them. To the argumes in the process, this photon son be seemed the state though the medium or explicited book doing it by the mirrors of the distance between the mirrors on it is created, as the right hand side of the diagram the possibly reflecting mirror test some by these photons through creating the lose beam by infra real reduction. As photons are clearing the lose beam of infrared along the medium more and course clearing are surrollers to fall providing population inversional is in process and more electrons are in executed state them in the ground state.

6.

(i)	Explain what 'coherent' means in this sentence.	1
19		
	The light is in a fixed phose relative for the some amplifies	
	TOTAL CONTRACTOR OF THE CONTRA	e-q
(ii)	Calculate the photon energy.	I
	E=hy = (6.63×10-39) (2.82×1019) (= 5×108 constill = 1.87×10" J. = 3×108 1.87×10" J. = 3×108 1.87×10" J. = 3×108 1.87×10" J. = 3×108	
	E=hf = (6.63×10")(2.82×10") / = 7	
	mster + x 1.87 ×10 J. / 1084×10 1	
(iii)	Calculate the number of these photons leaving the laser per second.	
	$p_{-} \stackrel{\Delta E}{\leftarrow} E = 25 \qquad n_{-} = \frac{25}{192400} $	
	OE = Pt h= 1.3+ x1020 photo.	123
	= 25(1) × 1×10° photons	
iv)	A simplified energy level diagram for this (four level) laser is given.	
(iv)		
(iv)	level P	
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(b) 'Light' amplification occurs as the radiation passes through the amplifying medium in the laser cavity.



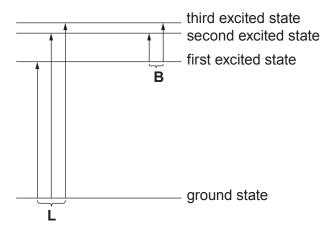
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Shimshold emission is when a possing thelon of the right of the process of the book of the process of the process of the process, this photon can be seen as the thing it the argument of the process, this photon can be seen as the thing it by the content of the process, this photon can be seen as the thing it by the process, this photon can be seen as the thing it by the process of the distance between the inferiors in the process of the distance between the inferiors in the process of the distance between the property deflecting million lets some by these photons through creating the loser beam by inferior and rediction. As photons pass bothweeds and paperty depth to feel traveling population investing is in process and more electrons are strictly state than in the ground state.



(a)	(i)	(	Са 	lc	ul	at 	e	th	ne 	: S	ta	ır'	S 	W	a'	ve 	ele	er 	ng	jtł	า 	of	f p	эe	:a	k	sp	эe	c	tra	al	ir	nte	er 	າຣ	ity	y. 	 					••••			 		[2]
	(ii)	(		nti	nı	uc	DU	S	s	ре	ес	tr	ur	n	0	f	Š	ir	iu	s	A	١.	(	Ν	oi	e.	r	na	ak	ſе	ti																	the
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intensity																																																
	0+0					2	0	0					4	0	0			•		(	60	ÖC	)					8	0	0					1		0( w	ve	ele	en			20 1/	0 nn	n			
	(iii)	١	ΝI	na	t c	CC	olc	u	r	W	Dυ	ılc	d y	yC	u	е	X	p	e	ct	S	Sir	il	IS	P	۱ ۱	0	b	e'	?																		[1]
(b)	Use	St	ef	ar	ı's	: L	_a	w	t	0	ca	alo	cu	ıla	ite	e 1	th	е	d	lia	an	ne	et	er	. (	of	S	iri	us	s .	Α.		•••	•••	••••	•••	•••	 •••			•••	•••	••••			 	••••	[3]
									• • • •	•••			•••			• • • •	•••							•••					•••				• • • •					 			• • • •					 		

(c) The diagram shows the lowest energy levels of a hydrogen atom, and five possible transitions between these levels.



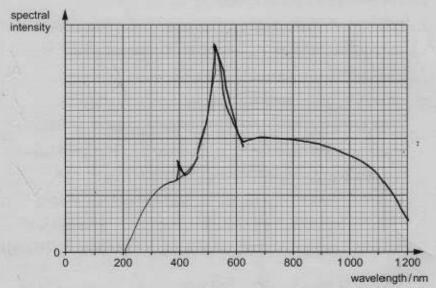
(i)	Name the process (involving photons) which is responsible for the transitions. [1]
(ii)	Briefly describe the observed feature of the spectrum of a star which this process explains. [1]
(iii)	All the transitions shown in the diagram take place in the atmosphere of Sirius A State which group of transitions, <b>L</b> or <b>B</b> , is almost completely absent in a much cooler star, giving a reason for your answer.

## **TURN OVER FOR QUESTION 8**

 The star Sirius A has a surface temperature of 9900 K and a luminosity (total power output of electromagnetic radiation) of 1.00 × 10<sup>28</sup> W.

 $\lambda = \frac{\omega}{9900} = \frac{2.90 \times 10^{-3}}{9900} = 1.93 \times 10^{-7}$ 

(ii) Sketch on the axes a graph of spectral intensity against wavelength for the continuous spectrum of Sirius A. (Note: make the peak spectral intensity three or four large squares above the wavelength axis.) [2]



(iii) What colour would you expect Sirius A to be?

[1]

a blue

(b) Use Stefan's Law to calculate the diameter of Sirius A.

[3]

P = AOT"

1x100 = A o [9900)4

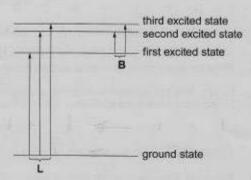
A = 1x1024 = 1.836 x 1319

A = 4 TT

- = AMMON 1208

- 2.4 x 100

(c) The diagram shows the lowest energy levels of a hydrogen atom, and five possible transitions between these levels.



(i) Name the process (involving photons) which is responsible for the transitions. [1]

pumping.

 Briefly describe the observed feature of the spectrum of a star which this process explains.

black bond spectrum

(iii) All the transitions shown in the diagram take place in the atmosphere of Sirius A. State which group of transitions, L or B, is almost completely absent in a much cooler star, giving a reason for your answer. [2]

B is mosen

is movem because a cooler star

has less energy

so connot puny

electrons

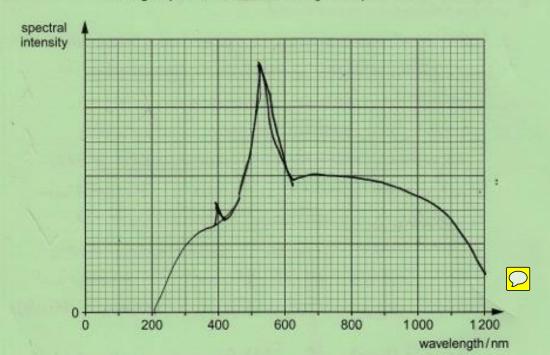
and Us elections

## **TURN OVER FOR QUESTION 8**

The star Sirius A has a surface temperature of  $9900\,\mathrm{K}$  and a luminosity (total power output of electromagnetic radiation) of  $1.00\times10^{28}\,\mathrm{W}$ .

Calculate the star's wavelength of peak spectral intensity.

Sketch on the axes a graph of spectral intensity against wavelength for the continuous spectrum of Sirius A. (Note: make the peak spectral intensity three or four large squares above the wavelength axis.)



What colour would you expect Sirius A to be?

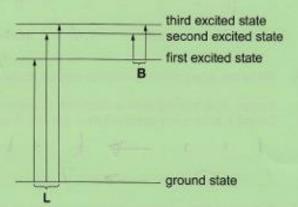
Use Stefan's Law to calculate the diameter of Sirius A

A = 4 TTC

O WJEC CBAC LIS

Examiner only

(c) The diagram shows the lowest energy levels of a hydrogen atom, and five possible transitions between these levels.



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11 0

pumping.

Briefly describe the observed feature of the spectrum of a star which this process explains.



black bond spectrum



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[2]

B is onesens because a cooler stor

no us energy

so cannot pump



electrons

and the electrons

**TURN OVER FOR QUESTION 8** 

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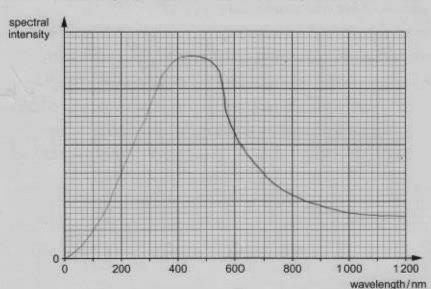
121

$$\lambda_{\text{max}} = \omega T^{-1}$$

$$= (1 \times 10^{28}) (1/9900)$$

$$= 1.01 \times 10^{24}$$

 (ii) Sketch on the axes a graph of spectral intensity against wavelength for the continuous spectrum of Sirius A. (Note: make the peak spectral intensity three or four large squares above the wavelength axis.)



(iii) What colour would you expect Sirius A/to be?

[1]

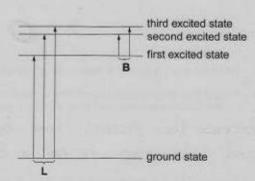
(b) Use Stefan's Law to calculate the diameter of Sirius A.

[3]

$$p = A \sigma T 4$$
 $1 \times 10^{28} = A (5.67 \times 10^{-8}) (9900)^{4}$ 
 $A = 1.84 \times 10^{-19}$ 
 $68(^{2} = 1.84 \times 10^{-19})$ 

JEMES 4839 1991

(c) The diagram shows the lowest energy levels of a hydrogen atom, and five possible transitions between these levels.



(i) Name the process (involving photons) which is responsible for the transitions. [1]

strains Propping stimulated emmission

(ii) Briefly describe the observed feature of the spectrum of a star which this process explains. [1]

The colour of the star tout

(iii) All the transitions shown in the diagram take place in the atmosphere of Sirius A. State which group of transitions, L or B, is almost completely absent in a much cooler star, giving a reason for your answer. [2]

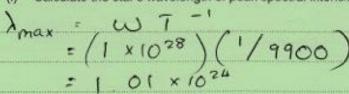
B, because in a cooler stair there is loss energy to get rup to pirst excited state.

**TURN OVER FOR QUESTION 8** 

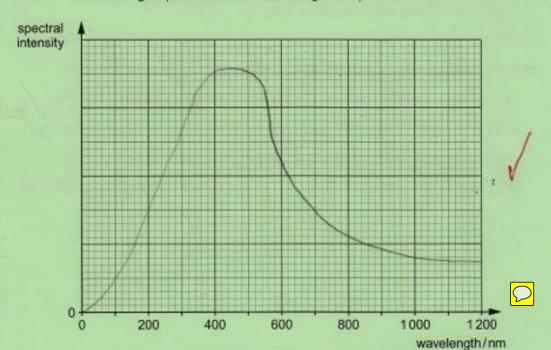
 The star Sirius A has a surface temperature of 9900 K and a luminosity (total power output of electromagnetic radiation) of 1.00 × 10<sup>28</sup> W.

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0



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(iii) What colour would you expect Sirius Ato be?

[1]

violet

(b) Use Stefan's Law to calculate the diameter of Sirius A.

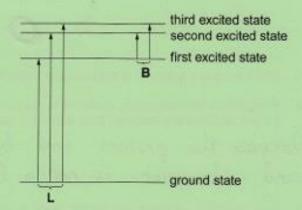
[3]

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 $4X(^2 = 1.84 \times 10^{-19})$ 

CHANGE 1839 1004

diameter = 4834962841

The diagram shows the lowest energy levels of a hydrogen atom, and five possible transitions between these levels.



Name the process (involving photons) which is responsible for the transitions. [1] stimulated emmission



Briefly describe the observed feature of the spectrum of a star which this process explains.

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because in a cooler

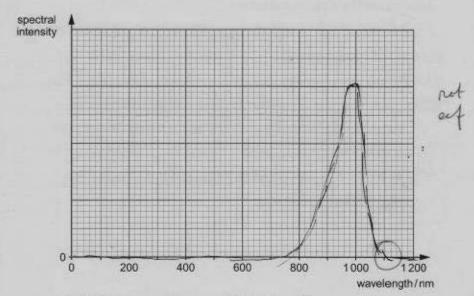
TURN OVER FOR QUESTION 8

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Amex = WT-1 Amex = (990)(1×1020) Amex = 9.99x 1030 mm

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[1]

Blue Widel

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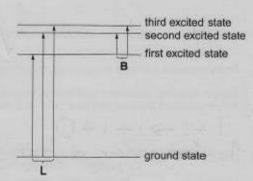
[3]

= Al on = TIC

1837× 1019 = 771

(1322-01)

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(i) Name the process (involving photons) which is responsible for the transitions. [1]

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the body enits/absorbs of reclicity

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B. because in a cooler stor there isn't as much energy changes and there will be no ground state

**TURN OVER FOR QUESTION 8** 

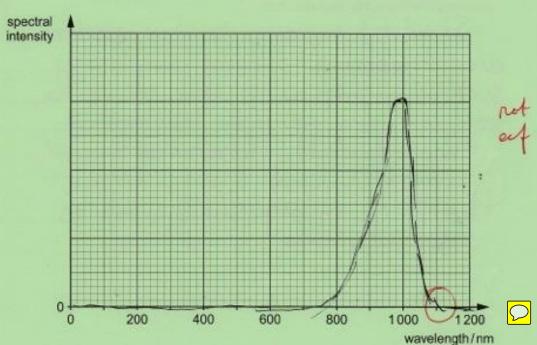
out of	Examine
[2]	0
the ee or [2]	0
[1]	1
[3]	1

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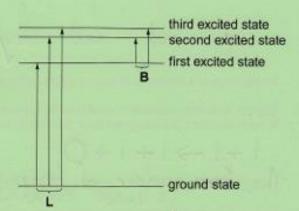
Use Stefan's Law to calculate the diameter of Sirius A.  $P = A \sigma T^4 \implies P = (\pi r^3) \sigma T^4$ 

= Al on = Tr

(1022-01)

Examiner only

(c) The diagram shows the lowest energy levels of a hydrogen atom, and five possible transitions between these levels.



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Block body radiation, this is where the body emits/absorbs est recliable

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