CSE CENTRE FOR STRATEGIC EDUCATION
Leading educational thinking and practice

IARTV

STUDENT:	TEACHER:

YEAR 12
CSE TEST: MAY 2010
PHYSICS
Written test 1

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions To be answered*	*Number of marks*
A – Core – Areas of study			
1. Motion in one and two dimensions	20	20	38
2. Electronics and photonics	14	14	26
B – Detailed studies			
1. Einstein's special relativity	13	13	26
OR			
2. Investigating materials and their use in structures	13	13	26
OR			
3. Further electronics	13	13	26
			Total 90

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, up to two pages (one A4 sheet) of pre-written notes (typed or handwritten) and one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 39 pages. The question and answer book has a detachable formula sheet and answer sheet for Section B multiple-choice questions as centrefolds.

Instructions

- Detach the multiple-choice answer sheet and then the formula sheet from the centre of this book during reading time.
- Write your **name** and **teacher's name** in the spaces provided above on this page.
- Write your name in the space on your answer sheet for multiple-choice questions.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses must be in English.

At the end of the examination

- Place the answer sheet for the multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – Areas of study

Instructions for Section A

Answer **all** questions for **both** Areas of study in this section in the spaces provided.
Where an answer box has a unit printed in it, give your answer in that unit.
You should take the value of g to be 10 N kg^{-1}.
Where answer boxes are provided write your final answer in the box.
In questions worth more than one mark, appropriate working should be shown.

Consider the circuit shown in Figure 9.

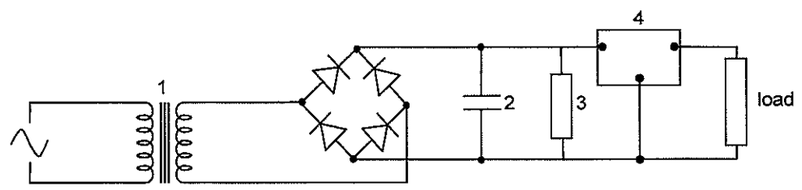


Figure 9

Question 13
Which one of the components, labelled 1 to 4 in Figure 9, would normally require a heat sink?

A. 1
B. 2
C. 3
D. 4

END OF QUESTION AND ANSWER BOOK

The following information relates to Questions 11 and 12.

A varying DC voltage V is applied to two circuits. The voltage has a ripple which varies from a minimum value of 5.8 V to a maximum value of 6.2 V with a period of 20 ms. The circuit in Figure 7 uses a 5.0 V zener diode as a voltage regulator while the circuit in Figure 8 uses a 5.0 V 7805 IC voltage regulator. Both circuits contain the same load resistor.

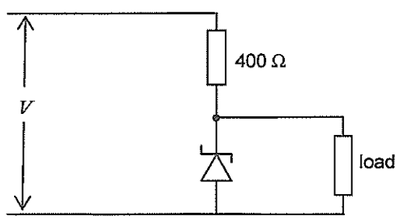


Figure 7

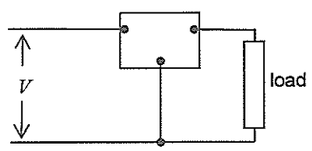


Figure 8

At one instant, for the circuit shown in Figure 7, $V = 6.2$ V and the current in the zener diode is 2.0 mA.

Question 11

At this time which of the following is the best value for the current in the load resistor?

A. 16 mA
B. 8.0 mA
C. 2.0 mA
D. 1.0 mA

At another instant, for the circuit shown in Figure 8, $V = 5.8$ V.

Question 12

At this instant the current in the load resistor, shown in Figure 8, is

A. greater than in Question 11.
B. the same as in Question 11.
C. less than in Question 11.
D. not able to be determined because the value of V varies over time.

Area of study 1 – Motion in one and two dimensions

The following information relates to Questions 1–4.

Sam decides to take part in the annual *Walk against Want* on his unicycle (Figure 1). Sam has a mass of 77 kg and his unicycle a mass of 3 kg.

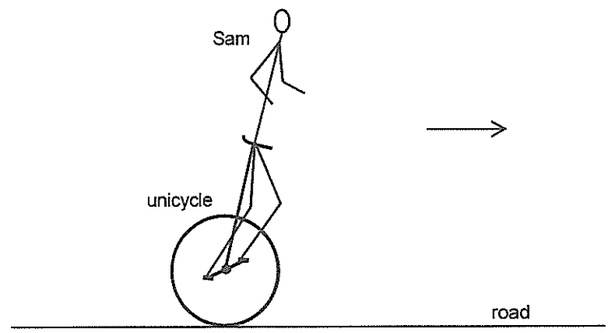


Figure 1

Figure 2 shows a graph (slightly idealised) of his speed against time as he moves off at the start in a straight line.

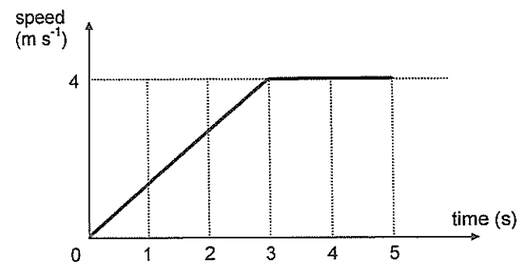


Figure 2

Question 1

What is the magnitude of Sam's acceleration 2.0 s after he starts moving?

m s^{-2}

2 marks

Question 2
What is the magnitude of the net force acting on Sam **4.0 s** after he starts?

N

1 mark

In Figure 3 Sam's weight is represented by an arrow.

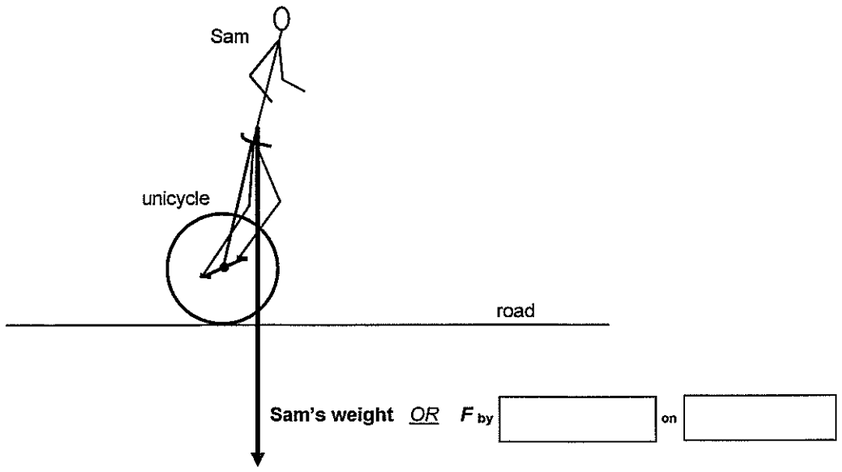


Figure 3

Question 3
Show another way of expressing this force by filling in the boxes in Figure 3.

1 mark

The secondary voltage $V_{secondary}$ (Figure 5) has a period of 10 ms and a peak value of 9.0 V and each of the 4 diodes has a switch-on voltage of 0.70 V.

Question 7
Which statement best describes the output voltage V_{output}?

A. The peak value is 7.6 V and the frequency is 100 Hz
B. The peak value is 9.0 V and the frequency is 100 Hz
C. The peak value is 7.6 V and the frequency is 200 Hz
D. The peak value is 9.0 V and the frequency is 200 Hz

Question 8
Which of the following values best gives the approximate size of the ripple voltage of V_{output} of the power supply?

A. 0 V
B. 2.5 V
C. 5.0 V
D. 7.5 V

Question 9
Which one of the following changes to the circuit shown in Figure 5 would result in a smaller ripple voltage?

A. Increase the period of the primary voltage, $V_{primary}$.
B. Replace the 4-way bridge rectifier with a single diode.
C. Decrease the resistance of the resistor.
D. Increase the capacitance of the capacitor.

At one instant, the direction of current is from X to Y as shown in Figure 6.

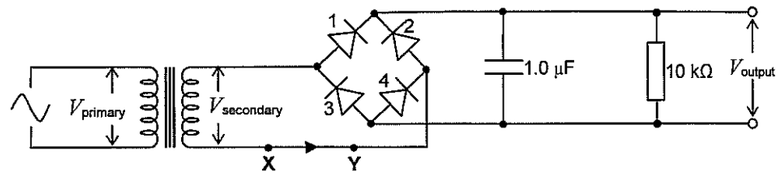


Figure 6

Question 10
At this same instant which statement is correct?

A. Diodes 2 and 3 are conducting.
B. Diodes 1 and 4 are conducting.
C. Diodes 2 and 4 are conducting.
D. Diodes 1 and 3 are conducting.

This additional information relates to Question 6.

Before testing the circuit shown in Figure 2, Melinda removes the 50 μF capacitor and connects a CRO across the output. The resulting circuit is shown in Figure 4.

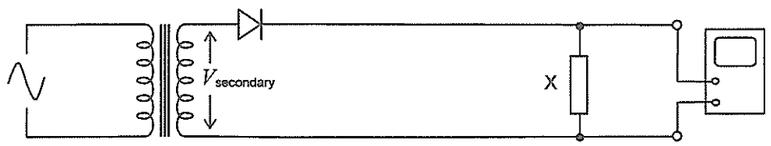
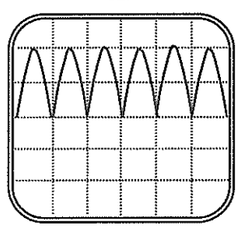


Figure 4

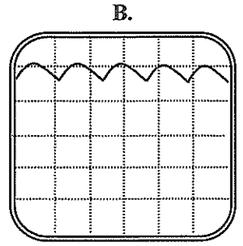
Question 6

Which one of the following diagrams best displays the trace that would be seen on the CRO?

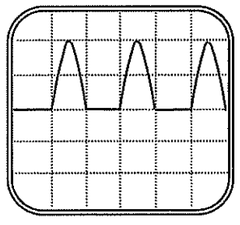
A.



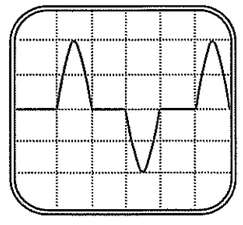
B.



C.



D.



This additional information relates to Questions 7-10.

Daniel, a friend of Melinda, suggests replacing the single diode in the Figure 2 circuit with a 4-way diode bridge rectifier to provide a better power supply. The modified circuit is shown in Figure 5.

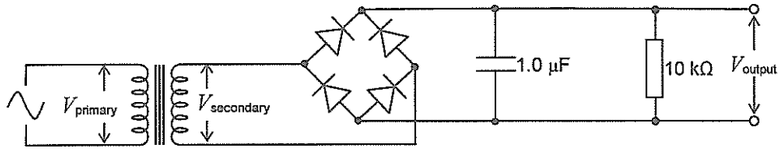


Figure 5

In Figure 4 an arrow has been added to represent the **total** force the road exerts on Sam and his unicycle while he is accelerating.

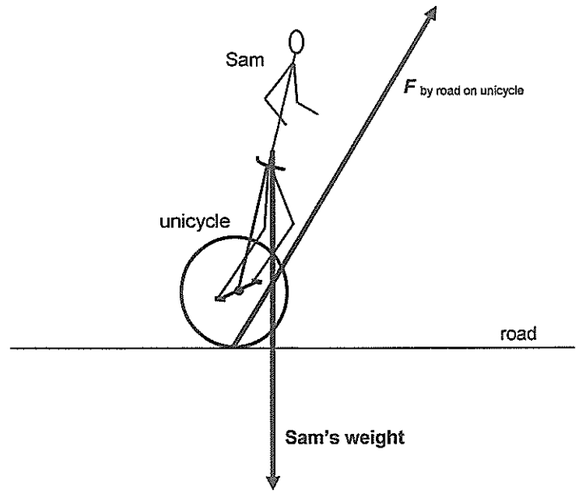


Figure 4

Question 4

Explain why this arrow is directed **forward** rather than being **vertical**.

2 marks

The following additional information relates to Questions 5–7.

On his way home Sam rides his unicycle around a curved skateboard track shown in Figures 5 and 6, which are not drawn to the same scale.
The curve has a radius of 5.1 m and the surface is banked at an angle θ to the horizontal.
When Sam rides at a constant speed of 4.0 m s^{-1}, the tyre of his unicycle experiences no sideways force from the surface of the track up or down the banked slope.

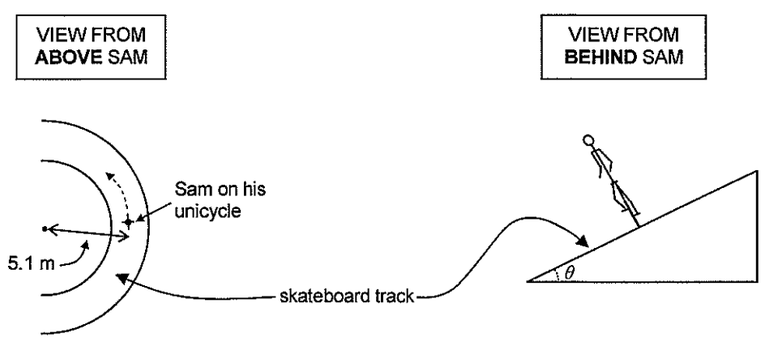


Figure 5

Figure 6

Question 5
Determine the magnitude of the total net force acting on Sam and his unicycle.

N

2 marks

Question 6
On Figure 6 draw an arrow to show the direction of this total net force on Sam and his unicycle.

1 mark

The following information relates to Questions 4 and 5.

Melinda is constructing a power supply and decides to use a single diode as part of the circuit. The circuit is shown in Figure 2.

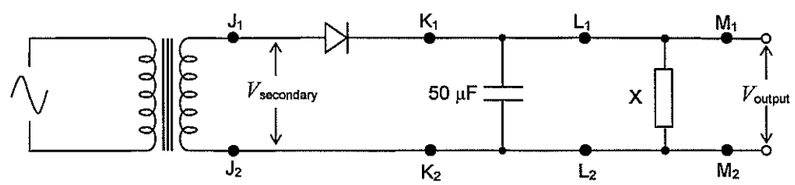


Figure 2

Question 4
The purpose of the diode is to:

A. regulate the output voltage V_{output}
B. smooth the output voltage V_{output}
C. reduce the size of the secondary peak voltage $V_{secondary}$
D. rectify the output voltage V_{output}

Into the circuit in Figure 2 a CRO could be connected at possible locations J (i.e. between J_1 and J_2), K, L and M.

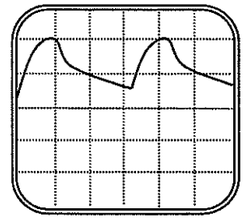


Figure 3

Question 5
Which statement correctly identifies possible locations J, K, L and M for the CRO to generate the screen display shown in Figure 3?

A. Any of locations K, L or M but not J
B. Only location M but not J, K or L
C. Any of locations L or M but not J or K
D. Any of locations K or L but not J or M

Detailed Study 3 – Further electronics

A 20:1 step-down transformer is used to supply power to a laptop computer using an RMS voltage of 110 V applied to the primary side of the transformer.

Question 1
The peak-to-peak voltage across the secondary side of the transformer is:

A. 15.6 V
B. 5.5 V
C. 11.0 V
D. 7.77 V

The circuit shown in Figure 1 is used to charge a capacitor X. When the switch is closed, it takes 2.7 s to charge the capacitor to 63% of its fully charged state.

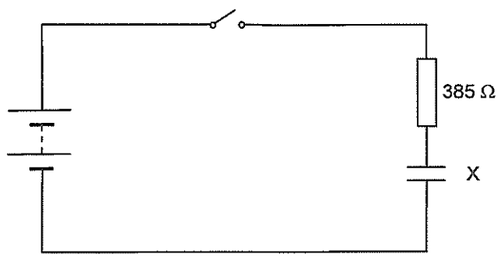


Figure 1

Question 2
The capacitance of the capacitor X is:

A. 70 mF
B. 7.0 mF
C. 142 mF
D. 35 mF

Donna wishes to find the value of the RMS voltage across a light globe powered by a 50 Hz AC power supply.

Question 3
The best instrument to use would be

A. a CRO
B. an AC analogue ammeter
C. a digital multimeter set to AC voltage mode
D. a digital multimeter set to DC voltage mode

Question 7
Calculate the size of the angle θ at which the track is inclined to the horizontal. See Figure 6.
Give your answer to the nearest degree.

degree

2 marks

Question 8
In the bumper bars of modern cars steel has been replaced by softer materials that crumple. Explain why.

3 marks

The following information relates to Questions 9–11.

In a motocross event Derwen leaves a horizontal section of the track on his Kawasaki KLR650 at point P as shown in Figure 7 and becomes airborne.

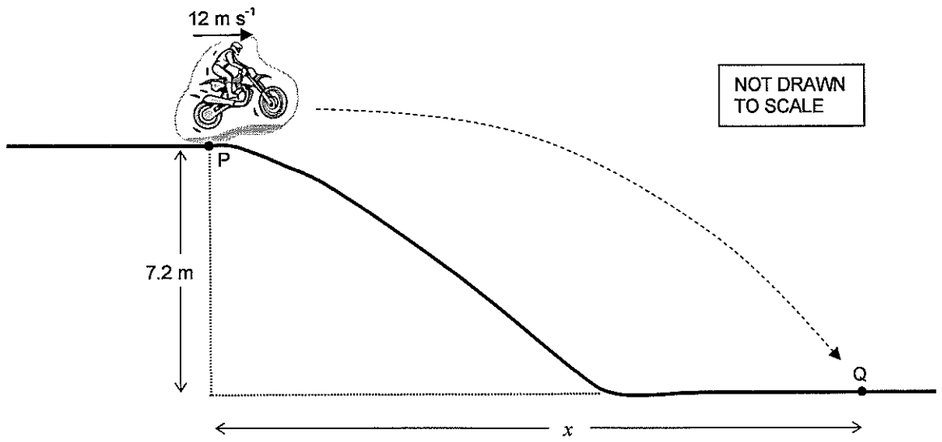


Figure 7

He leaves point P at a horizontal velocity of 12 m s^{-1} and hits the ground at point Q on the lower section 7.2 m below the upper section.

In **Questions 9 and 10** you can assume that air resistance is negligible.

Question 9

What time elapses while Derwen is travelling between P and Q?

s

2 marks

Question 10

While in flight what horizontal distance x does he travel?

m

2 marks

The following information relates to Questions 12 and 13.

Figure 6 shows the stress-strain graph for a material being **loaded** under a tensile force (indicated by square ■ points) and then **unloaded** (indicated by dot ● points). The original object was 3.0000 m long.

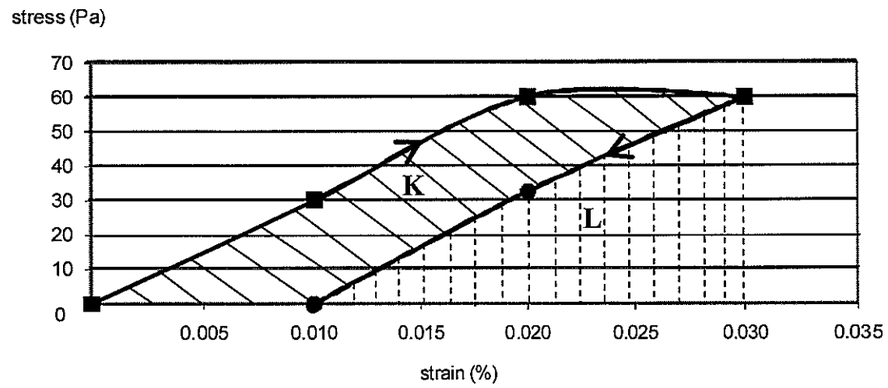


Figure 6

Question 12

Determine the final length of the material after it was unloaded.

A. 3.0001 m
B. 3.0003 m
C. 3.0100 m
D. 3.0300 m

Question 13

Which area of the graph best indicates the energy per unit volume lost as heat during this process?

A. K
B. L
C. K + L
D. K – L

END OF DETAILED STUDY 2

Question 8
Which of the following is **NOT** true for particular composite materials?

A. Steel has been included to add tensile strength to concrete.
B. Straw and grasses have been included to add tensile strength to mud bricks.
C. In steel-reinforced concrete beams the concrete adds tensile strength.
D. Carbon fibre adds tensile strength to the plastic used in tennis racquet frames.

The following information relates to Questions 9–11.

Figure 5 shows the stress-strain graphs for four materials, α, β, γ and δ with the point of fracture indicated by an asterisk (*) for each.

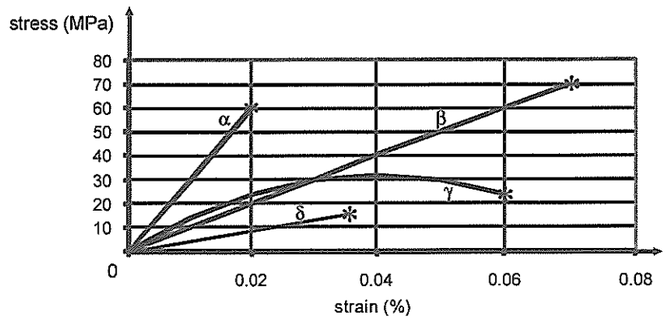


Figure 5

Question 9
Which of the four materials would be considered to be the most brittle?

A. α
B. β
C. γ
D. δ

Question 10
Which of the four materials would be considered the toughest?

A. α
B. β
C. γ
D. δ

Question 11
Which of the four materials behaves most like a ductile supermarket shopping bag?

A. α
B. β
C. γ
D. δ

Air resistance would affect the flight to some extent and is to be taken into account in **Question 11**.

Question 11
In considering the effect of air resistance, would your answer to Question 9 have been **higher**, the **same** or **lower**?
Explain why.

3 marks

The following information relates to Questions 12–14.

Following an oil tanker spill on the Hume Freeway, a Holden AWD travelling at 4.8 m s^{-1} runs into the back of a stationary Toyota Coaster minibus. See Figure 8.
Immediately after contact the two vehicles travel forward locked together.
Assume the oil on the road makes frictional forces on the tyres negligible.
Mass of AWD plus passengers = 1.9×10^3 kg
Mass of minibus plus passengers = 3.8×10^3 kg

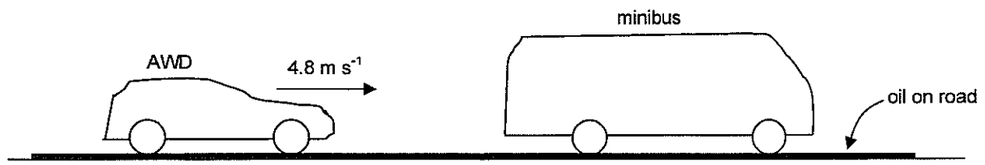


Figure 8

Question 12
How do the **impulse of the AWD on the minibus** and the **impulse of the minibus on the AWD** compare?
There is no need to do any calculations or give a reason for your answer.

1 mark

Question 13
Calculate the common speed of the two vehicles after contact is made?

m s^{-1}

2 marks

Question 4
Which of the following is closest to the magnitude of the force exerted on the pole by wire P?
A. 239 N
B. 258 N
C. 400 N
D. 680 N

Question 5
Cable R has a uniform diameter of 3.0 mm. Calculate the stress in cable R.
A. 64 MPa
B. 60 MPa
C. 16 MPa
D. 0.15 MPa

The following additional information relates to Questions 6 and 7.

Figure 4 shows the stress-strain graph for cable R.

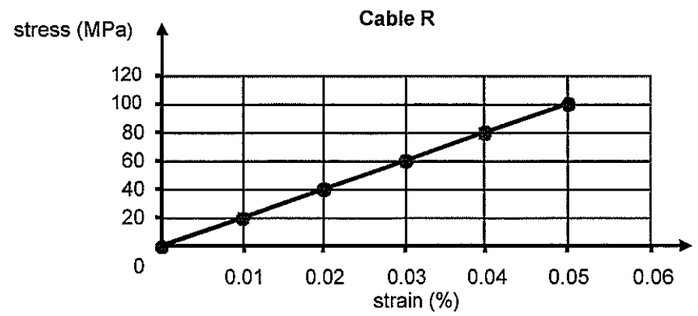


Figure 4

Question 6
Calculate Young's modulus for the material used for cable R.
A. 2.0×10^3 Pa
B. 2.0×10^8 Pa
C. 2.0×10^9 Pa
D. 2.0×10^{11} Pa

Question 7
Cable R is measured to be 3.07 m long.
What of the following is closest to the elastic potential energy stored in cable R when experiencing a stress of 60 MPa?
A. 0.20 J
B. 0.78 J
C. 2.17 J
D. 9.00 J

The following information relates to Questions 3–7.

Figures 2 and 3 illustrate the arrangement of a volleyball net. Cable R is pegged into the ground. Horizontal wires P and Q attach the net to the vertical poles and are 0.90 m apart. Cable R and wire P are both attached to the light aluminium pole at a point 2.35 m above the ground. The angle between cable R and the pole is 40°.

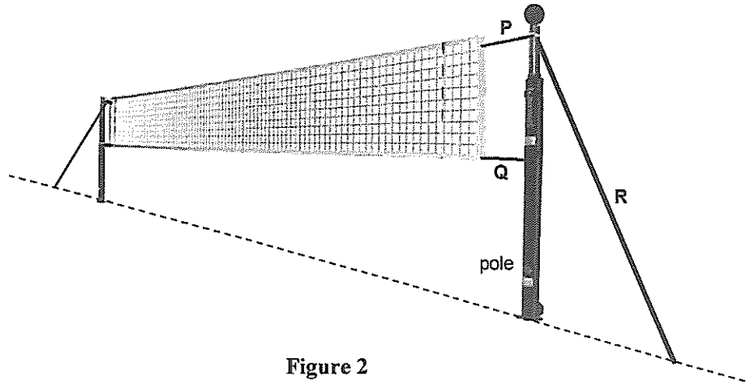


Figure 2

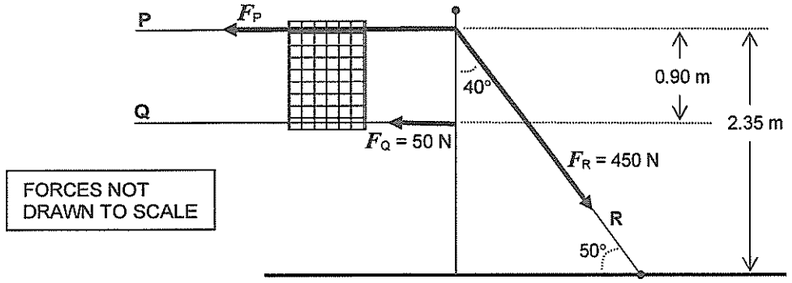


Figure 3

Question 3
Which of the following correctly describes the types of force acting on the pole and wire P?

	pole	wire P
A.	tension	tension
B.	compression	compression
C.	tension	compression
D.	compression	tension

The tension in wire Q is found to be 50 N and the tension in cable R is found to be 450 N. You can assume the weight of the aluminium pole is insignificant in comparison with the other forces on the pole.

Question 14
State whether this collision is **elastic** or **inelastic**.
Use calculations to support your answer.

3 marks

The following information relates to Questions 15–17.

When someone moves into a car and sits down, the body of the car moves down slightly due to the compression of the four tyres and the four car springs. This could be modelled as **four** identical open-coiled springs holding up an object (the body of the car) as in Figure 9. Each modelled spring represents the combined effect of a tyre and a car spring.

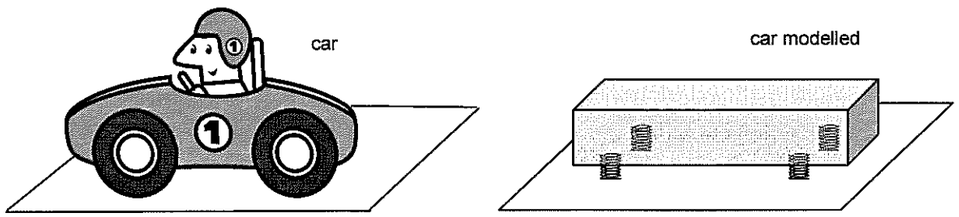


Figure 9

When four adults each of mass 75 kg get into a Toyota Corolla, the body of the car moves down by 8.0 mm.

Question 15
As they get into the car, what total work is done on the car by their combined weight?

J

2 marks

Question 16
If the Toyota was modelled as in Figure 9, what would be the force constant k of **each** of the four modelled springs?

N m^{-1}

2 marks

Detailed Study 2 – Materials and their use in structures

Malcolm, 45 years old, has a height of 178 cm in the morning but only 177 cm at the end of the day.

Question 1
Which of the following best describes the main forces acting on his body which cause this change in height?

A. Tension due to repetitive muscular contractions.
B. Tension due to food intake throughout the day.
C. A shear force due to the twisting he does in his employment.
D. Compression due to gravity acting on his body.

Alastair is sitting near the end of a cantilevered jetty beyond the support point of a column as illustrated in Figure 1.

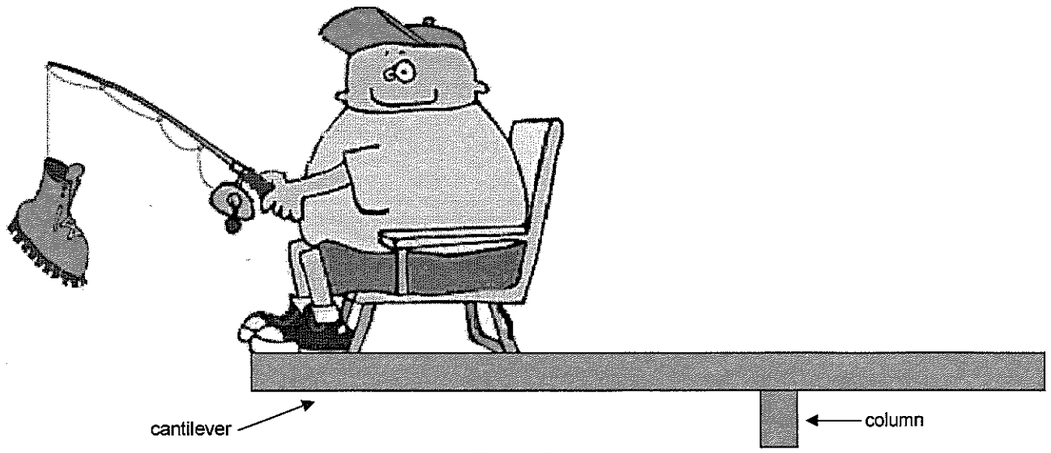


Figure 1

Question 2
Which of the following best describes the forces acting through the top and through the bottom of the cantilevered section?

	Top of cantilever	Bottom of cantilever
A.	tension	tension
B.	compression	compression
C.	tension	compression
D.	compression	tension

The following information relates to Questions 12 and 13.

Figure 2 shows an aerial photo of the Fermilab Tevatron in Illinois, USA. In the Tevatron, amongst other things, protons can be accelerated to very high speeds.

A particular proton is accelerated in the linear accelerator (LINAC) section of the Tevatron such that the proton has a Lorentz factor of 1.4.

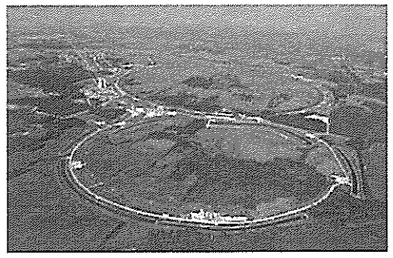


Figure 2

Question 12
Which of the following is closest to the speed of the proton?

A. 2.9×10^8 m s^{-1}
B. 2.8×10^8 m s^{-1}
C. 2.6×10^8 m s^{-1}
D. 2.1×10^8 m s^{-1}

One section of the Tevatron LINAC is 300 m long as measured in the laboratory.

Question 13
As measured in the proton's frame of reference, what would be the approximate length of this section of the LINAC?

A. 214 m
B. 300 m
C. 317 m
D. 420 m

END OF DETAILED STUDY 1
SECTION B – continued

Question 17
As a result of the four adults getting into the car, what **total** additional strain potential energy would be stored in the four modelled springs?

J

2 marks

The following information relates to Questions 18–20.

In June 2009 the Lunar Reconnaissance Orbiter (LRO) probe was launched from Florida and is currently in a low polar orbit around the Moon. Its mission includes surveying the surface for possible future landing sites. See Figure 9.

Mass of the Moon = 7.34×10^{22} kg

Mass of the LRO = 1.10×10^{3} kg

Assume the LRO's orbit is circular with radius = 1.79×10^{6} m

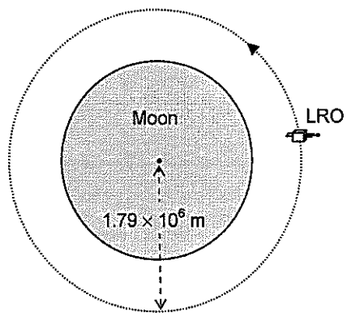


Figure 9

Question 18

Determine the weight of the LRO relative to the Moon.

N

2 marks

Question 19

Calculate the magnitude of the acceleration of the LRO as it moves around the Moon.

m s^{-2}

2 marks

Questions 8 to 11 are related.

Question 8

Which of the following is closest to the rest mass energy of an electron? (mass of electron = 9.1×10^{-31} kg)

A. 2.73×10^{-22} J

B. 2.73×10^{-14} J

C. 4.10×10^{-14} J

D. 8.20×10^{-14} J

The following information relates to Questions 9–11.

An electron in a cathode ray oscilloscope (CRO) moving towards the screen has a total mass energy of 1.23×10^{13} J. This is greater than its **rest** mass energy.

Question 9

This increase is due to its

A. electric potential energy.

B. ionisation energy.

C. kinetic energy.

D. elastic potential energy.

Question 10

If the rest mass energy of an electron (the answer to Question 8) is represented by E_0, which of the following is closest to the Lorentz factor in this situation?

A. $\frac{E_0}{1.2 \times 10^{-13}}$

B. $\frac{1.2 \times 10^{-13}}{E_0}$

C. $\frac{E_0}{9.1 \times 10^{-31}}$

D. $\frac{9.1 \times 10^{-31}}{E_0}$

Question 11

If the Lorenz factor for this situation (the answer to Question 10) is represented by γ, which of the following is closest to the change in mass of the electron due to this movement in the CRO?

A. $(9.1 \times 10^{-31}\,\gamma - 9.1 \times 10^{-31})$ kg

B. $(9.1 \times 10^{-31} - 9.1 \times 10^{-31}\,\gamma)$ kg

C. $9.1 \times 10^{-31}\,\gamma$ kg

D. $-9.1 \times 10^{-31}\,\gamma$ kg

Question 5
Which of the following statements is **both** from Einstein's second postulate **and** confirms one of the findings of the Michelson-Morley experiment?

A. The speed of light in a vacuum is equal to approximately 3×10^8 m s^{-1}.
B. The speed of light depends on the speed of the observer.
C. The speed of light has the same value for all observers in all inertial reference frames.
D. The speed of light has the same value for all observers in any reference frame.

Which of the following statements regarding classical Galilean relativity remains consistent with Einstein's postulates for special relativity?

Question 6
A. A frame of reference is a system travelling with a constant velocity or at rest, used to measure the motion of an object.
B. The laws of physics are different for different observers.
C. The speed of light is dependent on the frame of reference of the observer.
D. The speed of any object is independent of the observer's frame of reference.

Four students are discussing Einstein's famous equation $E = mc^2$ in reference to an electron of mass m.

Question 7
Which one of the following statements is correct?

A. Bryn says that the mass of the electron is fully converted into energy E when it is travelling at the speed of light.
B. Jeph says that the electron has an energy of E due entirely to having a mass m.
C. Kim says that a photon of light of energy E is emitted when a free electron is captured by an atom.
D. Murree says a photon of light of energy E is emitted when the electron accelerates fully to the speed of light.

Question 20
What is the magnitude of the Moon's gravitational field strength at any point on the LRO's orbit?

N kg^{-1}

1 mark

Area of study 2 – Electronics and photonics

The following information relates to Questions 1–3.

In a Physics class, Jarrod and Moses have constructed the circuit shown in Figure 1. The ammeter reads 36 mA.

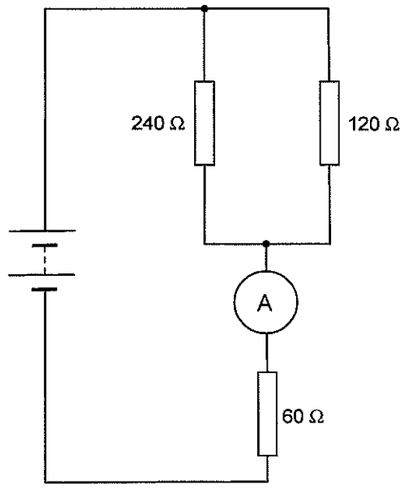


Figure 1

Question 1

Calculate the power developed in the 60 Ω resistor.

W

2 marks

A square at rest has sides of length 1.0 metre, as illustrated in Figure 1.

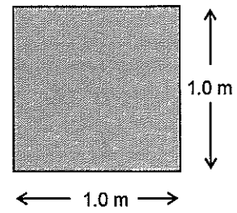
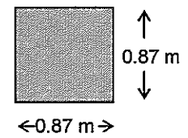


Figure 1

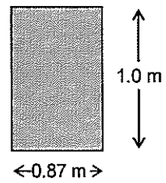
Question 3

If the square is moving horizontally to the right at 0.5*c* with respect to an observer, which of the following represents the dimensions of the square for the observer?

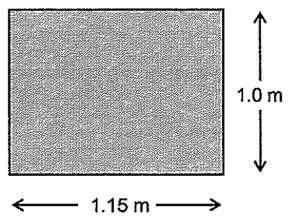
A.



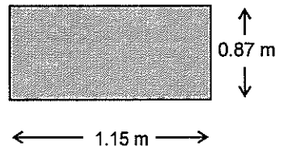
B.



C.



D.



In the best known Michelson-Morley experiment the time taken for the ray of light to make the return trip parallel to the Earth's 'movement through the ether' can be called T_1. The time taken for the light to make the return trip of the same distance but perpendicular to the earth's 'movement through the ether' can be called T_2.

Question 4

In Table 1, which row most accurately describes both the **prediction** of these physicists before completing the experiment and the **conclusion** they reached?

Table 1

	prediction	conclusion
A.	$T_1 = T_2$	$T_1 > T_2$
B.	$T_1 = T_2$	$T_1 < T_2$
C.	$T_1 < T_2$	$T_1 = T_2$
D.	$T_1 > T_2$	$T_1 = T_2$

SECTION B – Detailed studies

Instructions for Section B

Select **one** Detailed study.

Answer **all** questions from the Detailed study, in pencil, on the answer sheet provided for multiple-choice questions.

Write the name of your chosen Detailed study on the multiple-choice answer sheet **and** shade the matching box.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 2, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

You should take the value of g to be 10 N kg^{-1}.

Detailed study **Page**

Detailed Study 1 – Einstein's special relativity

Andrew is travelling in a super rocket with a velocity of 0.995c relative to a stationary observer Brenda. Andrew observes 1 minute to elapse on the clock in his rocket.

Question 1
What time has elapsed on Andrew's clock as observed by Brenda?

A. 0.01 minute
B. 1 minute
C. 10 minute
D. 100 minute

James Clerk Maxwell postulated that light was a form of electromagnetic wave, travelling at approximately 3×10^8 m s^{-1} in a vacuum and that the speed of light depends only on the electrical and magnetic properties of the medium. This was met with some doubt from other physicists.

Question 2
Which one of the following was their main concern?

A. Electromagnetic waves were considered to be transverse.
B. Electromagnetic waves undergo constructive and destructive interference.
C. The speed of light as predicted by Maxwell did not agree with the speed found experimentally.
D. Maxwell was suggesting that the speed of light in a medium is independent of either the speed of the source or the speed of the medium.

Question 2
Determine the total resistance of the circuit.

	Ω

2 marks

Question 3
Calculate the potential difference between the terminals of the battery.

	V

2 marks

With the circuit shown in Figure 2, Rachel and Marcus are given the task of predicting what will happen to the brightness of 3 identical globes X, Y and Z when the switch S is closed.

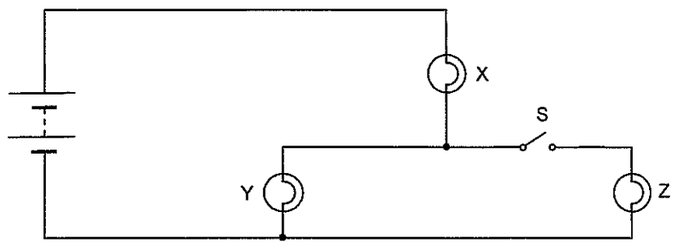


Figure 2

With the switch S open, globes X and Y have the same brightness while globe Z is not lit.
The **switch is now closed** and the brightness of all three globes changes.

Question 4

(a) In Table 1 indicate in **Column 1** with a tick, any globes which now have the same brightness as each other.

1 mark

(b) Indicate in **Column 2** with a tick, any of the globes where the brightness has increased with the closing of the switch.

2 marks

Table 1

Globe	Column 1	Column 2
X		
Y		
Z		

The following information relates to Questions 13 and 14.

Photodiodes are used to detect variations in the brightness of light. In the circuit in Figure 9, light is shone onto a photodiode. The voltage across the 1.0 MΩ resistor is 4.5 V.

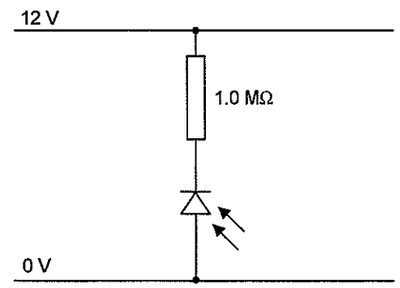


Figure 9

Question 13
Determine the current in the photodiode.

A

1 mark

Increasing the brightness of the light striking a photodiode will increase the current in the photodiode.
Light of a higher intensity is now shone on the photodiode.

Question 14
Which one of the following statements (**A–D**) correctly states the changes that occur to the resistance of the photodiode and the potential difference across the photodiode?

A The resistance of the photodiode decreases and the potential difference across the photodiode decreases.

B The resistance of the photodiode increases and the potential difference across the photodiode decreases.

C The resistance of the photodiode decreases and the potential difference across the photodiode increases.

D The resistance of the photodiode increases and the potential difference across the photodiode increases.

2 marks

END OF AREA OF STUDY 2
END OF SECTION A
TURN OVER

A group of students are experimenting with transmitting signals using amplitude modulation. They have invented a code for the phrases "yes", "no", "not sure" and "no response". These amplitude modulation codes are shown in Figures 7(a), 7(b), 7(c) and 7(d) respectively. Each signal lasts for 1 ms.

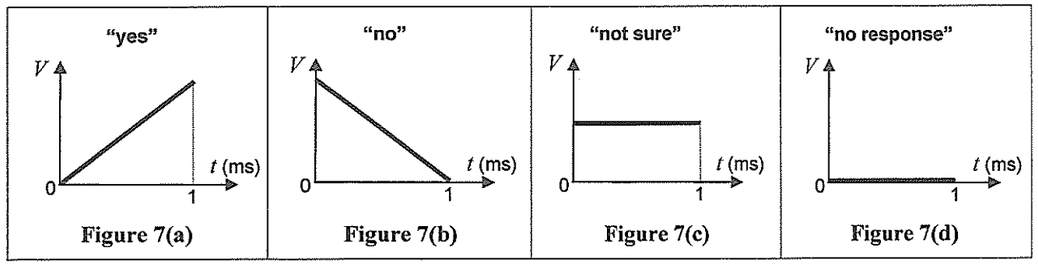


Figure 7(a) **Figure 7(b)** **Figure 7(c)** **Figure 7(d)**

Figure 8 shows a signal containing 4 codes that was transmitted during one trial.

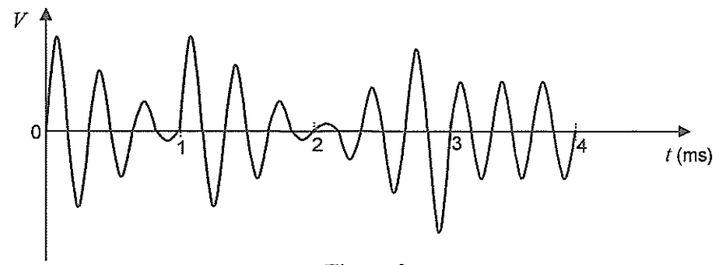


Figure 8

Question 12
Which one of the following gives the correct order of the words transmitted?

A. yes, yes, not sure, no response
B. yes, no, not sure, yes
C. no, yes, no response, not sure
D. no, no, yes, not sure
E. no, no, not sure, yes

2 marks

Amplifiers are used to increase the size of signals from microphones so that MP3 files can be recorded on computers. Some computers require that AC signals have a peak value no greater than 1.0 V. Otherwise clipping will occur.

Question 5
Explain what is meant by the term 'clipping'.

1 mark

The following information relates to Questions 6 and 7.

Figures 3(a) and 3(b) show simultaneous input and resulting output signals respectively for an amplifier used with a microphone.

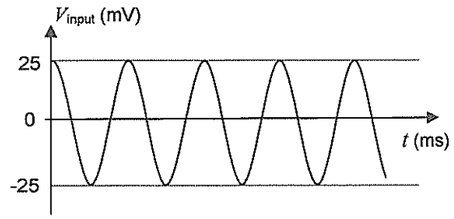


Figure 3(a)

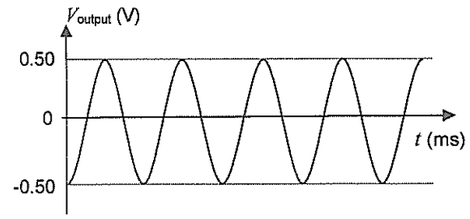


Figure 3(b)

Question 6
State whether the amplifier is an **inverting** or **non-inverting** amplifier.

1 mark

Question 7
Calculate the magnitude of the linear voltage gain of the amplifier.

2 marks

The following information relates to Questions 8 and 9.

A light sensor circuit contains an LDR as shown in Figure 4. The circuit will activate the floodlights on a tennis court when it gets dark. In daylight conditions, the LDR has a resistance of 1.2 kΩ, while in the dark its resistance increases.

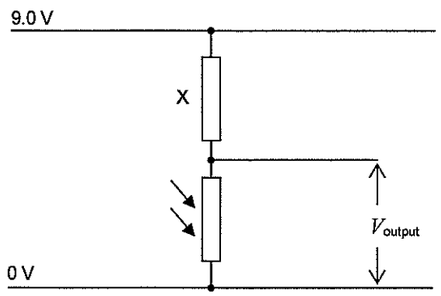


Figure 4

In daylight conditions, the output voltage V_{output} from the sensor circuit is 2.0 V.

Question 8
Calculate the resistance of the resistor X.

Ω

2 marks

Question 9
During the night will the output voltage V_{output} **increase**, **decrease** or remain the **same**? **Explain why**.

2 marks

The following information relates to Questions 10 and 11.

A blue LED is being investigated by Dayan and Dana. Using the circuit shown in Figure 5 they obtain for the LED a characteristic curve shown slightly idealised in Figure 6.

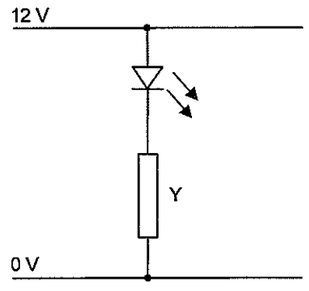


Figure 5

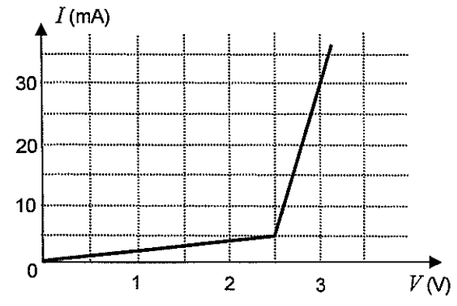


Figure 6

At one instant the current in the LED is 30 mA.

Question 10
At this instant, what is the power dissipated in the LED? Give your answer in milliwatt.

mW

2 marks

Question 11
Calculate the resistance of resistor Y.

Ω

2 marks

CSE CENTRE FOR STRATEGIC EDUCATION
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IARTV

YEAR 12

CSE TEST: MAY 2010

PHYSICS

Written test 1

FORMULA SHEET

Directions to students

Detach this formula sheet before commencing the examination.

This formula sheet is provided for your reference.

1	velocity; acceleration	$v=\frac{\Delta x}{\Delta t};\ \ a=\frac{\Delta v}{\Delta t}$
2	equations for constant acceleration	$v=u+at$ $x=ut+\frac{1}{2}at^2$ $v^2=u^2+2ax$ $x=\frac{1}{2}(v+u)t$
3	Newton's second law	$F=ma$
4	circular motion	$a=\frac{v^2}{r}=\frac{4\pi^2 r}{T^2}$
5	Hooke's law	$F=-kx$
6	elastic potential energy	$\frac{1}{2}kx^2$
7	gravitational potential energy near the surface of the Earth	mgh
8	kinetic energy	$\frac{1}{2}mv^2$
9	Newton's law of universal gravitation	$F=G\frac{M_1M_2}{r^2}$
10	gravitational field	$g=G\frac{M}{r^2}$
11	stress	$\sigma=\frac{F}{A}$
12	strain	$\varepsilon=\frac{\Delta L}{L}$
13	Young's modulus	$E=\frac{\text{stress}}{\text{strain}}$
14	transformer action	$\frac{V_1}{V_2}=\frac{N_1}{N_2}$
15	AC voltage and current	$V_{RMS}=\frac{1}{2\sqrt{2}}V_{p\text{-}p}$ $\quad I_{RMS}=\frac{1}{2\sqrt{2}}I_{p\text{-}p}$
16	voltage; power	$V=RI$ $\quad P=VI=I^2R$

17	resistors in series	$R_T=R_1+R_2$
18	resistors in parallel	$\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}$
19	capacitors	time constant : $\tau=RC$
20	Lorentz factor	$\gamma=\frac{1}{\sqrt{1-v^2/c^2}}$
21	time dilation	$t=t_o\gamma$
22	length contraction	$L=L_o/\gamma$
23	relativistic mass	$m=m_o\gamma$
24	total energy	$E_{total}=E_k+E_{rest}=mc^2$
25	universal gravitational constant	$G=6.67\times10^{-11}$ N m^2 kg^{-2}
26	mass of Earth	$M_E=5.98\times10^{24}$ kg
27	radius of Earth	$R_E=6.37\times10^6$ m
28	mass of the electron	$m_e=9.1\times10^{-31}$ kg
29	charge on the electron	$e=-1.6\times10^{-19}$ C
30	speed of light	$c=3.0\times10^8$ m s^{-1}

Prefixes/Units

p = pico = 10^{-12}

n = nano = 10^{-9}

μ = micro = 10^{-6}

m = milli = 10^{-3}

k = kilo = 10^3

M = mega = 10^6

G = giga = 10^9

t = tonne = 10^3 kg

END OF FORMULA SHEET

CSE TEST: MAY 2010
PHYSICS
Written Test 1
ANSWER SHEET

STUDENT NAME:

INSTRUCTIONS:

Use a **PENCIL** for **ALL** entries. For each question, shade the box which indicates your answer.
All answers must be completed like **THIS** example: [A] [■] [C] [D]
Marks will **NOT** be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer. **DO NOT** cross it out.

SECTION B

Show the Detailed Study answered by shading one box.

Detailed Study:

- ☐ **Detailed Study 1: Einstein's special relativity**
- ☐ **Detailed Study 2: Materials and their use in structures**
- ☐ **Detailed Study 3: Further electronics**

Please write the Detailed Study name in the box below to confirm your chosen Detailed Study.

Detailed Study:

ONE ANSWER PER LINE				
1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D

ONE ANSWER PER LINE				
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D

Please DO NOT fold, bend or staple this form.