Physics

Course Code: PHY315114

2014 Assessment Report

The paper this year was well received by both candidates and teachers. The length of the paper and its standard were both appropriate; there was little evidence of the average candidate not being able to finish the paper. Unfortunately, in Part 4 the coloured back page was used for the last question and it appeared to have been missed by some capable candidates. Candidates must check carefully that they have actually finished each booklet.

Many candidates were not able to resolve the orientation of the diagrams in Questions 6, 7 (b) and 8, sometimes using compass point directions when it was not appropriate. Also, a significant number of candidates struggled with providing correct units and directions for vector quantities.

The logical sequence required to provide a solution challenged too many candidates studying at this level. The standard format is: write down a relevant formula, show a step substituting numerical values, then present the answer with correct units and direction, if appropriate. NO SHORTCUTS, as they invariably lead to careless errors!

The markers of Part 3 (waves etc.) were disappointed by the poor quality of diagrams that were specifically requested as part of Questions (13 (a), b (i), 15 (a), & 17 ((b)); this cost candidates quite a lot of marks and resulted in the average mark for this criterion being significantly below that of the other criteria. In the future candidates should not rush these diagrams and avoid losing these precious marks unnecessarily; losing 8 out of 40 marks certainly puts paid to higher ratings!

PART 1 – Criterion 5

Question 1

(a) Of the candidates who answered this correctly, most used components for the force of ground on the skier; this was acceptable. Most candidates were able to draw a closed triangle, but they were not always properly labeled, or drawn to scale as asked.

(b) The correct answer (11.8°) was usually obtained, although the 12° often just appeared out of nowhere as an answer.

(c) Poorly done. Too many candidates calculated either the work done against friction **or** gravity but not both combined.

(d) Generally done well, using the answer from (c).

Question 2

(a) Most candidates had a reasonable idea, but candidates should ensure that they use clear Physics reasoning with appropriate supporting formulae. There were also many vague responses where force is ‘cushioned by ..’ or ‘absorbed by ..’ the crumple zone.

(b) Well done.

(c) Generally well done, although for Part (ii) quite a number of candidates used an **average** slope rather than a **maximum**.

(d) Mostly well done. The most common problem was a failure to show clearly a much greater slope for the graph for the older car.

Question 3

A lot of candidates completed this question correctly so gaining a handy 8 marks. For the less successful candidate issues were:

a) Occasionally the question was left blank, implying they did not see the question. Some candidates mistakenly had the ball's path travelling horizontally off the tee.

b) i) Sometimes the horizontal and vertical components of initial velocity were not determined correctly. Another error seen was that the signs for vector quantities were not used consistently.

   ii) Common approaches were either splitting the path into time to top of arc and time to reach the green, or using initial and final vertical velocities.

c) Well done.

d) Well done. Candidates often completed this part when they determined the answer to Part b), or used vertical components to solve separately. Candidates lost 1 mark if they failed to add 35 m to their final answer. Signs on vector quantities sometimes caused issues.

Question 4

a) Few candidates gained full marks for this part. Nearly all included the force due to gravity, but many failed to realise that the forces on the first diagram were balanced, and on the second diagram were unbalanced. Many included an 'applied' or 'centripetal' force on the second diagram, either horizontally left or right.

b) About half the candidates completed this correctly. Full marks generally relied on completing a correct force diagram. The use of sine, rather than tangent, of 11° resulted in the loss of one mark.

c) Poorly done. Descriptions of centripetal acceleration displayed a general lack of understanding by candidates.

d) Generally well done.

Question 5

Candidates tended to get good marks for this question. Nearly all included the two correct equations, and most showed the answer to the correct number of significant figures. Common errors were calculator errors, substitution of incorrect radii, not converting from km to metres, and, in Part b), trying to use Kepler's formula despite not having a value for T.

PART 2 – Criterion 6

Question 6

a) Most candidates answered this correctly.
b) Straightforward and answered correctly by the majority of candidates.
c) (i) The majority of candidates used the correct formula to get the correct numerical value, but most missed the part of the question asking the direction of the induced emf.
(ii) About 2/3 of candidates answered this question correctly.

Question 7

a) (i) Most candidates were able to determine the correct numerical value and units. Few were able to describe the effect of the force on the wires, ie repulsion.
(ii) Few candidates gained full marks for this question as they were unable to draw a diagram with the four elements required for full marks, ie the 'circular' shape of the field pattern, direction of the fields around X and Y, double density field around wire Y, and the increased density between wires X and Y.
b) (i) Most candidates successfully calculated the answer but less than half were able to provide the correct direction clearly on the diagram as requested. Many candidates were confused with the orientation of the diagram.
(ii) While many candidates made a good attempt at this question only a few received full marks. Common errors were omitting to find the direction of the magnetic field completely, or finding or providing the wrong angle in describing the direction of the resultant magnetic field.

Question 8

a) Most candidates drew an adequate representation of the electric field to gain 1 mark.
b) (i) Many candidates calculated the correct value and gave the correct units but few were also able to describe the direction of the electric field.
(ii) About half the candidates completed this question accurately. Of those who did not get full marks, most attempted the question by doing a scalar addition rather than a vector addition.
(iii) Of the candidates who attempted this question, most completed it well.

Question 9

This question was quite wordy and candidates had some difficulty extracting relevant information from the question sections. The first part was made somewhat more difficult through a subtle error in the question, rendering the graph in conflict with the preceding sentence. This affected the first answer to the question.

a) Most candidates read the PD at 26 m directly from the graph (2000 V) instead of looking at the PD at the start (60 000 V), which is the correct answer. They were allocated 0.5 marks instead of 1 mark.

b) The marker was looking for recognition of the possibility of a dangerous PD being set up between feet 1 m apart but a much lower PD if the feet were held together. Generally, candidates managed this although some answers entirely missed the point! And voltage does not flow through a person, current does in response to the PD!!

c) i) Too many candidates merely selected the voltage at 3 m from the graph (1400 V), substituted in V=IR and concluded that current was too high. What candidates should have done is measure the PD between say, 2 m and 3 m or 3 m and 4 m – a stride – (about 2000 V), thus giving a current that is just lethal.

ii) A similar situation to the above, where candidates often failed to look across a stride but only at a less than lethal PD so concluding that safety was about 25 m away instead of about 5 or 6 m.

Question 10

This question was generally well answered though a number of candidates had trouble with the charge on a proton and oxygen nucleus! In Part b) not many recognised the direction of the force (repulsion) while in Part c) few candidates linked the E_p to the E_K as required by the question. The marker was fairly generous with respect to these details. The last section, the accelerating PD, was well done.

Question 11

a) i) Many candidates correctly gave the direction of the current around the ring. However, some candidates wanted the current to point directly upwards 'in opposition to the movement'!

ii) Most were able to correctly apply Lenz's Law to the situation. Some, however, managed to give very obscure answers.

b) This graph was the poorest done of all parts of this question. Most candidates recognised a reversal of current but many had the graph upside down, given they had claimed the initial current was anticlockwise. Few had the graph hesitating at zero between poles passing, while some had a current apparently flowing forever after the magnet had passed.

PART 3 – Criterion 7

Question 12

This question was well answered. The most common error was candidates suggesting increasing the length of the violin string to reduce the frequency to196 Hz. Since the strings in a violin have a fixed length, this response was given half marks.

Question 13

The diagram for Part a) had to be drawn carefully, showing a fixed wavelength and rays drawn at right angles to the wave fronts. This was rarely done and very few candidates were awarded full marks. The rest of the question was well answered, as it should have been as it was quite straightforward.

Question 14

a) Reference to a difference in path length for the two rays of one half a wavelength was required; this was rarely done.

b) c) & d) Well answered. In Part d) a common mistake was to multiply by 1.5 rather than to divide.

e) Although intentionally difficult, this part was answered well by a minority of candidates who were able to show a deep understanding of the delaying of a wave by passing it through a higher refractive index medium.

Question 15

a) Despite specifically being asked to show the water level, most candidates did not do this. Those that did invariably drew the water level at the bottom of the tubes, hence not showing at all that the height of the air column altered modes of resonance. The next most common mistake was not showing a node at the closed end; most candidates correctly sketched anti-nodes at the open end.

b) Although the question specifically stated to use **all data** from Part a) most candidates did not, hence few successfully completed this part. Any attempt to quantify the end-effect earned a bonus mark.

Question 16

This question was by far the most poorly answered question in Part 3, but was attempted by nearly all candidates.

a) (i) A small minority of candidates left this blank.

(ii) Very few candidates used the changes in wavelength to compare the speeds of the wave at ground level with higher in the air. This would have been by far the simpler justification. Most candidates attempted to show a refraction away or towards the normal, depending on what answer they had given for Part (i). Even when argued incorrectly, if their justification matched their previous answer, marks were awarded. There was clearly not much understanding that a normal is at 90° to the boundary between media; here the boundary was between cool and warm air. The majority of candidates incorrectly drew their normal as a tangent to the wave fronts that were shown in the diagram.

b) A significant minority of candidates gave explanations totally unrelated to the concept assessed in the question. Many stated that is was quieter at night or simply that it was cooler at night than during the day. Quite a few candidates used the word: reflection, but clearly did not mean Total Internal Reflection and did not demonstrate that they realised the 'bending' referred to refraction.

Question 17

a) (i) A straightforward question answered correctly by just about all candidates

(ii) Whilst a small majority answered this correctly, many candidates confused incident and refracted angles, though most realised it involved 90° somewhere.

(iii) Very few correct answers. Only a minority used their answers from Parts (i) and (ii). There was little evidence that candidates realised that the incident angle at the back of the rain drop equalled the refracted angle where the ray entered the drop; candidates who earned full marks invariably drew angles in either their own diagram or in the diagram supplied at the beginning of the question. Even though incorrect based on Parts ((i) and (ii), candidates who stated TIR because $i > i_c$ at least got some marks.

b) Generally done satisfactorily. The most common errors were:
- red refracting more than blue, rather than less;
- not showing partial TIR and partial refraction at the back of the drop (but errors were carried forward from Part a) (ii));
- not showing angles of reflection equal;
- refracting red away from the normal upon leaving the drop, both at the back and the 'bottom' of the drop.

c) Generally done satisfactorily. However, a significant minority of candidates gave explanations totally unrelated to the concept assessed in the question; sunlight being too bright for the camera to take pictures of the rainbow was a common misconception. Light from the sun being too bright (usually stated as being: too powerful) in comparison to the rainbow was also common.

PART 4 – Criterion 8

Question 18

a) A straightforward question to start the section, with many candidates gaining full marks. Some overlooked the fact that the value was 175 keV and not 175 eV and were, therefore, a factor of one thousand out in their answer. A small number of candidates calculated the frequency instead of the wavelength.

b) Few candidates received the full three marks allocated to this question, with most failing to describe the variation in deceleration of the incident electrons that results in the large variation of wavelengths generated – hence the 'continuous' spectrum. The 'characteristic' spectrum was much better described.

c) The intercept on the wavelength axis (*x*- axis) corresponds to the shortest wavelength generated corresponding to the highest energy electron striking 'head on' and giving up all its kinetic energy. This point was rarely labeled and described (links to Part a) of this question). The 'spikes' superimposed on the continuous spectrum were often not included or poorly drawn and not labeled as required.

Question 19

a) (i) Reasonably well answered by most. Common mistakes were to overlook the fact that the values in the table were ' x 10^{-19} J ' and that energy was lost by the electron.

(ii) Most candidates correctly used the value that they obtained in Part a) (i) to gain full marks for this part.

(iii) A mark was given where the part of the EM spectrum was correctly identified for the value of wavelength calculated in Part a) (ii). Many candidates who answered the previous part correctly failed to answer this part correctly, perhaps not referring to their Information

Sheets to simply read off where in the EM spectrum the wavelength was. The most common answer was to just quote 'UV' which, of course, was incorrect.

b) When expressed in the manner it was in the table, the energy required was simply the value listed, ie 2.42×10^{-19} J. However, the question asked that this be expressed in eV so this conversion was required for full marks. Some candidates simply wrote 2.42 eV as the answer, again neglecting the fact that the value was 2.42×10^{-19} J.

Question 20

a) Very few candidates followed the direction of 'Use the graph to answer the following'. The question (for 3 marks) was not a simple 'describe fusion and fission reactions', but required a description of how larger than Fe nuclei react (by fission) and smaller nuclei (by fusion) in order to increase the binding energy per nucleon to obtain a more stable configuration.

b) Most candidates gained a mark for explanations describing why energy was released.

Question 21

a) This question as well answered by most candidates. The question specifically asked for the energy in Joules, so leaving the answer in eV was penalized by the loss of one mark. A small number of candidates were penalized for quoting far too many decimal places in their answer. The most common error was to miscalculate the mass defect (in amu) in the early stages of the calculation.

b) Well done by most candidates.

c) Poorly done. Most candidates calculated mass defect for the lithium equation and did not see how the lithium particles related to the energy production in the first equation.

Question 22

a) Most candidates balanced the 'numbers', however, most failed to include the neutrino.

b) Done well by those who attempted the question. Some just underlined rest energy and did not give a response.

c) Quite well done.

Question 23

a) Mostly well answered.

b) The calculation was successfully completed, but most candidates gave the incorrect units, if any at all.

c) Both parts were done well, although in Part (ii) candidates had some trouble with units, orders of magnitude and relating N to mass.

[redacted]

Tasmanian Qualifications Authority

PLACE LABEL HERE

Tasmanian Certificate of Education

PHYSICS

Senior Secondary

Subject Code: PHY315114

External Assessment

2014

Part 1

Time: approximately 45 minutes

On the basis of your performance in this examination, the examiners will provide a result on the following criterion taken from the course statement:

Criterion 5 Demonstrate knowledge and understanding of Newtonian mechanics including gravitational fields.

Section Total
/40

Pages: 16
Questions: 5

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CANDIDATE INSTRUCTIONS

You **MUST** make sure that your responses to the questions in this examination paper will show your achievement in the criteria being assessed.

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

Note:

When candidates are asked to 'show that' an answer to a question is 'about' a numerical value given to one or two significant figures:

- A candidate should provide their own answer to three significant figures (unless told otherwise in that question).
- A candidate whose answer rounds off to the given answer should continue to use their own three significant figure answer in any subsequent questions requiring this answer.
- A candidate whose answer is **significantly** different from that given by the examiner should use the one or two significant figure answer given by the examiner in answering subsequent questions.

This examination is 3 hours in length. In total it is recommended that you spend approximately 45 minutes answering the questions in this part.

The 2014 External Examination Information Sheet for Physics can be used throughout the examination.

No other written material is allowed into the examination.

All written responses must be in English.

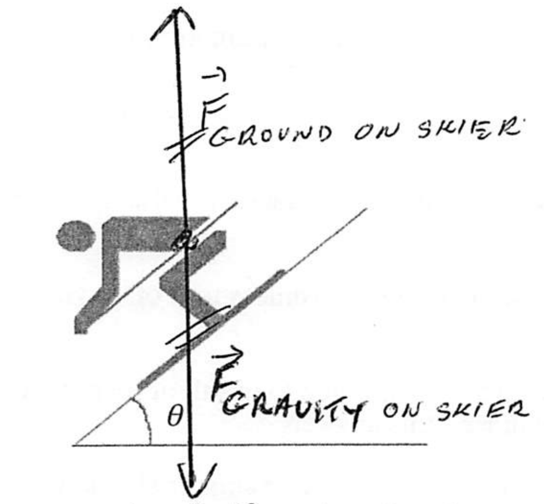
A set of spare diagrams has been provided in the back of the answer booklet for you to use if required.

If you use a spare diagram, you MUST indicate you have done so in your answer to that question.

Question 1

For Marker Use Only

The diagram below shows a person on snow skis sliding down a snow-covered slope at **constant speed**. The mass of the person and skis combined is 75.0 kg and the force of friction between the skis and the slope is 150 N.



$F_{NET} = 0$ as $a = 0$
as $\vec{v}$ = CONST

THIS ANSWER $\frac{4}{3}$ ie 1 BONUS (NOT ~~SEEN~~ GIVEN BY ANY STUDENTS!)

OTHER ANS - MOST COMMON

$F_{NET} = 0$

(a) On the diagram, draw the main forces acting on the skier. Then, in the space on the right, draw a clear vector diagram of those forces. Your vectors should be clearly labelled and drawn roughly to scale. (3 marks)

(b) Show that the smallest angle (to the horizontal) which will allow the skier to slide down the slope, without pushing, is approximately 12°. (2 marks)

As force of friction is 150 N up slope & $F_N = 0$
force due to gravity down the slope must be 150 N down the slope

i.e. $mg \sin\theta = 150$ N

$\therefore \theta = \sin^{-1}\left(\frac{150}{75.00 \times 9.81}\right) = 11.8^\circ \simeq 12^\circ$

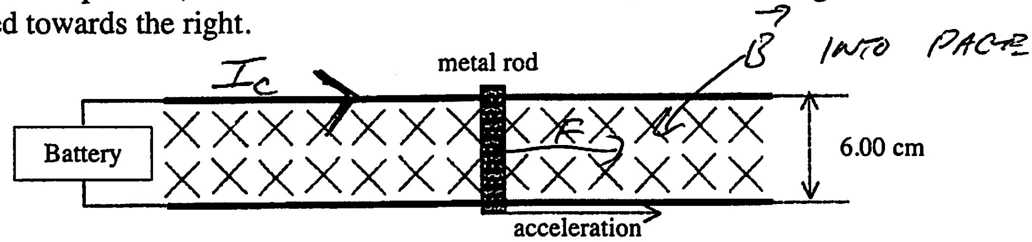
Question 1 continues.

For Marker Use Only

Question 6

In a linear motor, a freely-moving conductor is connected to two long rails. A magnetic field creates a force on the conductor.

In an industrial process, the conductor is a small metal rod, which is being accelerated to a high speed towards the right.



(a) On the diagram show the direction of the current causing this acceleration of the metal rod. (1 mark)

I_c = CONVENTIONAL CURRENT

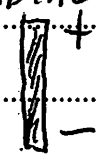
(b) If the magnetic field strength is 2.50 T and the current is 20.0 kA, calculate the force on the moving rod. (1 mark)

$F = I \Delta l B \sin\theta = 2\times10^4 \times 0.06 \times 2.5 T = 3000 N$ TO RIGHT

(c) (i) The rod accelerates to a speed of 400 m s^{-1}. Calculate the maximum value of the emf induced in the moving rod and indicate its direction. (2 marks)

$emf = vlB = 400 \times 0.06 \times 2.5 = 60 V$

METAL ROD



TOP OF ROD +

BOTTOM OF ROD −

(ii) What instantaneous power must be provided to overcome this induced emf? (1 mark)

$P = IV = 2\times10^4 \times 60$

$= 1.2 \times 10^6 W = 1.2 MW$

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For Marker Use Only

Question 7

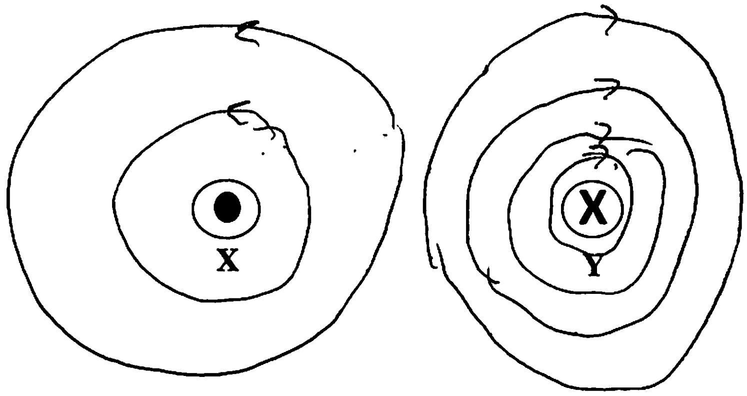
(a) Two straight parallel wires, **X** and **Y**, are carrying currents of 100 A and 200 A respectively in opposite directions. The wires are separated by a distance of 20.0 cm.

(i) Calculate the force per metre between the wires. (2 marks)

$F = \frac{k I_1 I_2 l}{d} = \frac{2 \times 10^{-7} \times 100 \times 200}{0{\cdot}2}$

$= 0{\cdot}0200$ N REPULSION

(ii) Sketch the likely **B**-field pattern in the region around the wires. (2 marks)



TWICE THE DENSITY OF FIELD LINES AS TWICE THE CURRENT

Question 7 continues.

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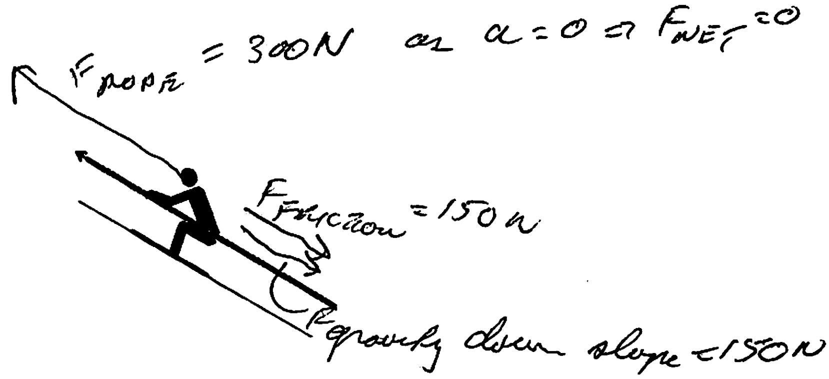
Question 1 (continued)

A while later, the skier is towed **up** the same slope at a constant speed of 1.50 m s^{-1}. The frictional forces remain the same.



(c) Calculate the amount of work done by the tow-rope in **one second**. (3 marks)

$W = F \cdot S = 300 \times 1.5 = 450 J$

↑ as $v = 1 m/s$ & $t = 1s$

(d) What power is required to tow the skier up the slope? (1 mark)

$P = \frac{W}{t} = \frac{450}{1} = 450 W$

/9

For Marker Use Only

Question 2

Modern cars incorporate 'crumple zones' where the body of the car is designed to undergo controlled collapse during a crash. Older cars were usually built with rigid bodies.

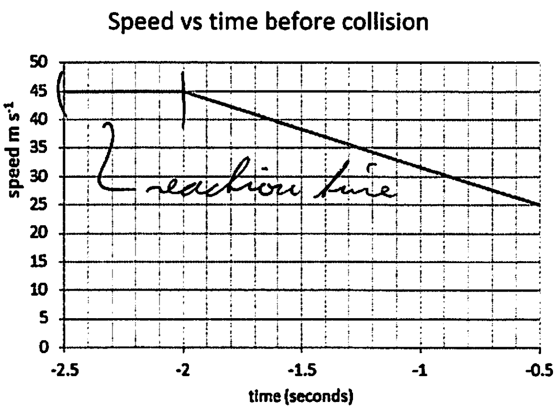
(a) Explain in terms of the forces involved why modern cars are safer for passengers during a crash. (2 marks)

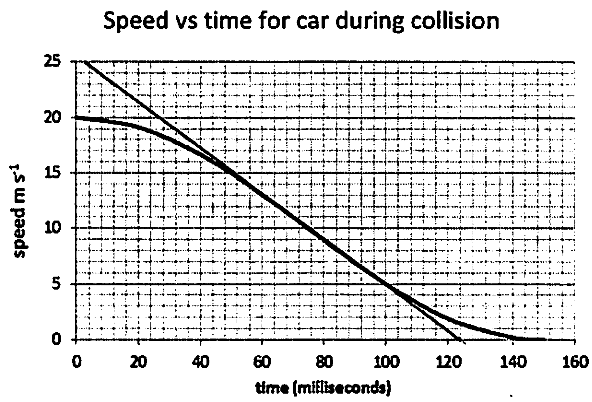
Δp = CHANGE IN MOMENTUM = CONST if m & Δv CONSTANT

$= F\Delta t$

By having crumple zone Δt is extended or stopping distance is extended so F is reduced - hence safer

A Crash Data Retrieval (CDR) system is designed to record information about the motion of a car both before and during a collision. The first graph shows the speed of a modern car from the moment the driver saw a hazard until just before the collision. The second graph relates to the motion of the car during the actual collision.





(b) Determine, for the period before the collision:

(i) the reaction time of the driver (1 mark)

0.5 s from graph 1

ANS for PART C (ii) the maximum deceleration of the car. (2 marks)

⇒ find max gradient on speed (velocity) ~ time graph

$a = \frac{\Delta v}{\Delta t} = \frac{-25}{.120} = -208$ m/s/s forwards

$= 208$ m/s/s BACKWARDS

Question 2 (b) continues.

Question 2 (b) (continued)

For Marker Use Only

(iii) how far the car travelled during this period before the collision. (2 marks)

S = AREA UNDER v~t GRAPH

= 45 × 0·5 + 35 × 1·5

= 22·5 + 52·5

= 75 m

b(ii) *

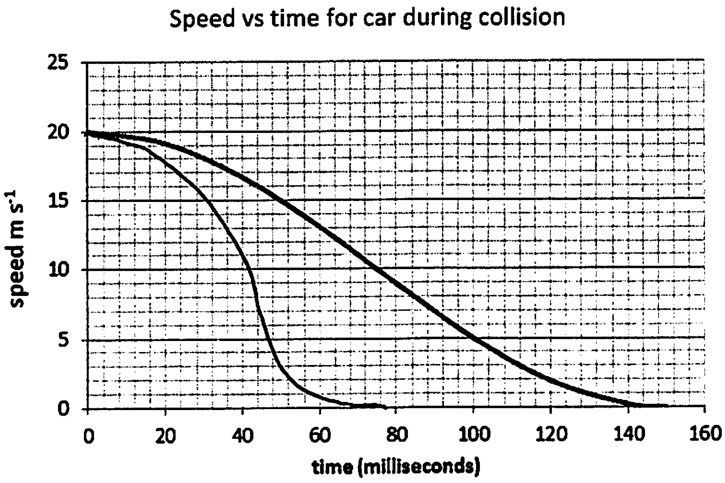
(c) Determine an approximate value of the maximum deceleration of the car ~~during~~ BEFORE the collision. (2 marks)

FROM GRAPH 1

$a = \frac{\Delta v}{\Delta t} = \frac{-20}{1·5} = -13·3$ m/s/s FORWARDS

$= 13·3$ m/s/s BACKWARDS

(d) On the copy of the second graph reproduced here, draw a likely curve for a collision involving an **older** car. Justify your answer. (2 marks)



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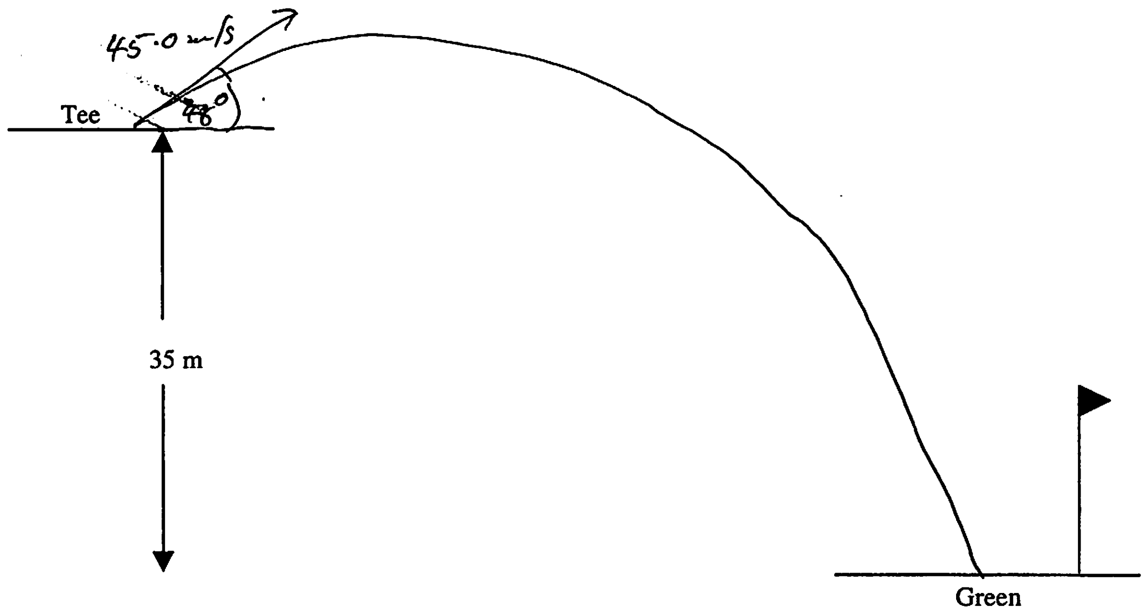
For Marker Use Only

Question 3

On a golf course, the 11th hole features a 35.0 m drop from the tee to the green. A golfer on the tee hits a ball with a speed of 45.0 m s^{-1} and angle of elevation 48.0°. In answering the questions ignore air-resistance.

(a) On the diagram below, sketch the flight of the ball. (1 mark)



Question 3 continues.

Question 3 (continued)

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(b) (i) Show that the vertical component of the velocity of the ball as it lands is approximately 42.0 m s^{-1}. (2 marks)

$v_o = v \sin\theta = 45 \times \sin 48^o = 33.4$ m/s

$2as = v^2 - u^2$

$2 \times 9.81 \times 35 = v^2 - (33.4)^2 \Rightarrow v = \sqrt{1115 + 687}$

$= 42.5$ m/s

(ii) Hence or otherwise, show that the total time of flight of the ball is approximately 7.8 s. (2 marks)

USING VERTICAL MOTION

$v = u + at \Rightarrow t = \frac{v-u}{a} = \frac{42.5 - -33.4}{9.81}$

$= 7.74$ s

(c) What horizontal distance would you expect the ball to travel before it lands? (1 mark)

$s = ut = 45 \cos 48 \times 7.74 = 233$ m

(d) Calculate the maximum height of the ball relative to where it lands. (2 marks)

$2as = v^2 - u^2$ (USE VERTICALLY FOR FALLING SECTION)

$2 \times 9.81 \times s = (42.5)^2 - 0^2$

$s = \frac{42.5^2}{2 \times 9.81} = 92.01$ m

$\therefore$ max height is 92.1 m

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For Marker Use Only

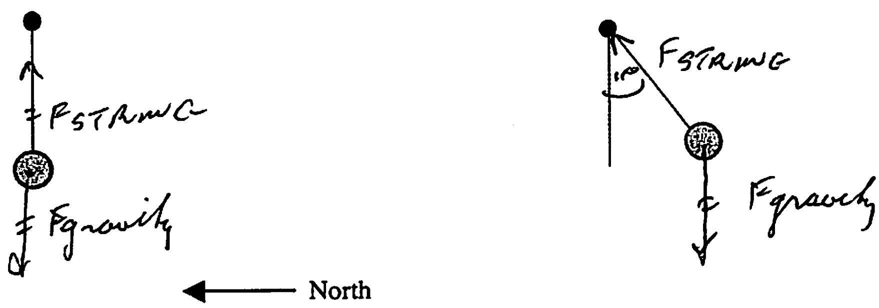
Question 4

There is a 75.0 g ornament suspended by a thread from the rear-view mirror of a car. As the car accelerates northwards, the driver notices the ornament hangs at 11.0° from the vertical.

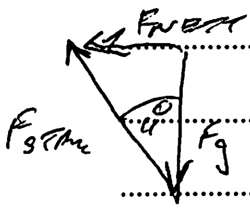
(a) Add vectors to each of the diagrams below to show the forces on the ornament: (2 marks)

(i) before the car moved

(ii) as the car accelerates



(b) Show that the magnitude of acceleration of the car in part (a) (ii) is approximately 2 m s^{-2}. (2 marks)



$= ma$

$$\tan\theta = \frac{F_N}{F_g} = \frac{ma}{mg} = \frac{a}{g}$$

$$\Rightarrow a = g\tan\theta$$

$$= 9.81 \times \tan 11^\circ$$

$$= 1.91 \text{ m/s/s}$$

Question 4 continues.

Question 4 (continued)

For Marker Use Only

Later, the car rounds a bend to the west while travelling at a constant speed of 15.0 m s^{-1}. The driver notices that the ornament hangs at the same angle of 11.0° from the vertical.

(c) Explain why this occurs even though the car is travelling at a constant speed. (2 marks)

The car is executing circular motion as the car rounds a bend so a centripetal force is needed by the ornament so it must hang outwards ~~so~~ the string can do this

(d) Calculate the radius of the bend in the road. (2 marks)

$a_c = 1.91 \text{ m/s/s} = \frac{v^2}{r} \rightarrow r = \frac{15^2}{1.91} = 118 \text{ m}$

/8

For Marker Use Only

Question 5

In 2011, the space vehicle 'Dawn' became the first man-made object to orbit an asteroid when it went into orbit around the asteroid Vesta.

Dawn's orbit had a radius of 943 km and period of 6.86 hours. Assume Vesta is spherical, with a radius of 263 km.

In this question, ignore any gravitational effects of the Sun or other objects.

(a) Show that the mass of Vesta is approximately 8×10^{20} kg. (2 marks)

$T^2 = \frac{4\pi^2 r^3}{GM} \Rightarrow M = \frac{4\pi^2 r^3}{GT^2}$

$= \frac{4\pi^2 \times (9.43 \times 10^5)^3}{6.67\times10^{-11} \times (6.86\times60\times60)^2}$

$= 8.14\times10^{20}$ kg $\simeq 8\times10^{20}$ kg

(b) Calculate the value of the acceleration due to gravity at the surface of Vesta. (2 marks)

$g = \frac{Gm}{r^2} = \frac{6.67\times10^{-11}\times 8.14\times10^{20}}{(2.63\times10^5)^2}$

$= 0.785$ m/s/s

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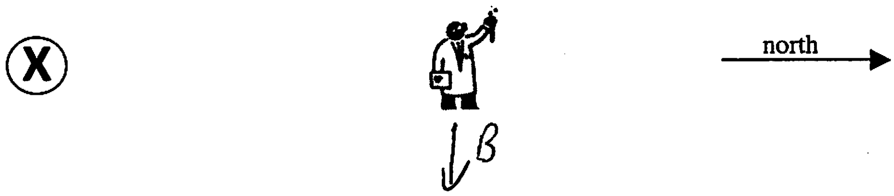
For Marker Use Only

Question 7 (continued)

(b) A physicist is standing 14.0 m north of a cable running east-west. The cable is carrying 1200 A of current towards the west.



(i) Calculate the magnetic field strength due to the current where the physicist is standing. On the diagram above clearly indicate the direction of the field.

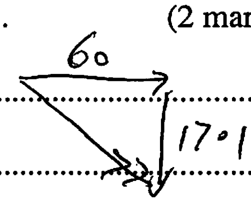
(2 marks)

$B = \frac{kI}{d} = \frac{2\times10^{-7} \times 1200}{14} = 1.71\times10^{-5}$ T DOWN

(ii) The physicist knows that the Earth's magnetic field where he is standing is 60.0 μT horizontally, towards the north.

Evaluate the resultant magnetic field strength at his position. (2 marks)

$|B| = \sqrt{60^2 + 17.1^2} = 62.4\,\mu T$



$\theta = \tan^{-1} \frac{17.1}{60} = 15.8^{\circ}$

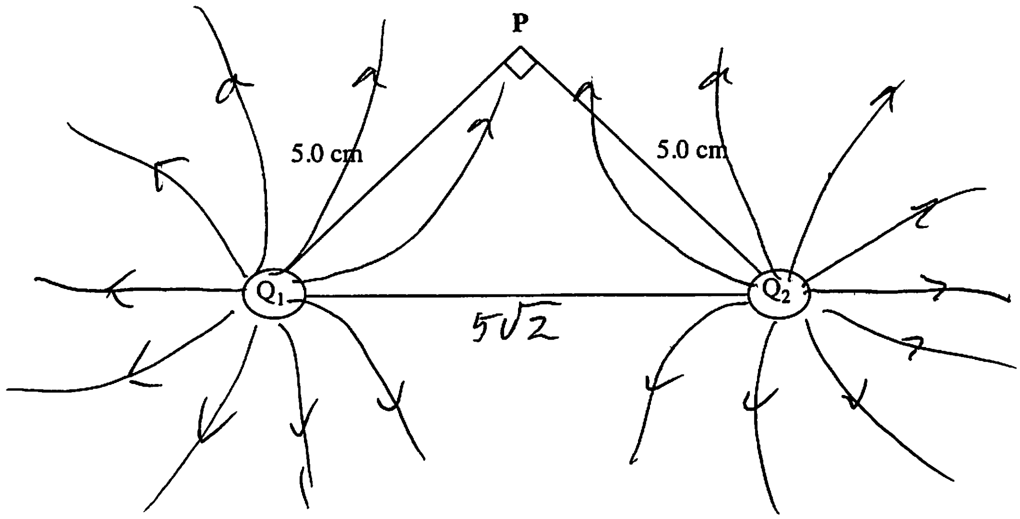
B is 62.4μT NORTH at 15.8° below the horizontal

/8

For Marker Use Only

Question 8

Two equal charges Q_1 and Q_2 of $+5.00 \times 10^{-8}$ C are fixed in position as shown. A point **P** is vertically above the mid-point of Q_1 and Q_2.



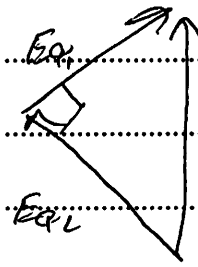
(a) On the diagram above, sketch the resultant E-field around the two charges. (1 mark)

(b) (i) Determine the E-field at **P** due to Q_1. (2 marks)

$$E = \frac{kq}{r^2} = \frac{9\times10^{9} \times 5.00\times10^{-8}}{(0.05)^2}$$

$$= 1.8\cancel{5}0 \times 10^{5}\ \text{V/m away from } Q_1$$

(ii) Hence, show that the resultant E-field at **P** has a magnitude of approximately 3×10^5 SI units. (2 marks)



$$E_{TOTAL} = 1.8\cancel{5}0 \times 10^{5}\sqrt{2}$$

$$= 2.54 \times 10^{5}\ \text{V/m}$$

$$\approx 3 \times 10^{5}\ \text{V/m}$$

Question 8 (b) continues.

Question 8 (b) (continued)

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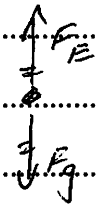
(iii) A small particle of charge $+1.50 \times 10^{-9}$ C is then placed at **P**. This particle remains stationary at **P**.

Determine the mass of this particle. (2 marks)



$|F_E| = |F_g| \Rightarrow Eq = mg$

$\therefore m = \frac{Eq}{g} = \frac{2.5 \times 10^{5} \times 1.5 \times 10^{-9}}{9.81}$

$= 3.08 \times 10^{-5}$ kg

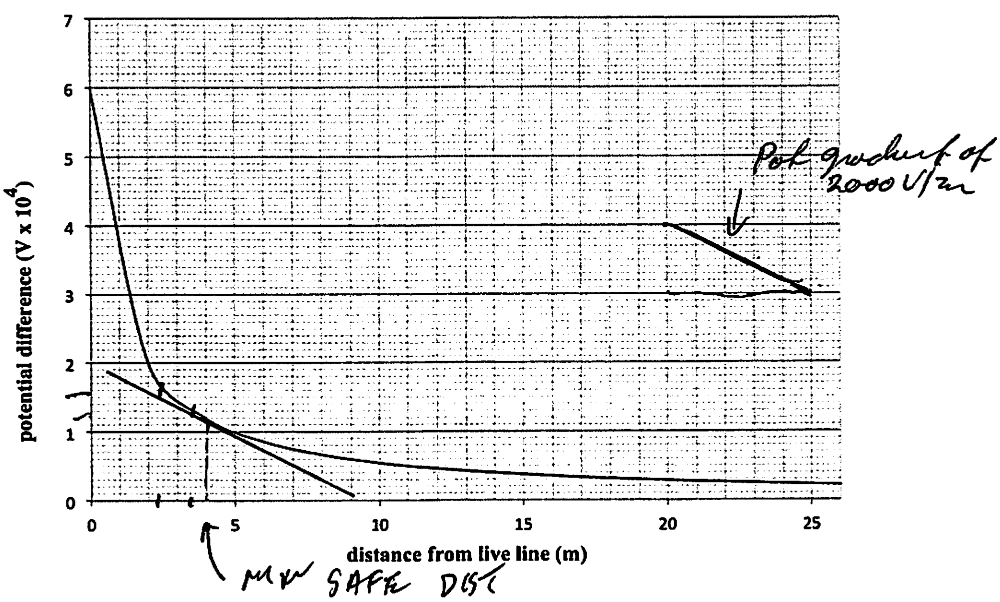
/7

For Marker Use Only

Question 9

If a 'live' electrical transmission line falls and makes contact with a point on the ground, it creates an electric field in the ground around the point of contact. The following graph shows the potential difference between such a live line and points on the ground at increasing distance from the line.

Potential difference Vs distance from line



(a) What is the 'voltage' of the line, relative to ground a long distance from the line? (1 mark)

60,000 V assuming V ground to be 0

(b) Advice from an electrical power company includes the following:

When there is a live power line on the ground near a car you are in (for example, after a collision with a power pole), you should stay inside the car if you can. If you cannot stay in the car, put your feet together and kangaroo-hop away from the live line.

By referring to the information in the paragraph, discuss the possible hazard of moving directly away from the power line by taking normal (~ 1 m) walking strides instead of kangaroo-hopping. (2 marks)

Serious eg at 2 m from the pole there is a P.d of 3,000 V between the feet if 1m stride taken. Even at 10 m from pole. Pd is 500 V between feet which would be an issue depending on conditions

Question 9 continues.

Question 9 (continued)

For Marker Use Only

(c) A person is at risk of lethal electric shock if 20.0 mA passes through the body. Suppose a particular person presents an electrical resistance of 100.0 kΩ and has a stride length of 1.00 m and walks directly away from the live line.

(i) Determine if there is a lethal risk to this person when the person is at a distance of 3.00 m from the live line to which the graph refers. (2 marks)

assume feet at 2.5 + 3.5 m ⇒ Pd ≈ 3000 V between feet $I = \frac{V}{R} = \frac{3000}{1\times10^5} = 3\times10^{-2} = 30$ mA

This is greater than lethal current so lethal.

(ii) Determine the approximate minimum safe distance from the line for this person. Show your reasoning. (3 marks)

need potential gradient of less than 2000 V/m

Pot gradient of 2000 V/m shown on graph and is tangent at ≈ 4 m from wire so this is min safe distance.

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For Marker Use Only

Question 10

In the production of fluorine-18, a proton $\left({}^{1}_{1}\mathrm{H}\right)$ is fired at high speed at the nucleus of oxygen-18 $\left({}^{18}_{8}\mathrm{O}\right)$. In this question, assume that all particles are spherical.

(a) What is the charge, in coulombs, for: (1 mark)

(i) the proton? $+1{\cdot}6\times10^{-19}$ C

(ii) the oxygen nucleus? $8\times1{\cdot}6\times10^{-19} = 1{\cdot}28\times10^{-18}$ C

In order for a nuclear reaction to occur, the centres of the proton and nucleus must approach within 4.35×10^{-15} m of each other.

(b) Calculate the electric force between the proton and nucleus at this distance. (2 marks)

$F = \dfrac{kq_1q_2}{r^2} = \dfrac{9\times10^{9}\times1{\cdot}6\times10^{-19}\times1{\cdot}28\times10^{-18}}{4{\cdot}35\times10^{-15}}$

$= 97{\cdot}4$ N REPULSION

Question 10 continues.

For Marker Use Only

Question 10 (continued)

The increase in electrical potential energy as the proton approaches the nucleus can be calculated using the formula:

$$E_P = \frac{kq_1q_2}{r}$$

(c) With the assistance of this formula, show that the minimum initial kinetic energy which the approaching proton needs in order to react with the oxygen nucleus is approximately 4×10^{-13} J. (2 marks)

$-\Delta E_k = +\Delta E_p = +\frac{kq_1q_2}{r} = +\frac{9\times10^9 \times 1.6\times10^{-19} \times 1.28\times10^{-18}}{4.35\times10^{-15}}$

$= +4.24\times10^{-13}$ J.

(d) Suppose the proton were fired from a linear accelerator. Calculate the required potential difference within the accelerator. (2 marks)

$\Delta E_k = qV \Rightarrow V = \frac{\Delta E_k}{q} = \frac{4.24\times10^{-13}}{1.6\times10^{-19}}$

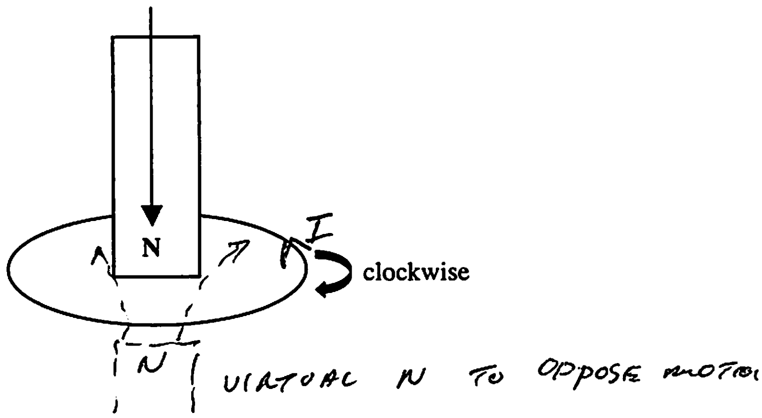
$= 2.65\times10^{6}$ V

/7

Question 11

A bar magnet is **dropped** into a loop of conducting wire.

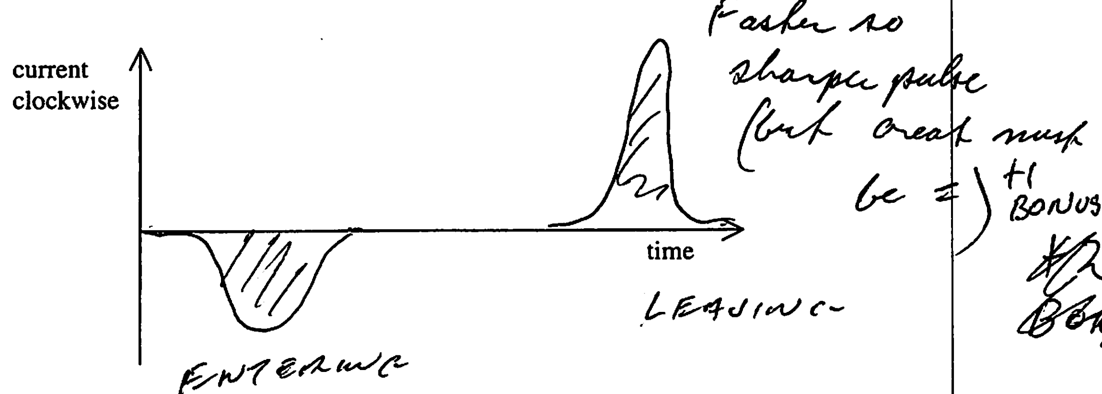
(a) (i) On the diagram show the direction of current induced in the loop when the magnet is moving at the instant shown. (1 mark)



(ii) Explain your reasoning in determining the direction of current at this instant. A diagram may assist in your answer. (2 marks)

LENZ'S LAW I flows in direction to oppose motion so must be creating a $\vec{B}$ field up to repel North pole. (See above diagram)

(b) On the axes below, sketch the expected graph of the current against time as the magnet **accelerates** *all the way* through the loop, starting from a distance above the loop and finishing a distance below it. (2 marks)



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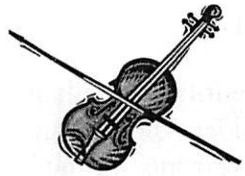
For Marker Use Only

Question 12



A violin has strings of length of 325 mm. Its 'E' string is tuned to play a note with a fundamental frequency of 660 Hz.

(a) Show that the speed of a wave down the 'E' string is approximately 430 m s^{-1}. (2 marks)

$\frac{\lambda}{2} = 0.325\,m$

$\Rightarrow \lambda = 0.650\,m$

$v = f\lambda = 660 \times 0.650$

$= 429\ m/s$

(b) The 'E' string has a linear mass density of 3.83×10^{-4} kg m^{-1}.

Show that the tension in the string is approximately 70 N. (2 marks)

$v = \sqrt{\frac{T}{\mu}} \Rightarrow v^2 = \frac{T}{\mu} \Rightarrow T = v^2\mu$

$= (429)^2 \times 3.83 \times 10^{-4}$

$= 70.5\,N$

(c) The 'G' string is tuned to a fundamental frequency of 196 Hz. What are **two** ways in which this lower fundamental frequency can be achieved? (2 marks)

Lower frequency by ~~an~~ (1) Increasing μ

(2) decreasing T

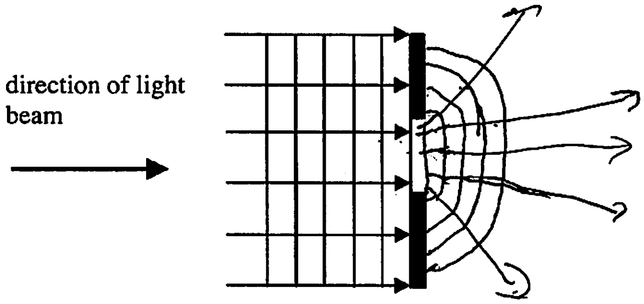
IN VIOLIN STRINGS ARE ALL APPROX SAME LENGTH SO INCREASING LENGTH IS NOT AN APPROPRIATE ANSWER. (IT WAS GIVEN $\frac{1}{2}$ A MARK)

/6

For Marker Use Only

Question 13

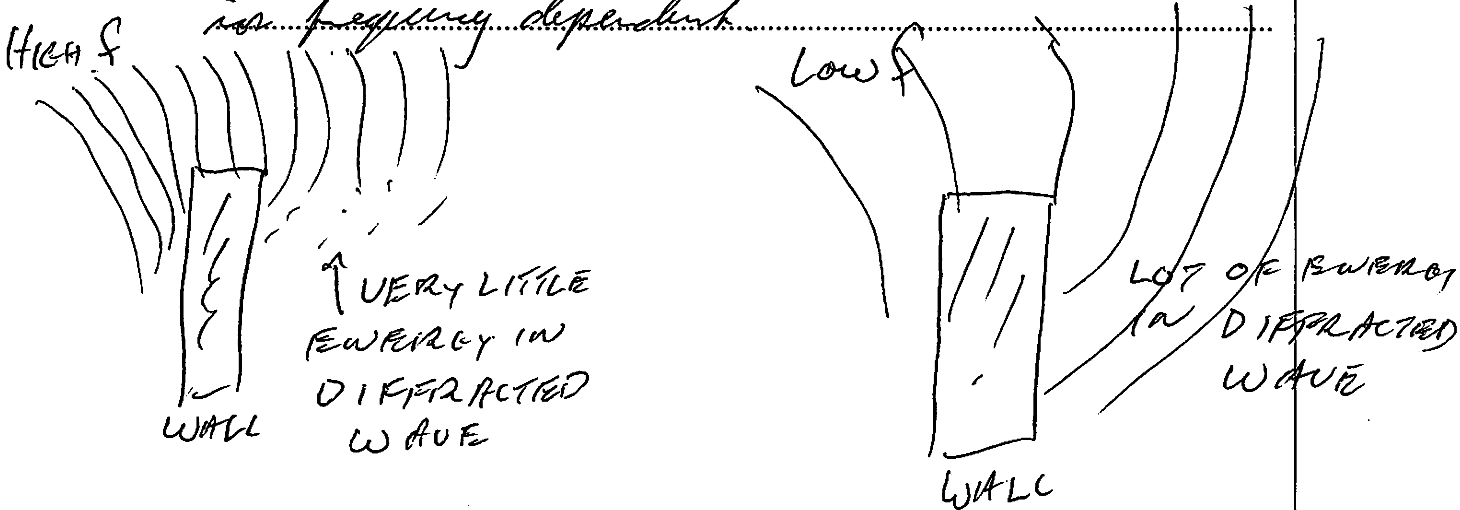
(a) The following diagram shows both rays and wavefronts for a parallel beam of light incident on a slit in an opaque screen. Complete the diagram to show both rays and wavefronts for the light **after** it has passed through the slit in the screen. (2 marks)



(b) A person has neighbours who live on the other side of a high wall. Despite the high wall, the person still hears the sound of a jazz band when it practises in the neighbours' home.

(i) Explain why the sounds are still heard despite the wall. Include a diagram in your answer. (2 marks)

Diffraction occurs over the wall - the amount is frequency dependent



Question 13 (b) continues.

Question 13 (b) (continued)

For Marker Use Only

(ii) Assume that the bass drum and trumpet were played at the same volume.

Which of the two would the person hear more clearly — the low frequencies of the bass drum or the high frequencies of the trumpet? Justify your answer.

(2 marks)

The base drum as lower f's diffracted more as shown in previous diagrams

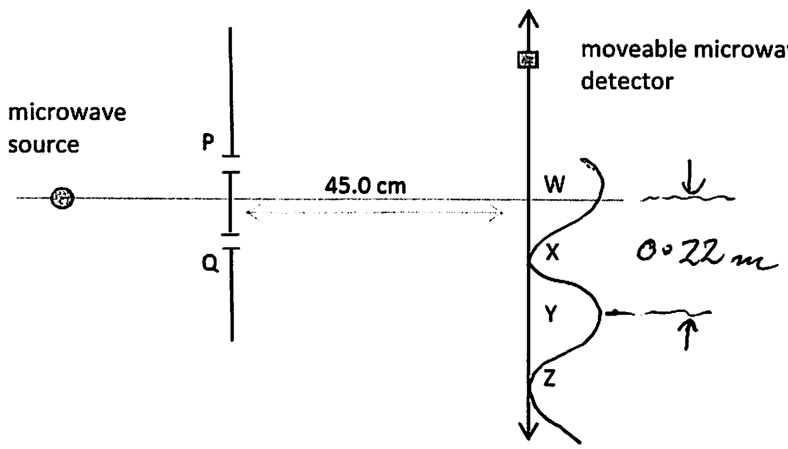
/6

For Marker Use Only

Question 14

A teacher demonstrated the principles of Young's Double Slit experiment using a microwave source and detector as shown in the diagram below.

The microwaves used had a wavelength $\lambda = 2.70$ cm.



On the centre-line, a maximum of intensity was observed at **W**; when the detector was moved, a minimum of intensity was noticed at **X**, a second maximum at **Y**, 22.0 cm from the centre-line, and then a second minimum at **Z**.

(a) Explain carefully what causes the first minimum of intensity. (2 marks)

The distance QX and PX are different by $\frac{\lambda}{2}$ so when the two waves meet at x they are out of phase and thus cancel.

(b) Calculate the path difference between two rays travelling through slits **P** and **Q** to **Z**. (1 mark)

Path diff $= 1.5\lambda = 1.5 \times 2.70 = 4.05$ cm
$= 0.0405$ m

(c) Show that the separation of the two slits **P** and **Q** is approximately 6 cm. (2 marks)

$W = \frac{\lambda x}{d} \Rightarrow d = \frac{\lambda x}{W} = \frac{2.70 \times 0.45}{0.22}$

$= 5.52$ cm

Question 14 continues.

Question 14 (continued)

For Marker Use Only

The teacher obtained a rectangular slab of hard wax. In the microwave spectrum, the wax has a refractive index of 1.50.

(d) Calculate the wavelength of the microwave radiation after it enters the wax. (1 mark)

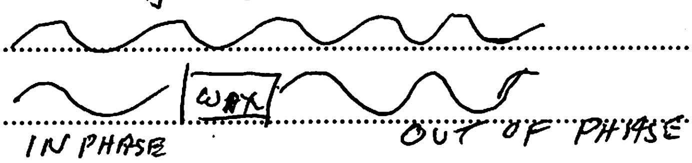
$\lambda = \frac{\lambda_{old}}{n} = \frac{2.70}{1.5} = 1.8\,cm$

$= 0.018\,m$

(e) The slab of wax was placed in front of slit **Q**. When the experiment was then repeated, a **minimum** intensity was observed at **W**. (3 marks)

(i) Explain this change from a maximum in the original demonstration to a minimum.

The wave has ~~th~~ delayed the microwave through it by $\frac{1}{2}\lambda$



/2

(ii) Calculate the minimum thickness of the wax slab.

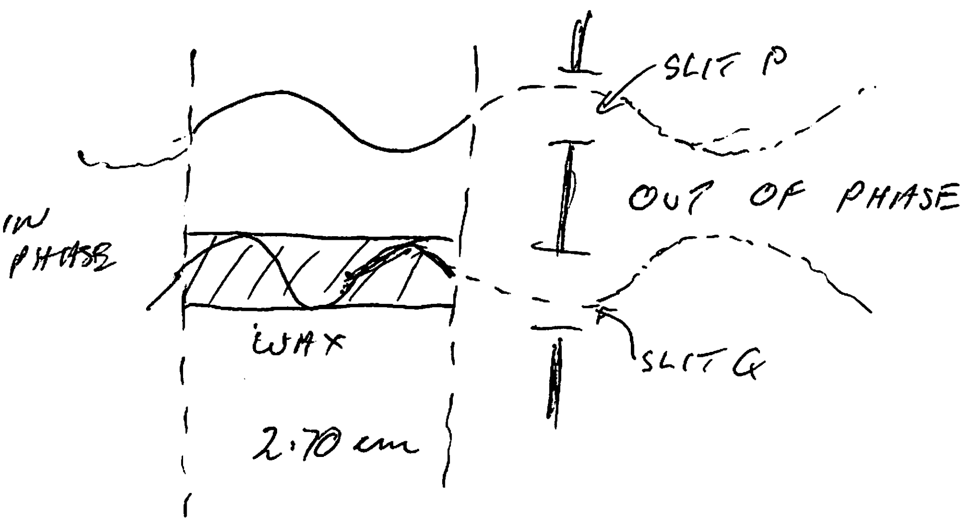
$\Delta OPD = (n-1)t$

$\frac{\lambda}{2} = (1.5-1)t$

$= 0.5\,t$

/1

$\Rightarrow t = \lambda = 2.70\,cm$



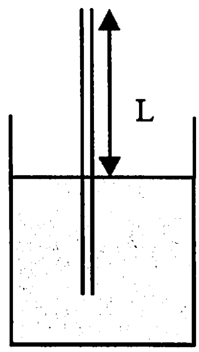
+2 BONUS FOR VERY GOOD ANS TO PART (II) (GIVEN TO 3 CANDIDATES ONLY)

/9

For Marker Use Only

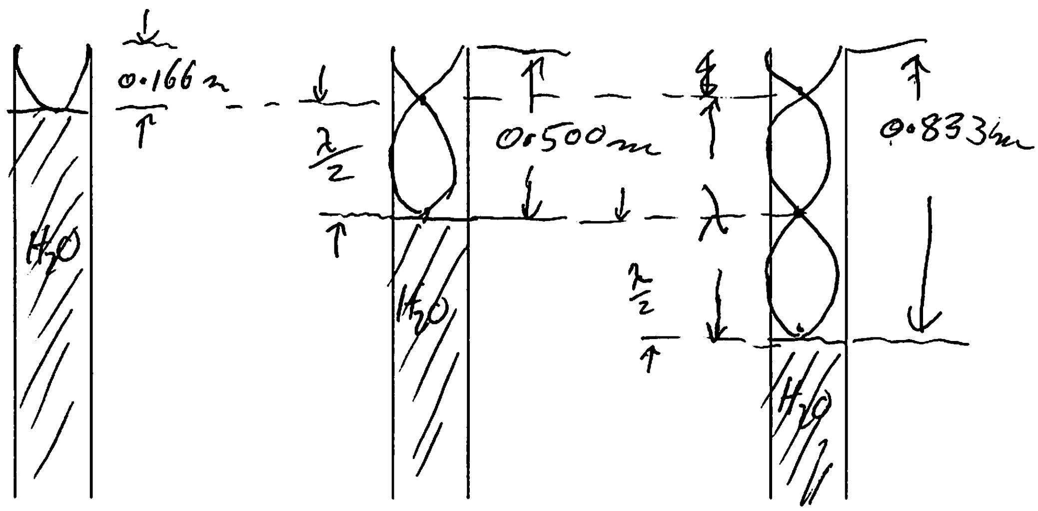
Question 15

In an experiment in the laboratory to measure the speed of sound, a student placed a thin hollow tube in a deep container of water as shown.



When a 512 Hz tuning fork was set vibrating at the open mouth of the tube, a loud resonant sound was heard at several different lengths, as the tube was raised out of the water. The shortest length for resonance was L = 0.166 m; it also occurred at 0.500 m and 0.833 m.

(a) Sketch a standing wave pattern within each tube to explain the three different resonant lengths. Show the water level within the tube. (3 marks)



(b) Determine the speed of sound from these observations.

You should ensure that you use **all** of the given data. Do **not** ignore end-effect. (3 marks)

$$\Delta \ell = \frac{\lambda}{2} = \frac{(0.833 - 0.500) + (0.50 - 0.166) + \left(\frac{0.833 - 0.160}{2}\right)}{3}$$

$$= \frac{0.332 + 0.334 + 0.3335}{3}$$

$$= 0.3335$$

$$\Rightarrow \lambda = 0.667$$

$$v = f\lambda = 512 \times 0.667$$

$$= 341.5 \text{ Hz}$$

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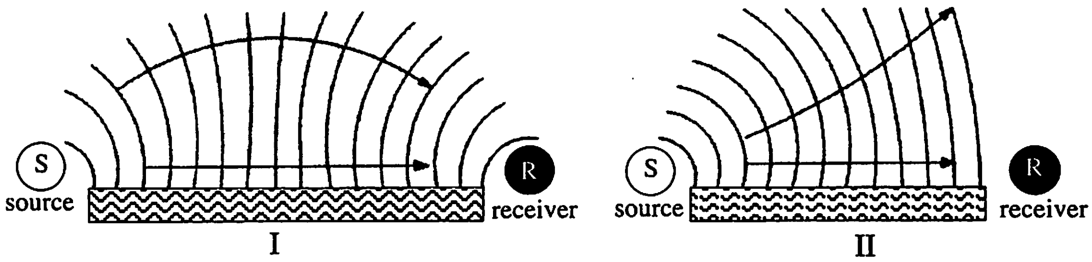
For Marker Use Only

Question 16

Sound travels more slowly in cold air than in warmer air.

During the daytime the ground is often warmer than the air above it, while at night the ground may be the colder. This causes a temperature gradient from hot → cold.

Change in speed can cause a 'bending' of the sound wave that can alter the distance noises appear to travel.



(a) (i) Which of the diagrams above, I or II, represents the situation at night? (1 mark)

(I) λ INCREASES WITH HEIGHT ⇒ T ↑ WITH HEIGHT

(ii) Justify your answer. (2 marks)

λ is lower near ground than higher ⇒ v lower near ground ⇒ T increasing with height ⇒ DIAGRAM I

(b) Explain why distant noises are often easier to hear at night. (1 mark)

SOUND is refracted back to ground and hence concentrated at the reciever ⇒ easier to hear c.f. daytime when sound is refracted away from ground reducing intensity

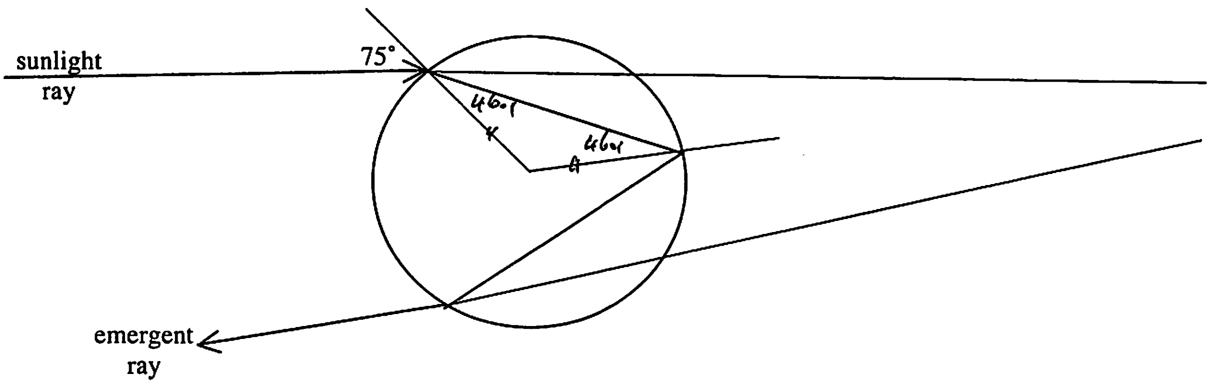
/4

For Marker Use Only

Question 17

Rainbows are caused by a combination of refraction and reflection of visible light in raindrops in the atmosphere.

The diagram below shows a ray of sunlight on a raindrop assumed to be spherical.



Part (a) focuses on the blue light and part (b) on the red light components of the sunlight ray.

(a) The refractive index for blue light in water is 1.34.

(i) If the angle of incidence of a ray of blue light onto the front of a droplet is 75.0°, calculate the angle of refraction. (2 marks)

$\frac{\sin i}{\sin r} = n \Rightarrow r = \sin^{-1}\left(\frac{\sin i}{n}\right)$

$= \sin^{-1}\left(\frac{\sin 75.0}{1.34}\right)$

$= 46.1^\circ$

(ii) Calculate the critical angle for blue light in water. (2 marks)

$i_c = \sin^{-1}\frac{1}{n} = \sin^{-1}\left(\frac{1}{1.34}\right)$

$= 48.3^\circ$

Question 17 (a) continues.

For Marker Use Only

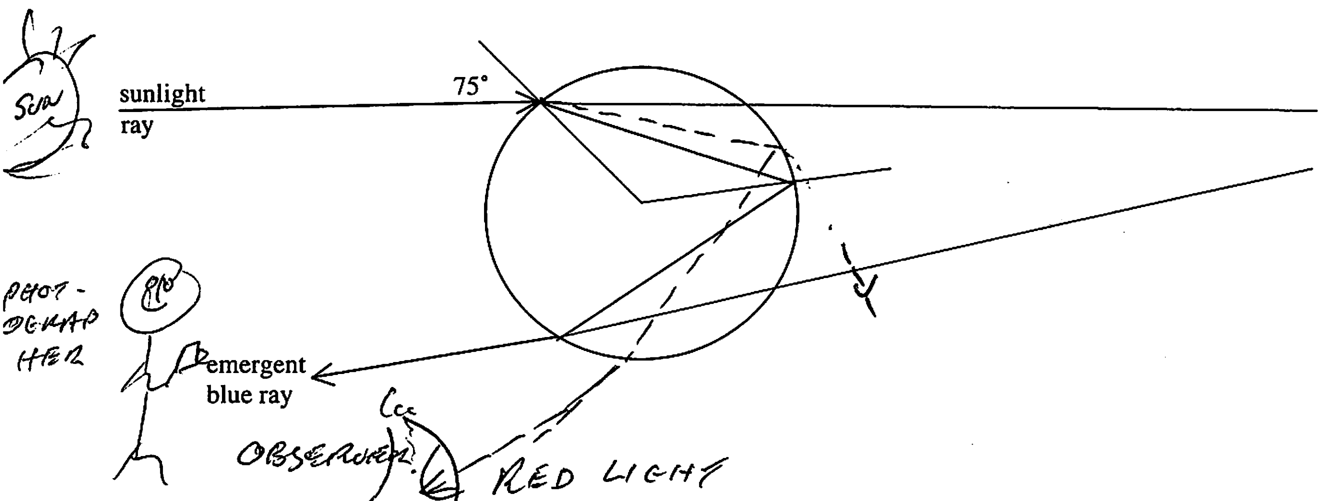
Question 17 (a) (continued)

(iii) Internal reflection occurs as the light ray strikes the far side of the raindrop, but is this internal reflection total? Justify your answer. (2 marks)

i on back face is $46.1^\circ < 48.3^\circ = i_c$

$\Rightarrow$ Total internal reflection does not occur

(b) Red light has a refractive index of 1.32. Sketch carefully the expected path, after first striking the drop, of the ray of red light compared to the shown path of the blue ray. (2 marks)



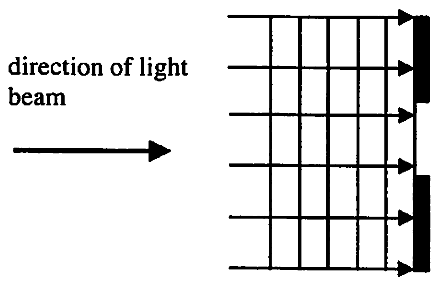
(c) Why is it not possible to take a single photographic image of a rainbow and the sun? (1 mark)

To observe a rainbow the sun must be behind you as shown above.

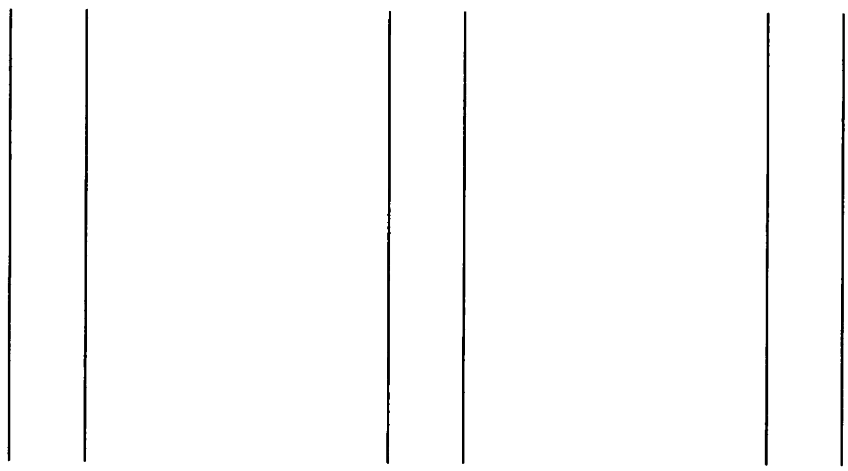
/9

SPARE DIAGRAMS

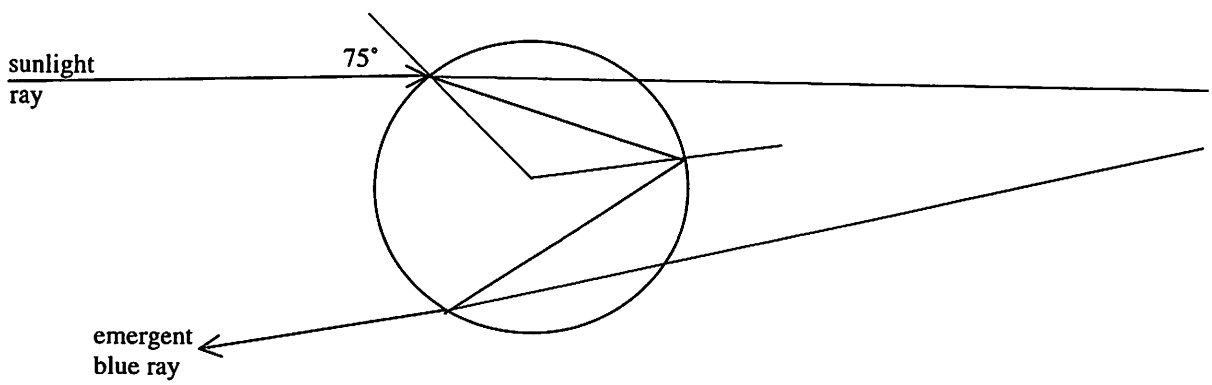
Question 13 (a)



Question 14 (a)



Question 17 (b)



For Marker Use Only

Question 18

(a) Calculate the minimum wavelength of X-rays from a Coolidge tube producing 175 keV electrons. (2 marks)

$\lambda_{MIN} = \frac{hc}{E_{MAX}} = \frac{4.14 \times 10^{-15} \times 3 \times 10^{8}}{1.75 \times 10^{5}}$

$= 7.10 \times 10^{-12}$ m

The spectrum from a typical Coolidge X-ray tube has two distinct features:

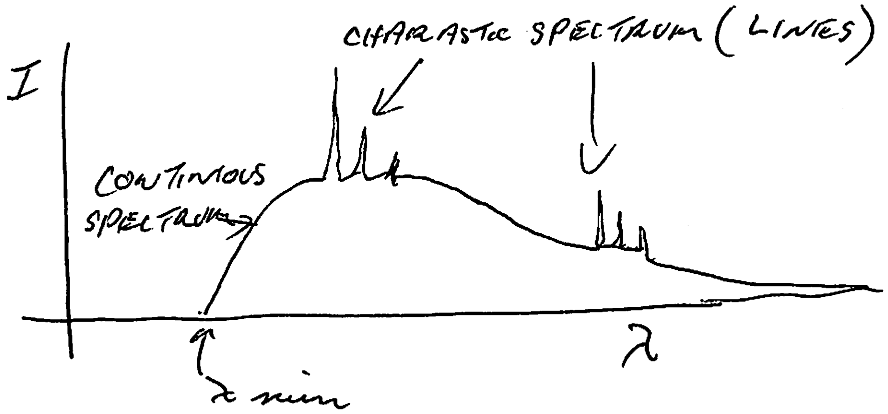
- continuous spectrum
- characteristic spectrum

(b) Explain, briefly, the origins of each of these parts of the spectrum: (3 marks)

(i) continuous random de-acceleration of electrons in metal lattice so all f's produced. "Bremsstrahlung radiation"

(ii) characteristic Inner electrons of target atoms are knocked out and then outer electrons 'ripple' down producing characteristic spectral lines.

(c) Sketch a typical Intensity (I) ~ wavelength (λ) spectrum for an X-ray tube, labelling **all** important features. (2 marks)



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For Marker Use Only

Question 19

The electron in the hydrogen atom can have different energies, depending on the quantum number of the orbital occupied by the electron. The following table shows the energies of the electron in the first five orbitals.

Orbital Quantum Number (n)	1	2	3	4	5
Orbital Energy (10^{-19} J)	–21.78	–5.45	–2.42	–1.36	–0.87

(a) An electron jumps from the n = 4 orbital to the n = 2 orbital

(i) What is the change in energy of the electron and has it lost or gained energy? (1 mark)

$\Delta E = (-5.45 - -1.36) \times 10^{-19}$

$= -4.09 \times 10^{-19}$ J

electron has lost energy

(ii) What is the wavelength of the photon emitted as the electron changes orbits? (2 marks)

$E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{4.09 \times 10^{-19}}$

$= 486$ n m

$= 4.86 \times 10^{-7}$ m

(iii) Where in the EM spectrum does the emitted radiation lie? (1 mark)

~~UV~~ VISIBLE (GREEN/BLUE)

(b) What is the minimum energy a photon needs, in electron volts, to ionise a hydrogen atom when the electron is in the n = 3 orbital? (2 marks)

From table above 2.42×10^{-19} J is required to IONISE H.

$= \frac{2.42 \times 10^{-19}}{1.6 \times 10^{-19}}$ eV

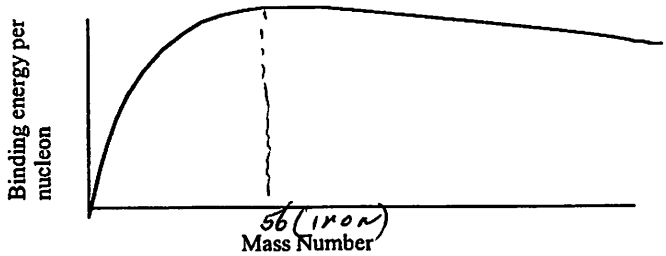
$= 1.51$ eV

/6

For Marker Use Only

Question 20

The graph below shows, in simplified form, the binding energy per nucleon as a function of mass number for different nuclides.



Use the graph to answer the following.

(a) Explain the difference between **nuclear fission** and **nuclear fusion**. (3 marks)

Binding energy is max at iron so splitting a large atom increases binding energy & thus releasing energy. This is called fission.
Combining light atoms also ~~do~~ increases binding energy & releases energy. This is called fusion.

(b) Explain why energy is released in these processes. (1 mark)

BINDING ENERGY ↑ so atoms more stable (lower energy) & thus energy is released.

/4

For Marker Use Only

Question 21

Nuclear fusion involves the combining of two low-mass nuclei to form a single nucleus, with energy being released.

The table below includes all masses that you will need to answer this question.

Isotope	Mass (amu)
$^{1}_{1}H$	1.007825
$^{2}_{1}H$	2.014102
$^{3}_{1}H$	3.016049
$^{3}_{2}He$	3.016029
$^{4}_{2}He$	4.002603
$^{1}_{0}n$	1.008665
$^{6}_{3}Li$	6.015123
$^{7}_{3}Li$	7.016003

Consider this fusion equation:

$$^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + ^{1}_{0}n + \Delta E$$

(a) Calculate the energy released per fusion (ΔE), in joules. (4 marks)

Δm = Mass of ~~products~~ reactants − mass of ~~reactants~~ products.

$= 2.014102 + 3.016049 - 4.002603 - 1.008665$

$= 0.01886$ amu

$\Delta E = 0.01886 \times 936 = 17.56$ MeV

$= 17.56 \times 1.6 \times 10^{-19} \times 10^{6}$

$= 2.81 \times 10^{-12}$ J

Question 21 continues.

Question 21 (continued)

For Marker Use Only

Deuterium is quite abundant, forming about one atom in 5000 of hydrogen in seawater. However, tritium is almost non-existent in the natural world, but can be produced from a variety of other nuclides.

One possible reaction producing tritium using the reasonably common lithium-7 is shown.

$$^{7}_{3}\text{Li} + ^{1}_{0}\text{n (fast)} \longrightarrow ^{3}_{1}\text{H} + ^{3}_{2}\text{X} + 2^{1}_{0}\text{n}$$

(b) Identify particle X. (1 mark)

$^{3}_{2}He$

(c) In Australia, the electrical energy consumption over a person's lifetime is expected to be about 3.4×10^{12} J.

Determine how many kilograms of lithium-7 would be needed to supply a person's lifetime electricity requirement using the two steps shown in the previous equations. (4 marks)

N^o of Li $= \frac{3.4 \times 10^{12}}{2.81 \times 10^{-12} J} = 1.21 \times 10^{24}$ atoms

$n(Li) = \frac{1.24 \times 10^{24}}{6.02 \times 10^{26}} = 2.06 \times 10^{-3}$ kg mol

$m(Li) = n \times M = 2.06 \times 10^{-3} \times 7$

$= 1.441 \times 10^{-2}$ kg

≈ 14 g

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Question 22

For Marker Use Only

The positron $\left({}^{0}_{+1}e\right)$ is the anti-particle of the electron.

In positron emission tomography (PET), a positron-emitter is attached to a particular molecule, which is then ingested by a patient. One widely used positron emitter is fluorine-18 $\left({}^{18}_{9}F\right)$ which decays by emitting a positron and an isotope of oxygen.

(a) Write a balanced equation for this decay, showing all products. (1 mark)

$^{18}_{9}F \rightarrow {}^{0}_{+1}e + {}^{18}_{8}O + \nu$

The rest energy of a positron and an electron are the same.

(b) Show that the value of this rest energy is approximately 0.5 MeV. (1 mark)

m(electron) = 0·000549 amu

~~&~~ 1 amu = 931 MeV → rest energy is 0·000549 × 931

= 0·511 MeV

(c) The positron emitted from the original decay quickly combines with an electron; they mutually annihilate producing a pair of identical photons.

(i) What is the energy of each photon produced? (1 mark)

0·511 MeV

(ii) Show that the wavelength of each photon is approximately 2.5×10^{-12} m. (1 mark)

$\lambda = \frac{hc}{E} = \frac{4.14\times10^{-15} \times 3\times10^{8}}{0.511\times10^{6}}$

$= 2.43\times10^{-12}$ m

Question 22 (c) continues.

For Marker Use Only

Question 22 (c) (continued)

(iii) Calculate the magnitude of the momentum of each photon. (1 mark)

$p = \frac{h}{\lambda} = \frac{6.63 \times 10^{-34}}{2.43 \times 10^{-12}} = 2.72 \times 10^{-22}$ Ns.

(iv) Explain **briefly** why the pair of photons produced will travel in opposite directions. (1 mark)

Assuming initial COMBINED momentum of positron and electron before annihilation is zero the overall $\vec{P}$ of two photons must also be zero. For this to be the case they must move in opposite directions.

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For Marker Use Only

Question 23

In medical diagnosis, PET scans often use Fluorine-18 (F-18). The F-18 can bond to a glucose molecule which goes to sites in the body of high metabolic activity. Since F-18 has a relatively short half-life, it is usually produced in the hospital where it is to be used.

The half-life of F-18 is 109.8 minutes.

(a) State **two** benefits in medical diagnosis of using a radioisotope with a half-life of about this magnitude. (2 marks)

(i) Lasts long enough to be absorbed in appropriate tissues ~~well~~

(ii) Patient not radioactive for a long period of time

(b) Determine the decay constant of F-18. (2 marks)

$\lambda = \frac{0.693}{t_{\frac{1}{2}}} = \frac{0.693}{109.8} = 0.00631 \text{ min}^{-1}$

$= 0.000105 \text{ sec}^{-1}$

(ii) Has a reasonably decay rate so detection is reasonably easy as count rate is suitably high.

Question 23 continues.

For Marker Use Only

Question 23 (continued)

(c) A patient is given a dose of glucose containing 0.102 ng of F-18.

(i) Show that the activity of this dose of F-18 is approximately 360 MBq. (2 marks)

$a = \lambda N = 0.000105 \times \frac{1.02 \times 10^{-13}}{18} \times 6.02 \times 10^{26}$

$= 3.58 \times 10^{8}$ Bq

$= 358$ MBq ($\simeq 360$ MBq)

(ii) The F-18 was produced 60 minutes before being administered to the patient.

Determine the mass of F-18 originally produced to provide the required 0.102 ng dose. (2 marks)

$m = m_0 e^{-\lambda t}$

$m_0 = m e^{\lambda t} = \cancel{1.102}\ 0.102\, e^{0.00631 \times 60}$

$= \cancel{1.49}$ ng

0.149 ng

TASMANIAN QUALIFICATIONS AUTHORITY

PHY315114 Physics

ASSESSMENT PANEL REPORT

Award Distribution

	EA	HA	CA	SA	Total
This year	17% (48)	22% (62)	25% (72)	36% (102)	284
Last year	18% (50)	21% (59)	21% (59)	40% (110)	278
Last year (all examined subjects)	10 %	19 %	39 %	32 %	
Previous 5 years	21 %	24 %	23 %	31 %	
Previous 5 years (all examined subjects)	11 %	19 %	39 %	30 %	

Student Distribution (SA or better)

	Male	Female	Year 11	Year 12
This year	81% (231)	19% (53)	0% (1)	100% (283)
Last year	80% (223)	20% (55)	1% (3)	99% (275)
Previous 5 years	78%	22%	1%	99%