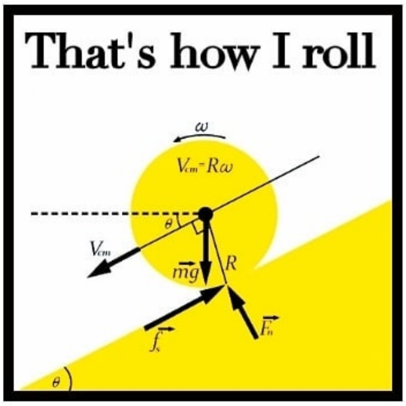
SWINBURNE
SENIOR SECONDARY COLLEGE

Physics
HOLIDAY HOMEWORK
Year 12, 2021



Teacher(s)/Subject Coordinator:	osman.sevgi@sssc.vic.edu.au
Work required in preparation for start of 2020:	Activity 1: Watch the following clip on scientific notation https://www.youtube.com/watch?v=WwmJ5nMmigQ and write down your personal 5 key points Activity 2: Complete the motion exam questions attached Activity 3: Attempt diagnostic test on fields according to the instructions
Textbooks and other resources:	Checkpoints Physics 3&4 Edrolo Textbook Scientific Calculator
Key Links:	https://www.vcaa.vic.edu.au/Pages/vce/studies/physics/exams.aspx https://www.vcaa.vic.edu.au/Documents/vce/physics/PhysicsSD-2016.pdf
Due date:	Friday 5th of February 2021

2020 PHYSICS UNITS 3&4
COURSE OUTLINE

OBJECTIVES

These units are designed to enable students to

- Explore the importance of energy in explaining and describing the physical world
- Explore the use of wave and particle theories to model the properties of light and matter
- Conduct an investigation involving at least two continuous independent variables

UNIT 3

AREA OF STUDY 1
How do things move without contact?
Students study the similarities and differences between gravitational, electric and magnetic fields.

AREA OF STUDY 2
How are fields used to move electrical energy?
Students study how electrical energy is produced and distributed.

AREA OF STUDY 3
How fast can things go?
Students study when to use Newton's laws of motion and when to use Einstein's laws of motion
Students explore the relationships between force, energy and mass

UNIT 3 ASSESSMENT

Outcomes

Students are required to demonstrate achievement of **three** outcomes.

Outcome 1

Students should be able to analyse gravitational, electric and magnetic fields, and use these to explain the operation of motors, particle accelerators and the orbits of satellites.

Outcome 2
Students should able to analyse and evaluate an electricity generation and distribution system.

Outcome 3
Students should be able to investigate motion and energy related energy transformations experimentally, analyse motion using Newton's laws, explain the motion of objects moving at very high speeds using Einstein's theory of special relativity.

ASSESSMENT TASKS (SACs)
Demonstration of the achievement of these outcomes will be based on the student's performance on a selection of **assessment tasks.** These tasks will take the form of:

Outcome 1

SAC #1
30 marks March

Outcome 2

SAC #2
30 marks Early May

Outcome 3

SAC #3
30 marks Late May

Total marks = 90 which will contribute approx **20%** to the final assessment

UNIT 4

AREA OF STUDY 1
How can waves explain the behaviour of light?
Students use evidence from experiments to explore wave concepts in a variety of applications.

AREA OF STUDY 2
How are light and matter similar?
Students explore the design of major experiments that have lead to the development of theories of ligt and matter.

AREA OF STUDY 3
Practical Investigation
Students design, conduct and report on (via a scientific poster) a practical investigation.

UNIT 4 ASSESSMENT

Outcomes

Students are required to demonstrate achievement of **three** outcomes.

Outcome 1
Students should be able to apply wave concepts to analyse, interpret and explain the behaviour of light.

Outcome 2
Students should be able to provide evidence for the nature of light and matter, and analyse the data from experiments that supports this evidence.

Outcome 3
Students should be able to design and undertake a practical investigation related to waves or fields or motion and present methodologies, findings and conclusions in a scientific poster.

ASSESSMENT TASKS (SACs)
Demonstration of the achievement of these outcomes will be based on the student's performance on a selection of **assessment tasks** (school assessed coursework). These tasks will take the form of:

Outcome 1

SAC #1 A test: answers to a range of qualitative and quantitative questions on the behaviour of light.

30 marks Early August

Outcome 2

SAC #2 Analysis of data from a number of experiments and a range of qualitative and quantitative questions on interactions of light and matter.
30 marks Late August

Outcome 3

SAC #3 A structured scientific poster that presents the methodologies, findings and conclusions of a student designed and conducted practical investigation.
35 marks September

Total marks = 95 which will contribute approx **20%** to the final assessment.

EXAMINATION
There will be an 2.5 hour end of year examination contributing **60%** to the final assessment.
(20 + 20 + 60 = 100)

Activity 1

Watch the video https://www.youtube.com/watch?v=WwmJ5nMmigQ and write down your 5 key points in the space below.

Point 1

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Point 2

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Point 3

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Point 4

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Point 5

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Activity 2

Use your understanding/ notes from Year 11 to answer the following questions from previous exams.

1

Block A, of mass 4.0 kg, is moving to the right at a speed of 8.0 m s^{-1}, as shown in Figure 1. It collides with a stationary block, B, of mass 8.0 kg, and rebounds to the left. Its speed after the collision is 2.0 m s^{-1}.

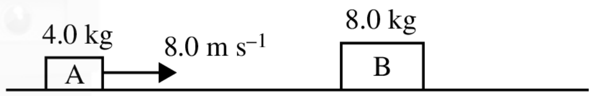


Figure 1

a. Calculate the speed of block B after the collision. 2 marks

m s^{-1}

b. Explain whether the collision is elastic or inelastic. Include some calculations in your answer. 2 marks

c. What are the magnitude, unit and direction of the impulse by block B on block A? 3 marks

Magnitude	Unit	Direction

Figure 3 shows an experiment in which a frictionless trolley, m_1, of mass 2.0 kg, moving to the right at 6.0 m s^{-1}, collides with and sticks to an initially stationary trolley, m_2, of mass 4.0 kg and also frictionless.

Figure 3

a. Calculate the magnitude of the total momentum of the two trolleys when they stick together after the collision. 1 mark

kg m s^{-1}

b. Determine, by using calculations, whether this collision is elastic or inelastic. 2 marks

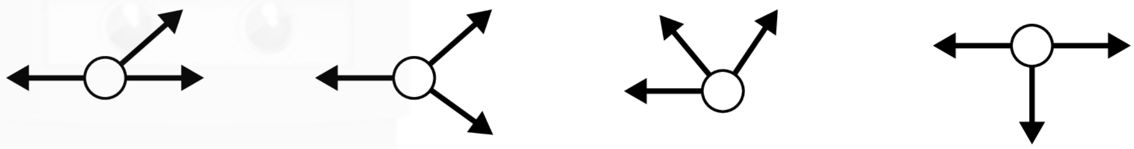
c. Calculate the magnitude and direction of the impulse exerted **on** m_1 **by** m_2 during the collision. 2 marks

N s

direction

A metal ring is to be held stationary by three forces that are all pulling on the ring. All the forces are greater than zero, but their magnitudes are not given. Possible directions of the forces on the ring are shown in the arrangements in Figure 5. Only one of these arrangements can hold the ring stationary.

A. **B.** **C.** **D.**



Not to scale

Figure 5

Identify which one of the arrangements (**A.–D.**) shown in Figure 5 could hold the metal ring stationary and explain the reasons for your answer.

2 marks

Three children's toy blocks, A (0.050 kg), B (0.10 kg) and C (0.20 kg), are sitting on a table as shown in Figure 3.

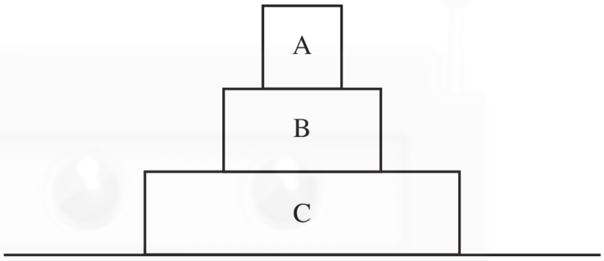


Figure 3

Question 7

What is the force by block C on block B?

Explain your answer in terms of Newton's laws.

N

2 marks

5

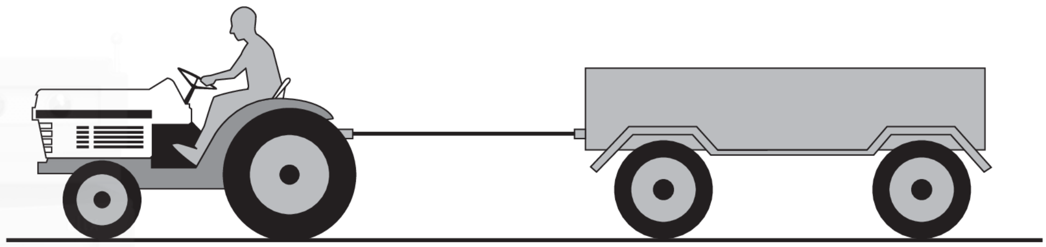


Figure 1

A tractor, including the driver, has a mass of 500 kg and is towing a trailer of mass 2000 kg as shown in Figure 1.

The tractor and trailer are accelerating at 0.50 m s^{-2}.

Ignore any retarding friction forces. Ignore the mass of the towing rope.

The tractor and trailer start from rest.

How far does the tractor move in the first 5.0 s?

m

2 marks

6

Fred is riding his sled on snow. Fred and the sled have a total mass of 60 kg. He travels downhill from A to B. The sled starts from rest.

A is a vertical height of 12.8 m above B. At B he then travels along a horizontal snowfield to point C. From A to C (on snow) there is no friction force.

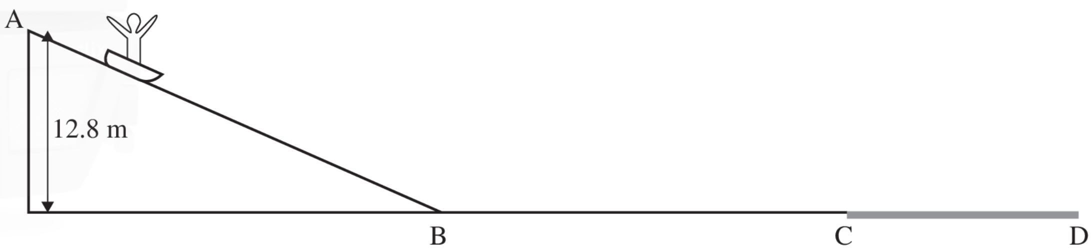


Figure 6

At point C he runs off snow onto grass where there is now a (constant) friction force and he slows to a stop at D after a time of 6.0 s.

What is the magnitude of the friction force as he travels from point C to point D?

N

2 marks

7

A small locomotive is used in a railway yard to arrange rail trucks on trains. The locomotive has a mass of 40 tonnes (40 000 kg).

In one situation, the locomotive is pulling two trucks, each of mass 10 tonnes, as shown in Figure 1.

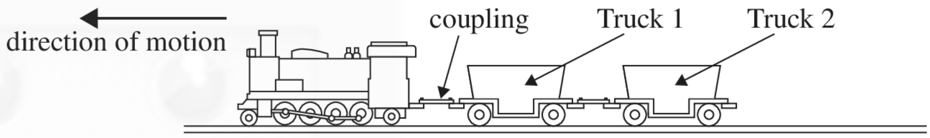


Figure 1

They start from rest and accelerate at 0.20 m s^{-2} for 5 s.

a. Calculate the distance travelled after 5 s. 2 marks

m

b. Calculate the tension in the coupling between the locomotive and Truck 1 as they accelerate. 2 marks

N

DO NOT WRITE IN THIS AREA

In another situation, the locomotive is moving at a constant 4.0 m s^{-1} when it collides with four stationary trucks, each with a mass of 10 tonnes. They couple together and then move off together, as shown in Figure 2.

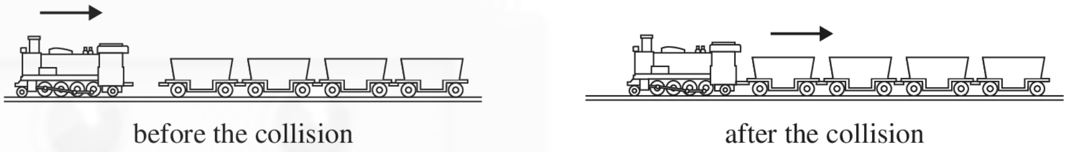


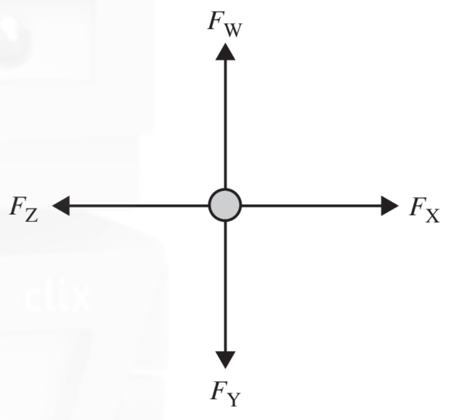
Figure 2

c. Calculate the speed of the combined locomotive and trucks immediately after the collision. 2 marks

m s^{-1}

d. Is the collision between the locomotive and the trucks elastic or inelastic? Justify your answer by calculation. 3 marks

Four students are pulling on ropes in a four-person tug of war. The relative sizes of the forces acting on the various ropes are $F_W = 200$ N, $F_X = 240$ N, $F_Y = 180$ N and $F_Z = 210$ N. The situation is shown in the diagram below.



Which one of the following **best** gives the magnitude of the resultant force acting at the centre of the tug-of-war ropes?

A. 28.3 N

B. 30.0 N

C. 36.1 N

D. 50.0 N

Activity 3

Instructions

Complete the following two diagnostic tests on fields. Start by answering all that you can with just your formula sheet and calculator. Then research the questions you could not answer on the internet and answer them **using a different coloured pen.**

Neap:

PHYSICS VCE UNITS 3&4
DIAGNOSTIC TOPIC TESTS 2017

TEST 1: HOW DO THINGS MOVE WITHOUT CONTACT? (I)

TOTAL 45 MARKS (45 MINUTES)

Student's Name: ___________________________ Teacher's Name: ___________________________

Directions to students

Write your name and your teacher's name in the spaces provided above.
Answer all questions in the spaces provided.

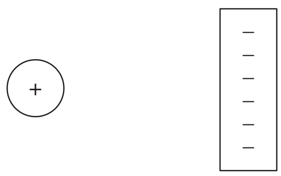
Use $k = 9.0 \times 10^{9}$ N m^{2} C^{-2}, $q_e = 1.6 \times 10^{-19}$ C and $m_e = 9.11 \times 10^{-31}$ kg.

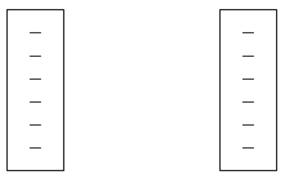
Question 1 (8 marks)

Draw eight electric field lines between each of the charged points or planes.

a.  2 marks

b.  2 marks

c.  2 marks

d.  2 marks

Question 2 (12 marks)

Draw eight magnetic field lines for each of the diagrams below. Arrows in wires show the direction of the positive current.

a.

2 marks

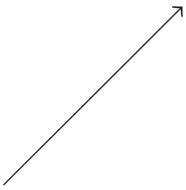
b.

3 marks

c.

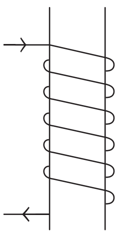
3 marks

d.



2 marks

e.



2 marks

Question 3 (4 marks)

Figure 1 shows the electric field around a point charge. A dashed line AB is shown cutting across the electric field.

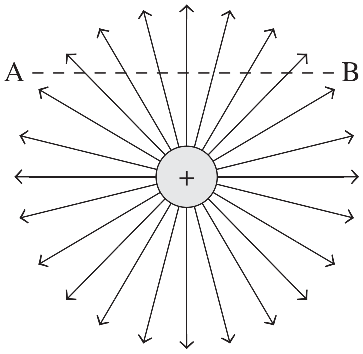


Figure 1

Complete the following sentences by circling the correct option from the choice of three that is given within each set of brackets.

a. As an electric field probe is passed from A to B along the line AB, the electric field direction is **zero** / **static** / **changing** and the magnitude of the electric field is **zero** / **static** / **changing**. 2 marks

b. As an electric field probe is passed from the centre radially outwards, the electric field direction is **constant** / **changing** and the magnitude of the electric field is **zero** / **constant** / **increasing** / **decreasing**. 2 marks

Question 4 (4 marks)

Two electrons are a distance of 1.0×10^{-10} m apart.

a. Determine the electric field strength at the position of one electron due to the other. 2 marks

N C^{-1}

b. Determine the magnitude of the electric force between the electrons. 2 marks

N

Question 5 (6 marks)

The potential difference between two plates of distance 2.0 cm is 12.0 V.

a. Determine the electric field strength between the two plates. 2 marks

N C^{-1}

b. Determine the electric force acting on an electron passing in the region of the electric field. 2 marks

N

c. Determine the work done on an electron if it travels from the negative plate to the positive plate. 2 marks

J

Question 6 (11 marks)

An electron is fired into a region of magnetic field, as shown in Figure 2.

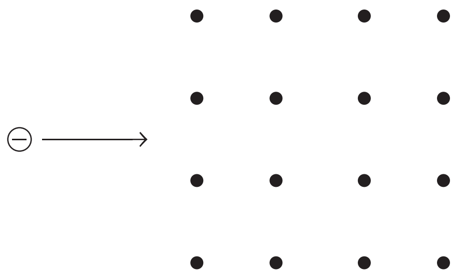


Figure 2

a. Sketch the path of the electron through the magnetic field in Figure 2 and identify the direction of the force at any point chosen by you along the path you sketch. 2 marks

b. If the electron travels at 2.0×10^6 m s^{-1} and the magnitude of the magnetic field is 0.50 T, determine the size of the force acting on the electron. 2 marks

N

c. Determine the radius of the path followed by the electron. 3 marks

m

d. Explain how the answers to parts **a.**, **b.** and **c.** would vary if the electron had been fired parallel with one of the magnetic field lines in Figure 2. 4 marks

Neap:

PHYSICS VCE UNITS 3&4
DIAGNOSTIC TOPIC TESTS 2017

TEST 2: HOW DO THINGS MOVE WITHOUT CONTACT? (II)

TOTAL 45 MARKS (45 MINUTES)

Student's Name: ____________________ Teacher's Name: ____________________

Directions to students

Write your name and your teacher's name in the spaces provided above. Answer all questions in the spaces provided.

Question 1 (11 marks)

For this question

- mass of the Earth = 5.98×10^{24} kg
- mass of the International Space Station = 4.20×10^{5} kg
- Universal Gravitational Constant = 6.67×10^{-11} SI units
- radius of the Earth = 6.38×10^{6} m.

The International Space Station is in a circular orbit at an altitude of 400 km above the surface of the Earth.

a. Determine the radius of the orbit of the International Space Station. 1 mark

m

b. Determine the gravitational field strength of the Earth at the position of the International Space Station in its orbit. 2 marks

N kg^{-1}

c. Determine the weight of the International Space Station at its position in orbit about the Earth. 2 marks

N

d. Determine the period of the International Space Station in its orbit in minutes. 3 marks

min

e. Astronauts in the International Space Station float as they live and work. They experience weightlessness during their time in the craft.

Explain why they are weightless during this time. In your answer make reference to the terms **weight** and **normal reaction**. 3 marks

Question 2 (8 marks)

Figure 1 shows two coils of uniformly wound wire. Both coils have the same positive DC current passing through them. Point A is a point midway between the two coils.

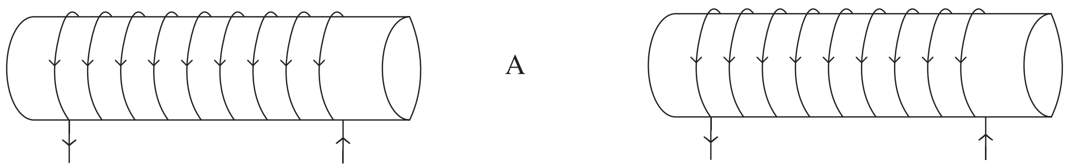


Figure 1

a. Draw the resulting magnetic field vector at point A. 1 mark

b. Explain how you arrived at your answer to part **a.** 3 marks

c. Explain the effect on your answer to part **a.** if one of the coils is rotated through 180°. 2 marks

d. Explain the effect on your answer to part **a.** if the current in one of the coils is decreased. 2 marks

Question 3 (4 marks)

Two negative charges, –Q and –2Q, are distances r and $2r$ from point X, as shown in Figure 2.

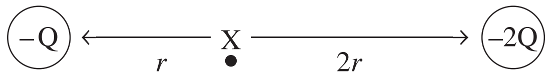


Figure 2

a. Show the direction of the resultant electric field at point X. 1 mark

b. Explain what happens to the magnitude and direction of the resultant field if the charge –Q is now placed at a distance $4r$ from point X. Show your working. 3 marks

Question 4 (3 marks)

A bundle of five 50 cm long wires are each carrying 2.0 A of DC current to the right in a uniform magnetic field of strength 9.0×10^{-2} T, as shown in Figure 3.

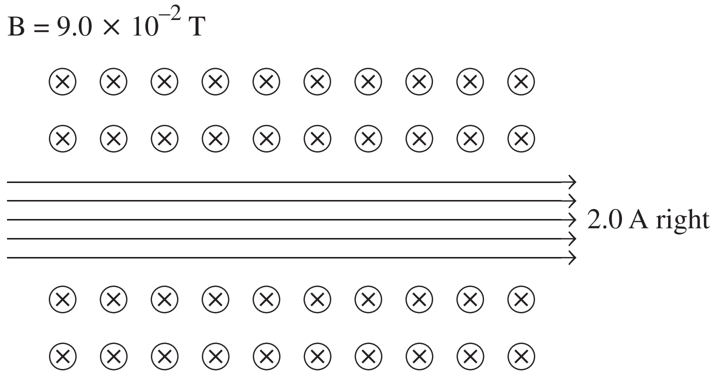


Figure 3

Calculate the magnitude of the magnetic force acting on the bundle of five wires carrying the current and determine the direction of the force.

N	direction

Question 5 (12 marks)

Figure 4 shows a schematic diagram for a simple DC motor. The coil is connected to a battery via a commutator and a switch.

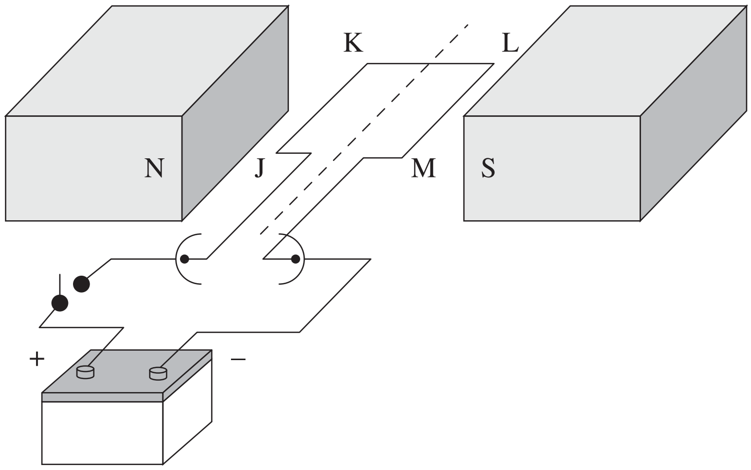


Figure 4

a. When the switch is closed, explain whether the coil turns clockwise or anticlockwise as seen from the front of the motor (near the battery). 3 marks

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b. Explain how the commutator works and therefore its importance. 3 marks

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c. State two simple ways in which the motor could be made to turn in the opposite direction. 2 marks

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The DC motor has 500 turns of wire, the current is 400 mA and the magnetic field is 0.50 T. The length of JK is 0.20 m and the length of KL is 0.05 m.

d. Calculate the magnitude of the force acting on the JK arm of the DC motor for the position of the coil shown in Figure 4. 2 marks

	N

e. Calculate the magnitude of the force acting on the KL arm of the DC motor for the position shown in Figure 4. 2 marks

	N

Question 6 (4 marks)

The linear accelerator SLAC can accelerate individual electrons to an energy of 8.0×10^{-9} J.

a. Determine the potential difference in V needed to achieve this energy. 2 marks

V

b. Determine the electric field strength in the chamber of the SLAC if it is 3.2 km long. 2 marks

$V\ m^{-1}$

Question 7 (3 marks)

Figure 5 shows a magnetic component section of a synchrotron particle accelerator. The electron beam curves inwards as a result of the magnetic field as shown.

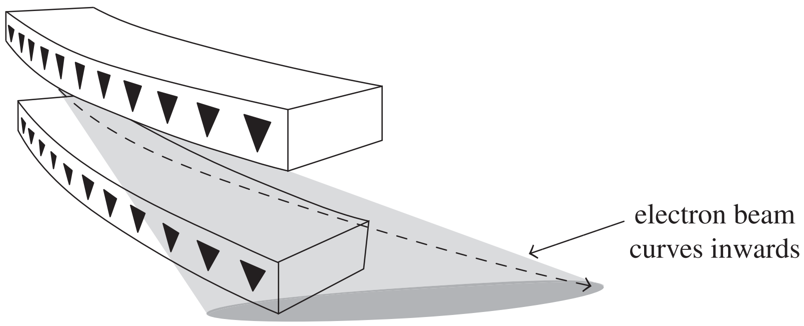

Figure 5

a. On Figure 5, show the direction of the magnetic field where the electron beam is. 1 mark

b. Explain how you arrived at your answer to part **a.** 2 marks

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