VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2004

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STUDENT NUMBER

Figures										Letter
Words										

PHYSICS – PILOT STUDY

Written examination 1

? ? ? 2004

Reading time: ? to ? (15 minutes)
Writing time: ? to ? (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 or two dimensions	15	15	40
2. Electronics and photonics	12	12	25
B – Detailed studies			
1. Einstein's relativity	13	13	25
OR			
2. Investigating structures and materials	13	13	25
OR			
3. Further electronics	12	12	25
			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 an approved graphics calculator (memory cleared) and/or 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 34 pages, with a detachable data sheet in the centrefold.

Instructions
- Detach the data sheet from the centre of this book during reading time.
- Write your **student number** in the space provided above on this page.
- Answer all questions in the spaces provided.
- **Always** show your working where space is provided because marks may be awarded for this working.
- All written responses must be in English.

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

SECTION A – Core

Instructions for Section A

Answer **all** questions **for both** Areas of study in this section of the paper.

Area of study 1 – Motion in one and two dimensions

In the movie *The Matrix*, Morpheus jumps from one building to another while Neo observes. Figure 1 shows his path. Morpheus leaves building A with a velocity of 7.0 m s^{-1} at an angle of 10°, and lands on building B 0.40 s later.

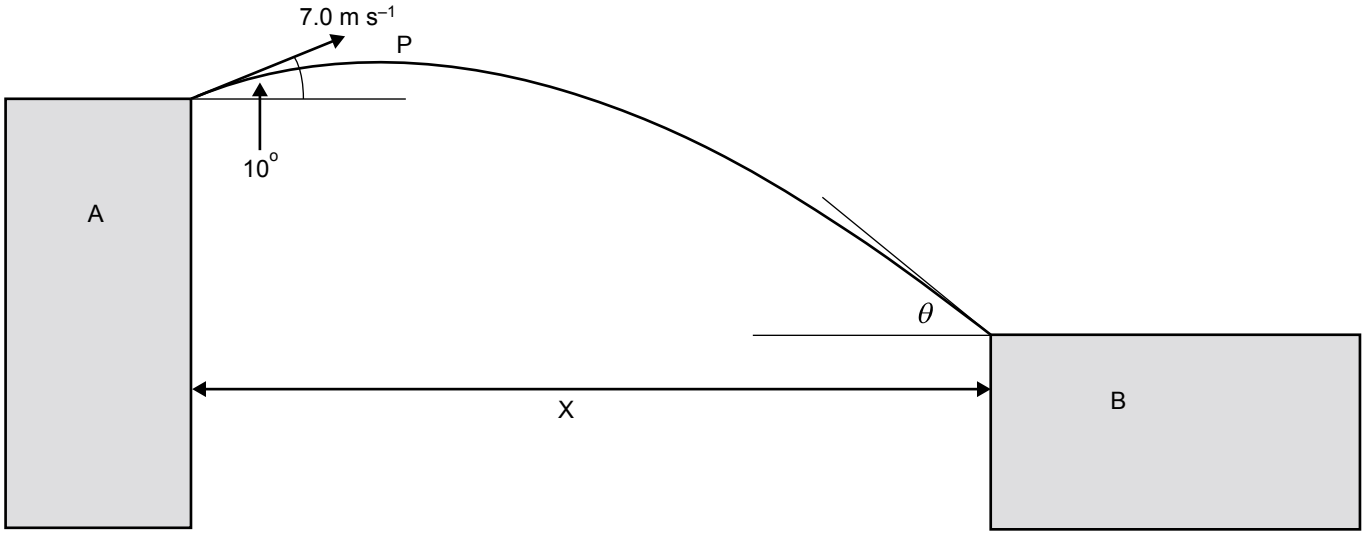


Figure 1

Question 1

What is the distance (X) between the two buildings?

m

3 marks

Question 2

With what speed, and in what direction (angle θ in Figure 1), was Morpheus moving when he landed on building B?

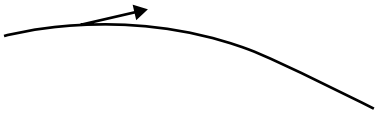
m s^{-1}	$\theta =$

4 marks

Question 3

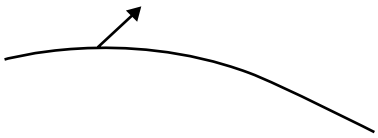
Which of the following diagrams **(A. – E.)** correctly shows the direction of the resultant force on Morpheus at the highest point in his flight (position P)? Ignore air resistance.

A.



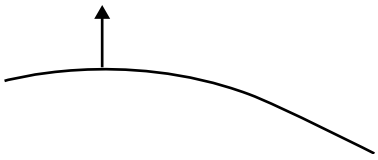
B.

C.



D.

E.



2 marks

A student walking at a constant speed in a straight line releases a heavy ball at position A, and continues walking. When the walker has reached position B, the ball reaches the ground. An observer, who is at rest, also sees the ball drop (Figure 2).

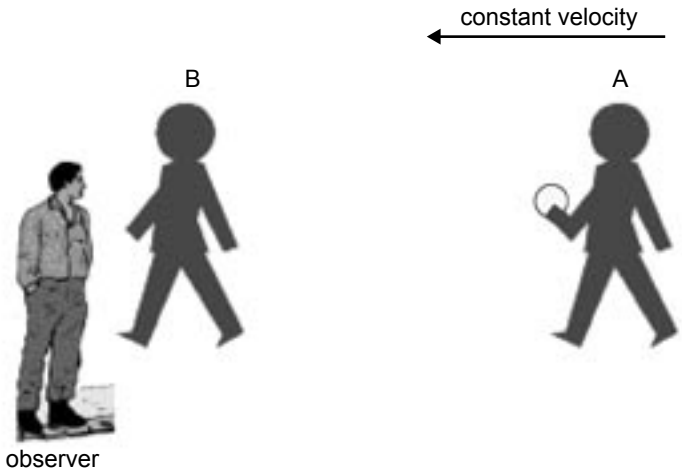
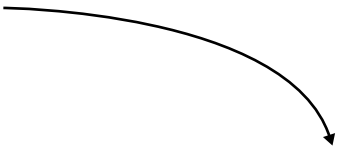


Figure 2

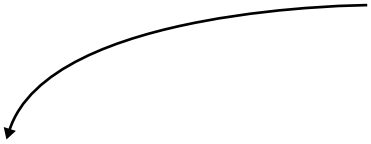
Question 4

Which of the curves below best represents the path of the ball **as seen by the walker**?

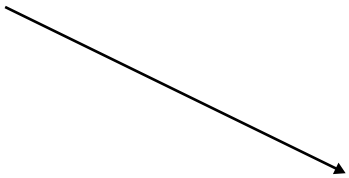
A.



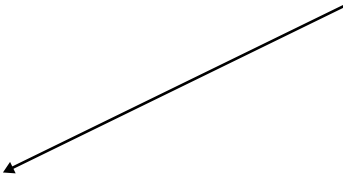
B.



C.



D.



E.

F.

2 marks

Question 5

Which of the curves above best represents the path of the ball **as seen by the observer**?

2 marks

In a supermarket car park, a car of mass 1000 kg collides with a loaded stationary supermarket trolley of mass 100 kg. After the collision the car and supermarket trolley are held together by the car's twisted bumper bar, and have a velocity of 10 m s^{-1}. The duration of the impact was 20 ms.

Question 6

What was the speed of the car before the collision?

	m s^{-1}

3 marks

Question 7

What is the average force exerted on the trolley by the car during the time interval?

	N

3 marks

Question 8

This is an **inelastic collision**. In the space below explain the meaning of the word **inelastic** in this context, and show, using calculations, that the collision was inelastic.

3 marks

A car of mass 1000 kg is being towed on a level road by a van (Figure 3). The vehicles are travelling at **a constant speed**. The tension in the horizontal rope is 300 N.

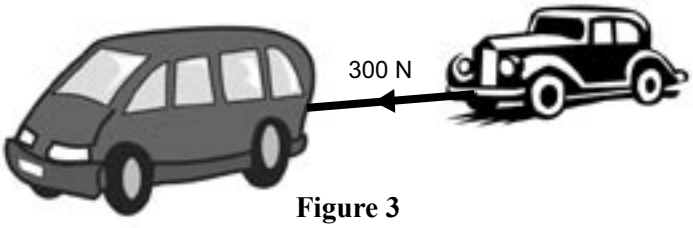


Figure 3

Question 9

In the space below, using Newton's laws of motion, explain why the car is travelling at a constant speed even though there is a tension force acting on it.

3 marks

The van now accelerates at 0.5 m s^{-2} for a period of 5 s.

Question 10

What is the tension in the rope during this period? Assume that the forces due to friction and air-resistance remain constant.

N

3 marks

Question 11

What is the change in the momentum of the car?

kg m s^{-1}

2 marks

The International Space Station (ISS) is in orbit around the Earth at an altitude 380 km (Figure 4).

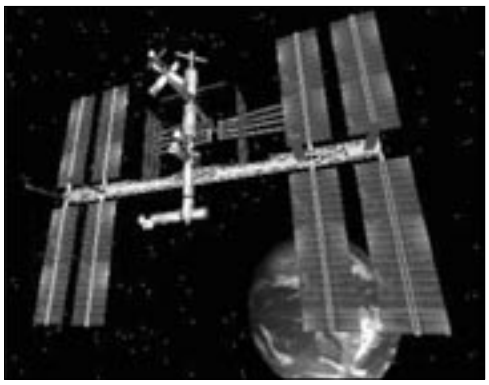


Figure 4

Radius of Earth = 6.4×10^6 m
Mass of Earth = 6.0×10^{24} kg
Total mass of ISS = 5×10^5 kg
Universal gravitational constant $G = 6.7 \times 10^{-11}$ N m^2 kg^{-2}

Question 12

What is the period of the ISS in seconds?

s

3 marks

Question 13

Which row of the table **(A. – E.)** best describes the acceleration and speed of the ISS, and the net force acting on it while in orbit around Earth?

	Acceleration	**Speed**	**Net force**
A.	zero	constant	zero
B.	zero	constant	finite
C.	finite	constant	zero
D.	finite	constant	finite
E.	finite	changing	finite

2 marks

In the film *The Lord of the Rings*, Legolas uses a longbow. This can be modelled as a simple spring of stiffness 400 N m^{-1}.

Legolas prepares to fire, and does 200 J of work in stretching the bowstring.

Question 14

How far is the model spring stretched?

m

2 marks

He then fires the arrow, of mass 250 g, vertically into the air.

Question 15

How high does the arrow go? Ignore air resistance.

m

3 marks

END OF AREA OF STUDY 1
SECTION A – continued

Area of study 2 – Electronics and photonics

A circuit is required to amplify a 10 mV (peak-to-peak), 1000 Hz voltage output from a microphone. The n-p-n CE amplifier shown in Figure 1 is suggested.

In the following transistor questions the DC voltages and current are indicated in upper case (V, I) while the small AC, time varying voltage and current signals, are indicated in lower case (v, i).

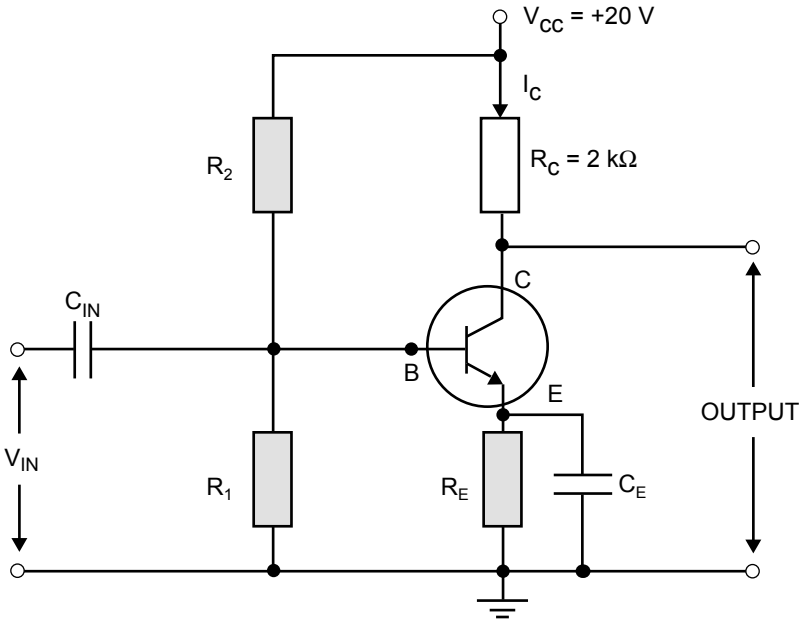


Figure 1

In Figure 1, R_1 and R_2 and the 20 V DC supply form a voltage divider shown in Figure 2.

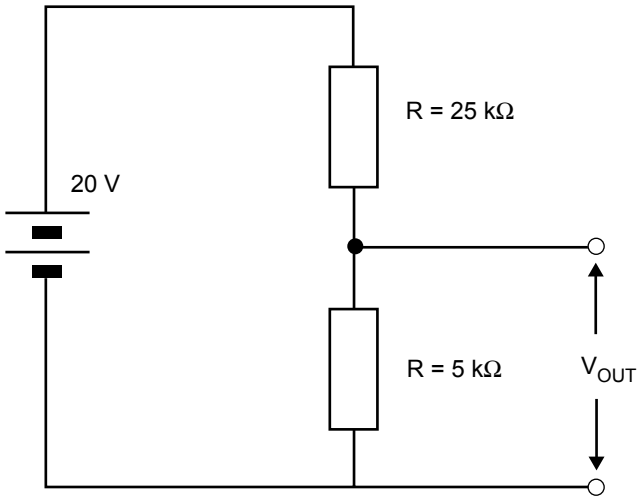


Figure 2

Question 1

What is the output voltage, V_{OUT}, of this voltage divider? Show your working and give your answer in volt (V).

V

2 marks

Question 2

What is the power dissipated in the 25 kΩ resistor of Figure 2? Show your working and express your answer in mW.

mW

2 marks

Question 3

If the transistor in Figure 1 is correctly biased, what is the base-emitter voltage V_{BE}?

A. about 0.0 V

B. about 0.3 V

C. about 0.7 V

D. about 1.0 V

2 marks

In Figure 1, the 10 mV input voltage from the microphone to the amplifier is initially disconnected, so $v_{IN} = 0$. The DC collector current is measured to be $I_C = 6.0$ mA.

Question 4

Show that the transistor DC output voltage for this situation is $V_{OUT} = 8.0$ V. Show your working.

2 marks

The microphone output is now connected to the amplifier so $v_{IN} = 10$ mV peak-to-peak. This causes a 1000 Hz sinusoidal variation in the collector current with a peak-to-peak value given by $i_C = 1.0$ mA. The amplified AC output voltage is given by $v_{OUT} = i_C R_C$.

Question 5

Calculate the peak-to-peak value of v_{OUT}, and thus determine the voltage gain of this transistor amplifier. Show your working.

2 marks

This amplified voltage is used to drive a loudspeaker. There must be no DC voltage component present in the voltage applied to the loudspeaker. The connection from the transistor amplifier to the loudspeaker is through a capacitor similar to that at the input side of the circuit, C_{IN}, shown in Figure 1.

Question 6

What is the purpose of this capacitor? You must explain how the DC and AC components of the output voltage from the first amplifier are affected by the capacitor at the input of the second amplifier.

2 marks

You are asked to design a circuit to detect a customer as they enter and leave a shop by walking through a light beam. The light source is a light-emitting diode (LED), and the light sensor is a light-dependent resistor (LDR). The circuit is shown in Figure 3.

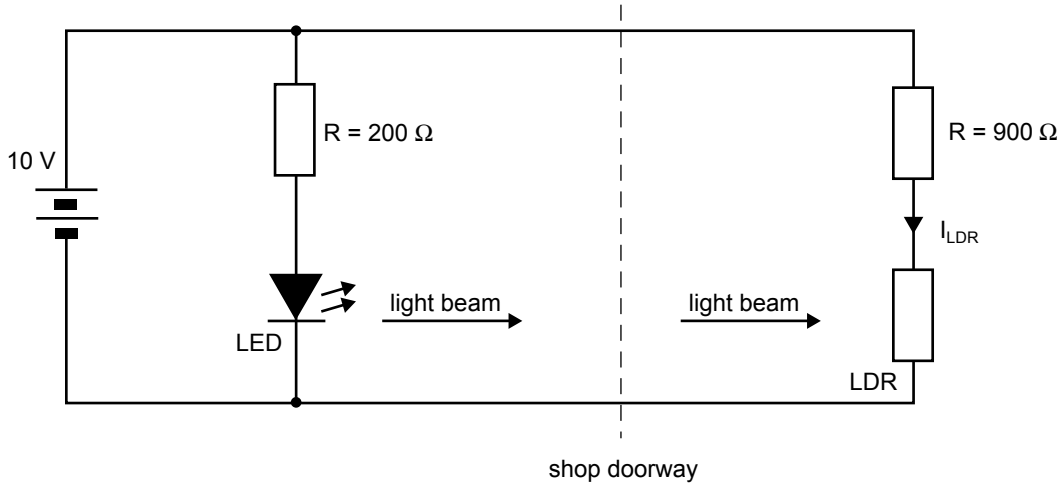


Figure 3

In order to test this design you first consider the LED circuit by itself; this is shown in Figure 4 along with the LED current-voltage characteristics.

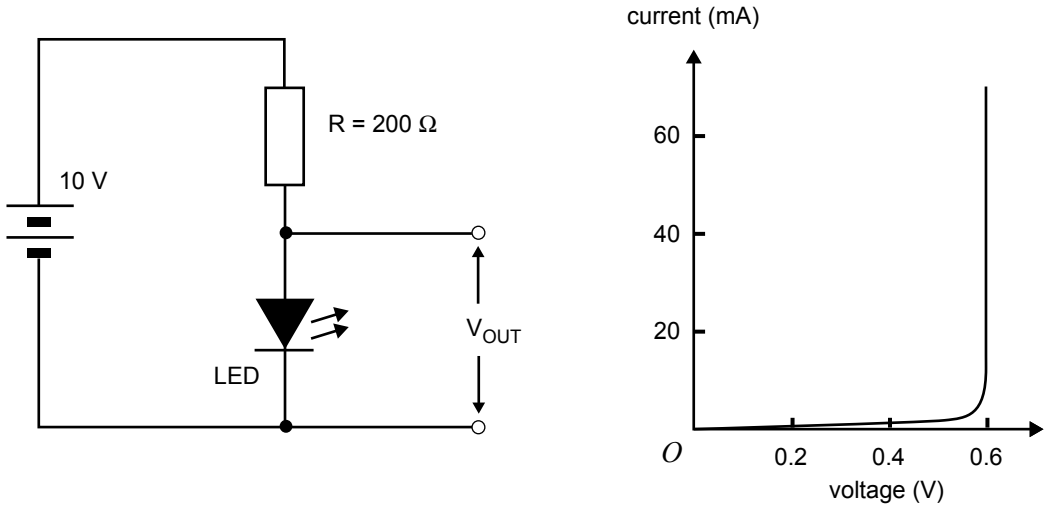


Figure 4

Question 7

What is the current in the circuit of Figure 4? Show your working and express your answer in mA.

mA

2 marks

Having established that this works correctly you now consider the complete circuit, including the LDR. The characteristics of this device are shown in Figure 5.

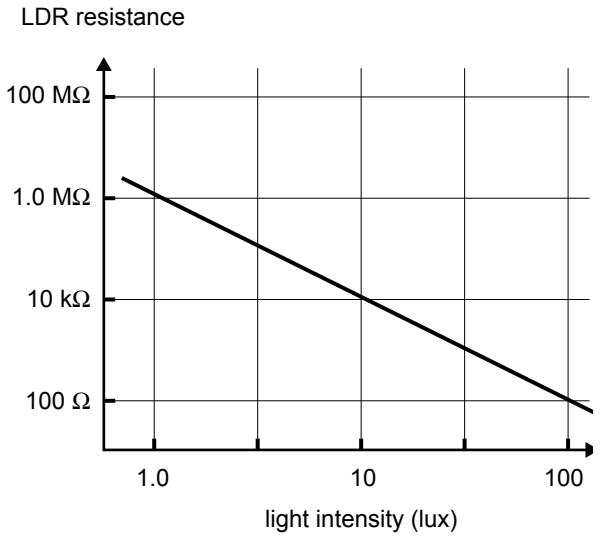


Figure 5

Question 8

When the light beam is **not** broken the incident light intensity at the LDR is 100 lux. Calculate the current in the LDR circuit, I_{LDR}. Show your working and express your answer in mA.

mA

3 marks

Question 9

When the light beam **is** broken as a customer walks through the door, the voltage measured across the 900 Ω resistor in series with the LDR is measured as 0.01 V. What is the incident light intensity at the LDR? Show your working.

lux

2 marks

Question 10

The light emitting diode (LED) in Figure 4 is an electro-optical converter.

Which one of the following statements **(A. – D.)** regarding energy conversion and transformation for the LED is correct?

A. If the current through the LED increases, the intensity of the light emitted by the LED also increases even though the voltage across the LED does not alter. All electrical energy is converted to light energy so it is a 100% efficient conversion process.

B. If the current through the LED increases, the intensity of the light emitted by the LED also increases even though the voltage across the LED does not alter. Not all electrical energy is converted to light energy so it is less than a 100% efficient conversion process as some energy will be dissipated as heat energy.

C. If the current through the LED increases, the intensity of the light emitted by the LED remains unchanged because the voltage across the LED does not alter. All electrical energy is converted to light energy so it is a 100% efficient conversion process.

D. If the current through the LED increases, the intensity of the light emitted by the LED remains unchanged because the voltage across the LED does not alter. Not all electrical energy is converted to light energy so it is less than a 100% efficient conversion process as some energy will be dissipated as heat energy.

2 marks

An opto-electronic system is used to transmit digital information between computers. In order to transmit this information on a light beam within an optic fibre, the intensity of the light beam is modulated by the instantaneous magnitude of the information voltage signal. Figure 6 shows the time variation of the voltage signal for some specific information. Note that the voltage has both positive and negative values.

Question 11

On the graph immediately below the information signal of Figure 6, sketch the light intensity as a function of time that could convey this information using intensity modulation. At the left-hand side of the graph the light intensity is indicated when no information (0 V) is being conveyed.

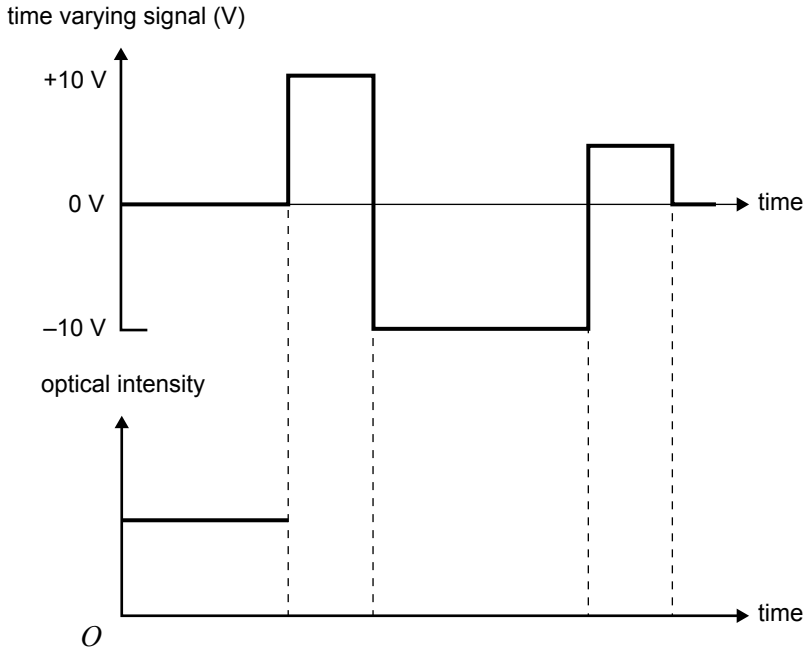


Figure 6

2 marks

For this system, the ratio of the output voltage amplitude to the input light intensity is shown in Figure 7 as a function of signal frequency.

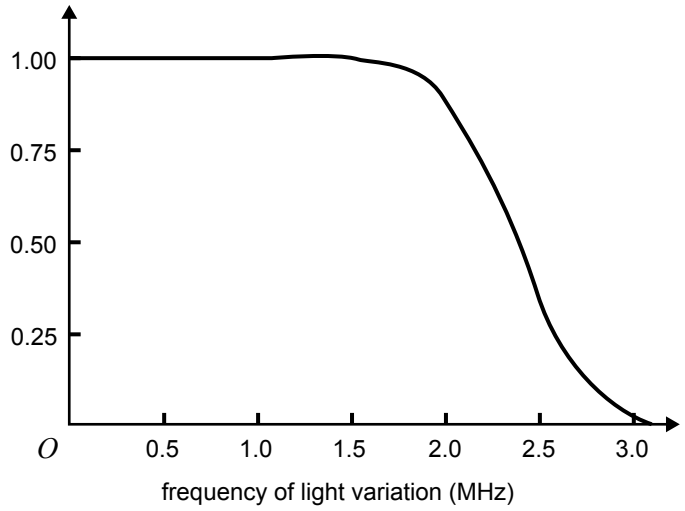


Figure 7

Question 12

State a reasonable value of the bandwidth, in MHz, for this opto-electronic transmission system.

MHz

2 marks

END OF SECTION A
TURN OVER

SECTION B – Detailed studies

Instructions for Section B

Choose **one** of the following **Detailed studies**. Answer **all** the questions on the **Detailed study** you have chosen.

Detailed study 1 – Einstein's relativity

Robin and Chris are playing in the gym inside their personal, glass rocket ship. Robin throws a basketball as shown in Figure 1 below. All the distances marked on the diagram are measured by Chris.

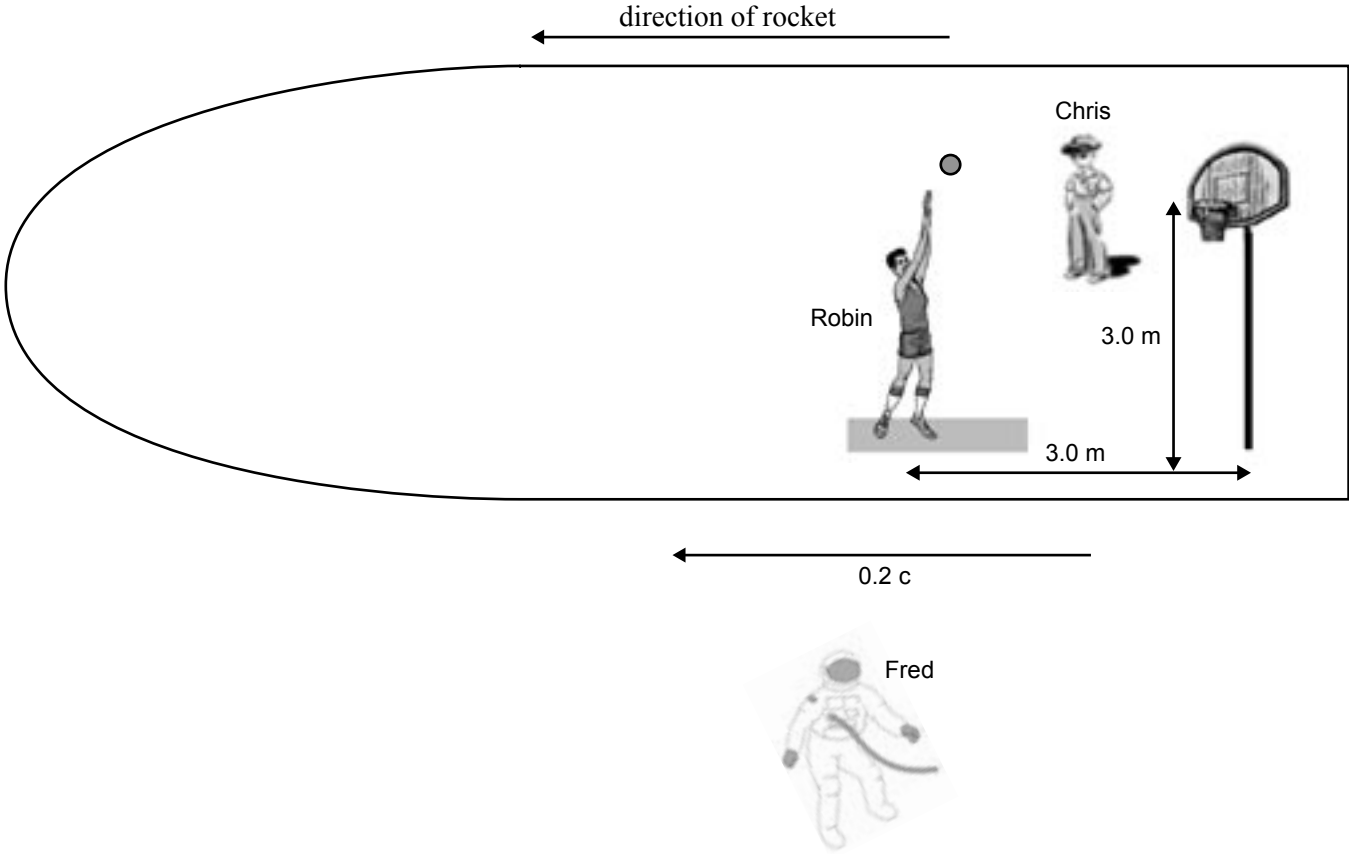


Figure 1

Astronaut Fred is floating freely in space. He observes the rocket ship travelling past him at a constant speed 0.2 c.

Question 1

What is the horizontal distance from Robin to the base of the basket, as measured by Fred?

m

2 marks

Question 2

Which one of the following **(A. – D.)** gives the vertical distance from the floor to the basket, as measured by Fred?

A. 2.4 m

B. 2.9 m

C. 3.0 m

D. 3.1 m

2 marks

An electron in a colour television tube moves so fast that its 'mass energy' is 21% greater than the mass energy of an electron at rest. The rest mass energy of an electron is 8.2×10^{-14} J.

Question 3

What is the kinetic energy of the electron?

J

1 mark

Question 4

What is the speed of the moving electron?

m s^{-1}

2 marks

Question 5

Imagine Justin and Britney are sitting in the same carriage of a train travelling north at a velocity that is some fraction of the speed of light. Justin is at the northern end of the carriage and Britney is at the southern end. Each of them holds a flashlight. An observer inside the carriage, located at its midpoint, sees Justin and Britney flash their flashlights **simultaneously**.

Cameron is standing on a platform beside the train.

Which statement below best describes what Cameron observes as the midpoint of the train carriage passes him?

A. Justin's and Britney's flashlights flash simultaneously, because special relativity states that light travels at the same speed in all frames of reference.

B. Justin's and Britney's flashlights flash simultaneously, because Cameron is equidistant from Justin and Britney.

C. Justin's flashlight flashes before Britney's.

D. Britney's flashlight flashes before Justin's.

2 marks

Question 6

An object has a rest energy of 18 J. Explain what this means.

2 marks

For the purpose of Questions 7, 8 and 9, imagine a world in which the speed of light is 60 km/h in all reference frames.

Question 7

Which one of the following statements **(A. – D.)** describes how a person in this world would appear to you as he/she walks past you at a constant speed?

A. fatter than when standing still

B. exactly the same as when standing still

C. thinner than when standing still

D. shorter than when standing still

2 marks

Question 8

Which one of the following statements **(A. – D.)** describes how a perfectly flat sheet of paper, which appears square when viewed at rest, would appear to you as it moves directly toward you (face on) at a constant speed?

A. rectangular and exactly the same size as when it is motionless

B. square and exactly the same size as when it is motionless

C. square and smaller than when it is motionless

D. rectangular and smaller than when it is motionless

2 marks

Question 9

You go to school in the morning on a train travelling at 50 km/h and return on the same train in the evening. What would you and your parents observe upon your return?

A. You are younger than when you boarded the train in the morning.

B. You and your parents have not aged.

C. You have aged more than your parents.

D. Your parents have aged more than you.

2 marks

Clerk Maxwell predicted that light was an electromagnetic wave that propagated with a velocity of approximately 3×10^8 m s^{-1} through a medium called 'aether'.

Question 10

Explain why Maxwell's predictions appeared to contradict the 'principle of relativity'.

2 marks

Michelson and Morley performed an experiment to measure the speed of Earth with respect to the aether. They assumed that Earth moves at a speed *v* through the aether. They hypothesised that the speed of light is different depending on whether it is measured parallel or perpendicular to the direction of Earth's movement through the aether.

Michelson and Morley measured *v* to be **zero**.

Question 11

Did the Michelson–Morley experiment find evidence to support the existence of the aether? Explain your answer.

2 marks

Question 12

Let T_1 be the time taken by a ray of light to make a return trip between two mirrors aligned **parallel** to the Earth's assumed motion through the aether.

Let T_2 be the time taken by a ray of light to make a return trip between two mirrors aligned **perpendicular** to the Earth's assumed motion through the aether.

Which of the following statements **(A. – D.)** best describes the value of the ratio T_1 / T_2 as measured by Michelson and Morley?

A. slightly less than one

B. equal to one

C. slightly greater than one

D. significantly greater than one

2 marks

The Sun is powered by the reaction 4 H $\rightarrow$ He, where four hydrogen nuclei (H) fuse to form a helium nucleus (He). The rest mass of a hydrogen nucleus is 1.673×10^{-27} kg and the rest mass of a helium nuclei is 6.645×10^{-27} kg.

Question 13

How much energy is released when four H nuclei fuse to form one He nucleus?

2 marks

END OF DETAILED STUDY 1
SECTION B – continued
TURN OVER

Detailed study 2 – Investigating structures and materials

Question 1

Figure 1 shows three sketches of a uniform cylindrical concrete pillar standing upright on level ground. For each of these three sketches you are to add a force vector indicating the application of a specific force. The forces you are to indicate are

- **i.** Figure 1(a): The weight force, $\mathbf{F}_1$, acting at the centre of mass.
- **ii.** Figure 1(b): A tension force, $\mathbf{F}_2$, acting at the top surface.
- **iii.** Figure 1(c): A shear force, $\mathbf{F}_3$, acting at the top surface.

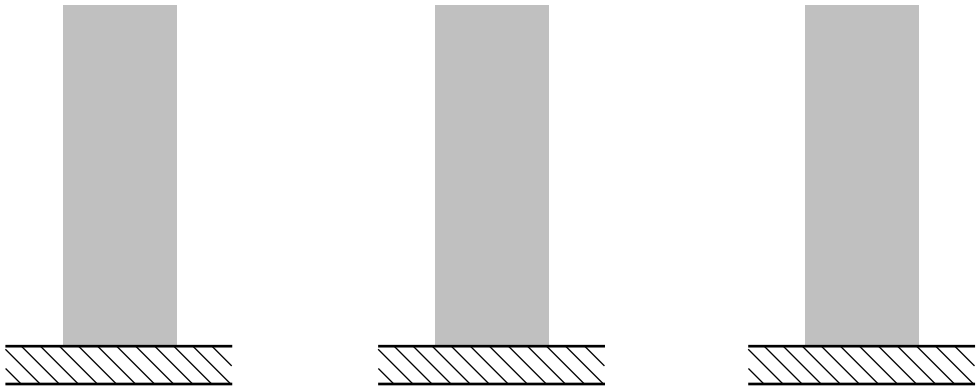


Figure 1a **Figure 1b** **Figure 1c**

3 marks

You are going to use cables to lift the concrete pillar into the correct position on a construction site. You are required to understand the stress–strain properties of the cable when in tension.

Question 2

Which statement **(A. – D.)** correctly defines stress and strain for a cable in tension?

A. Stress refers to the tension in the cable, while strain refers to the change in length of the cable due to this tension.

B. Stress refers to the ratio of the tension in the cable to its original length, while strain refers to the ratio of change in length of the cable to its cross-sectional area.

C. Stress refers to the ratio of the tension in the cable to the square of its original length, while strain refers to the ratio of change in length of the cable to the square root of its cross-sectional area.

D. Stress refers to the ratio of the tension in the cable to the cross-sectional area of the cable, while strain refers to the ratio of change in length of the cable to its original length.

2 marks

The concrete pillar is suspended from points X and Y using identical steel cables as depicted in Figure 2a. The cables OX and OY are each 5 m long and make an angle of 60° to the vertical. The cable OZ hangs vertically and is also 5 m long. All cables have identical cross-sectional areas of 5×10^{-4} m^2. The stress–strain relationship for this steel cable in tension is shown in Figure 2b.

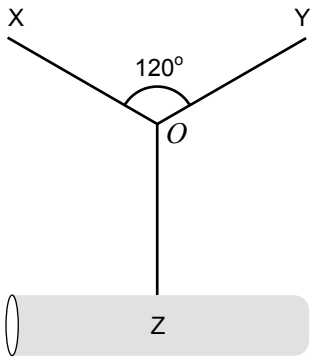


Figure 2a

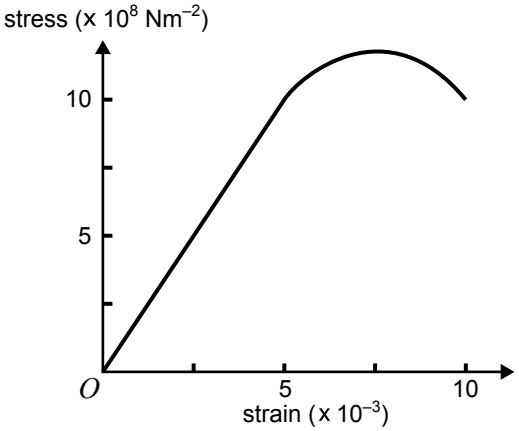


Figure 2b

Question 3

If the tension in the cable OZ is T, which statement **(A. – D.)** correctly states the tensions in the cables OX and OY?

A. They are both equal to T.

B. They are both equal to T sin(60°).

C. They are both equal to T cos(60°).

D. They are both equal to T cos(120°).

2 marks

Question 4

Using the information in Figure 2b show that Young's modulus, E, for the steel cable material is $E = 2 \times 10^{11}$ N m^{-2}.

2 marks

Question 5

What is the elastic limit of the steel cable material in terms of the strain value? Provide the appropriate unit.

1 mark

Question 6

In order to reduce the risk of failure when using this cable, a safety factor of 4 is assumed. With this safety factor what is the maximum working stress you would subject the steel cable to? Provide the appropriate unit.

1 mark

Question 7

A test is carried out on the cable material shown in Figure 2a. The test length is placed under tension with a stress of 5×10^8 N m^{-2}. Calculate the work done per m^3 of this cable. Show your working.

2 marks

The concrete pillar supported by these steel cables has a mass of 2.0×10^4 kg.

Question 8

By how much does the 5 m cable OZ extend when the concrete pillar is suspended? Show your working and give your answer in metre. You may assume that the gravitational field is given by $g = 10$ m s^{-2}. Use the value of Young's modulus 2×10^{11} N m^{-2}.

m

2 marks

You are asked to comment on possible materials to be used in the design of a ceramic sculpture that needs to be tough. Figure 3 shows the characteristics of three ceramic materials. All three ceramics display elastic behaviour only, with no plastic deformation.

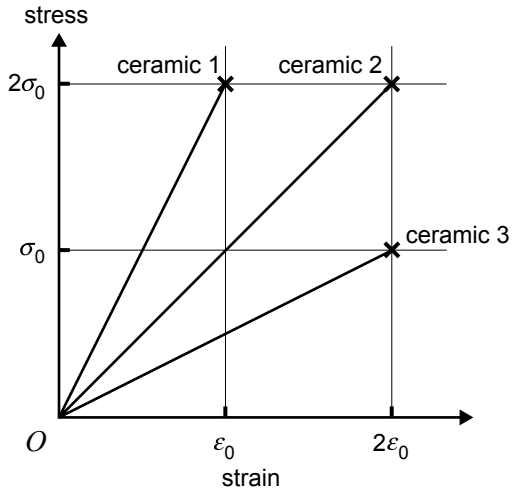


Figure 3

Question 9

Which one of the following statements **(A. – D.)** is correct?

The work per cubic metre of material required to produce failure in ceramic 1 is

A. the same as for ceramic 2.

B. the same as for ceramic 3.

C. twice that for ceramic 2.

D. twice that for ceramic 3.

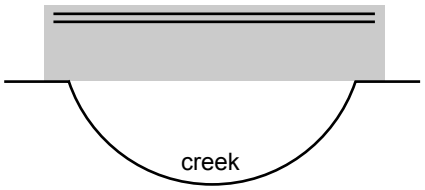
2 marks

A farmer wishes to put a simple concrete beam over a creek to form a bridge. In order to ensure that the bridge is sufficiently strong he uses a concrete beam reinforced with steel rods.

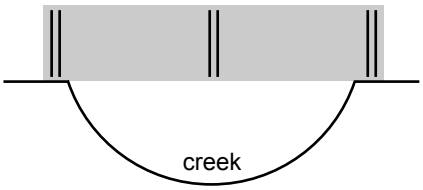
Question 10

Which sketch **(A. – D.)** shows the correct placement of the reinforcing steel rods (represented by the pairs of thick black lines) in the concrete beam in order to provide the maximum strength for the bridge?

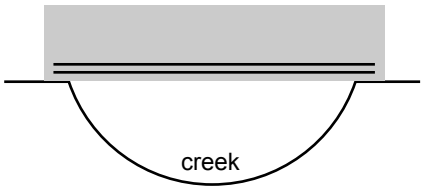
A.



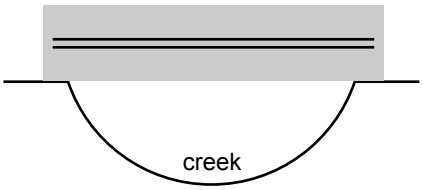
B.



C.



D.



2 marks

Question 11

A neighbour has a similar arrangement for a bridge, but instead uses concrete with no reinforcing. The concrete dimensions are identical for both bridges. Explain why the neighbour's bridge is more likely to fail than that of the farmer that uses reinforcing.

2 marks

In a construction project various materials are being considered. Figure 4 shows the stress–strain relationship for four different materials through to the point of failure, marked by the symbol ✕.

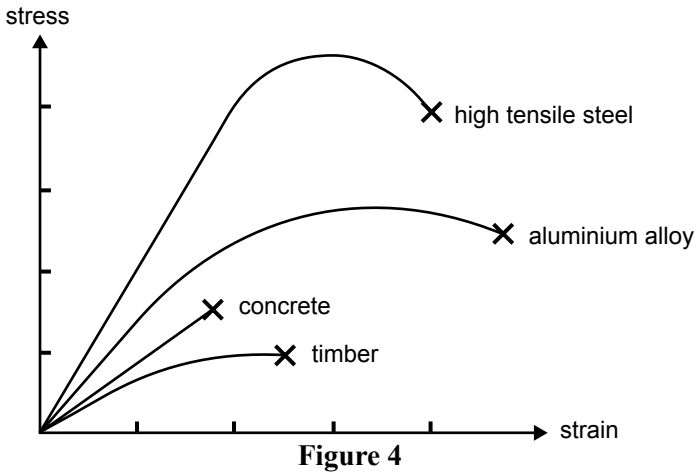


Figure 4

Question 12

Which of the four materials is the most brittle?

A. high tensile steel

B. aluminium alloy

C. concrete

D. timber

2 marks

Question 13

Which of the four materials is the most ductile, and may most readily be drawn into a wire?

A. high tensile steel

B. aluminium alloy

C. concrete

D. timber

2 marks

END OF DETAILED STUDY 2
SECTION B – continued
TURN OVER

Detailed study 3 – Further electronics

Question 1

The circuit of Figure 1 shows the basic design of a simple voltage-regulated DC power supply you intend to construct. In the space below this circuit clearly indicate the six basic components by writing the six terms: load, transformer, AC supply, smoothing circuit, rectifying circuit, voltage regulator, in their correct positions.

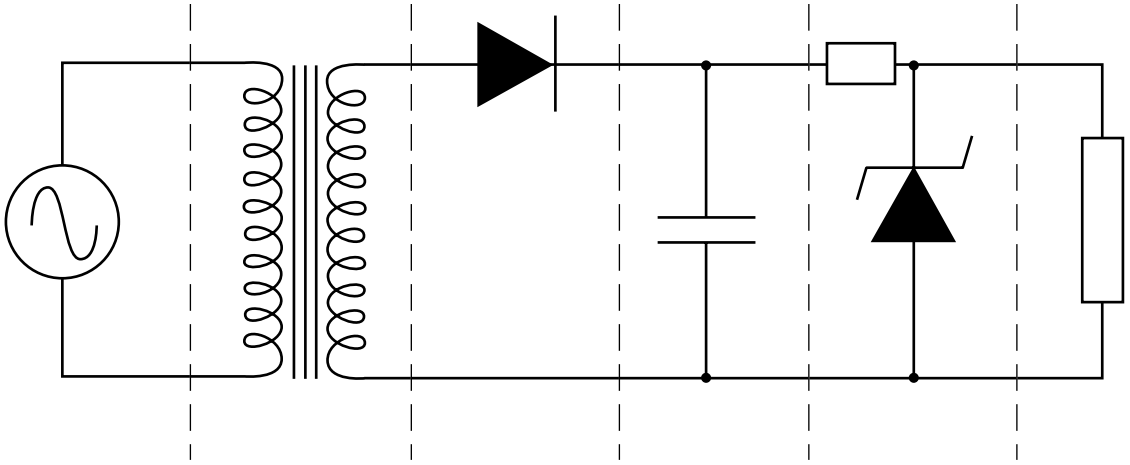


Figure 1

3 marks

You design this DC power supply, based on the circuit of Figure 1, to operate from the domestic 240 V_{RMS} mains supply and provide 9 V DC across the load.

Question 2

Which statement **(A. – D.)** concerning the output voltage, v_{OUT}, of the transformer is true?

A. v_{OUT} varies sinusoidally in time.

B. v_{OUT} has a constant value and does not vary in time.

C. v_{OUT} is always positive and varies in time as a rectified waveform.

D. v_{OUT} is always positive but slowly decreases with a known time constant.

2 marks

In testing the rectifying circuit of Figure 1 you apply a sinusoidal voltage signal to the input side of the rectifying circuit. You measure this voltage waveform using a cathode ray oscilloscope (CRO). The CRO display is shown in Figure 2a.

Question 3

On the blank CRO screen, Figure 2b, sketch the waveform you would expect at the output of the rectifying circuit. Assume the CRO vertical and horizontal controls are unchanged.

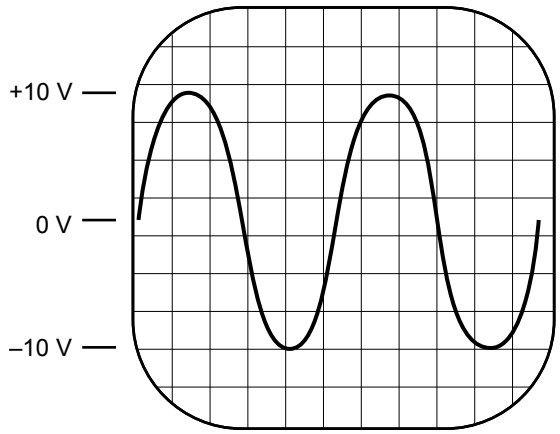


Figure 2a

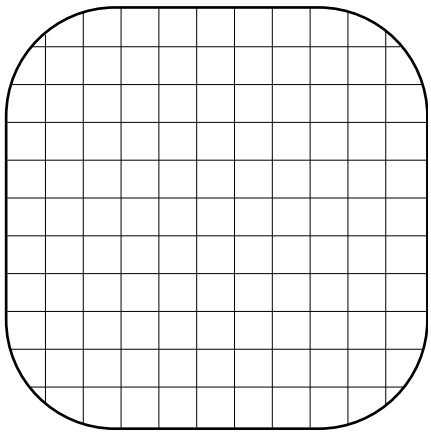


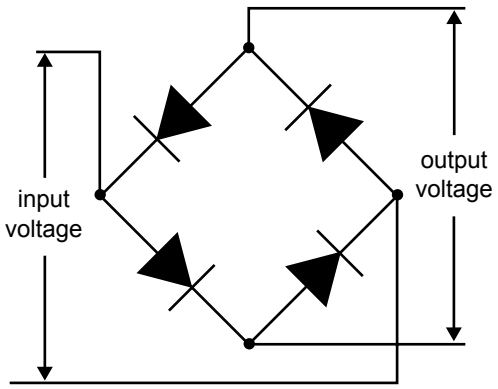
Figure 2b

2 marks

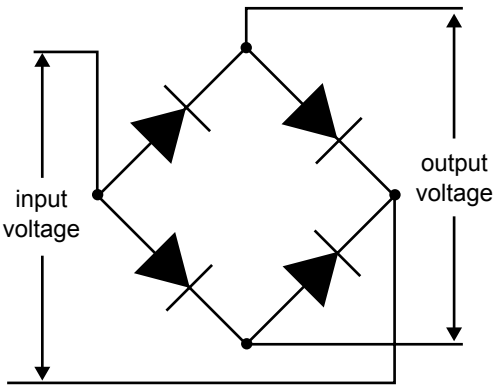
Question 4

The single diode in Figure 1 is replaced by a diode bridge. Which one of the following circuits **(A. – D.)** is correct for a full-wave rectifying diode bridge?

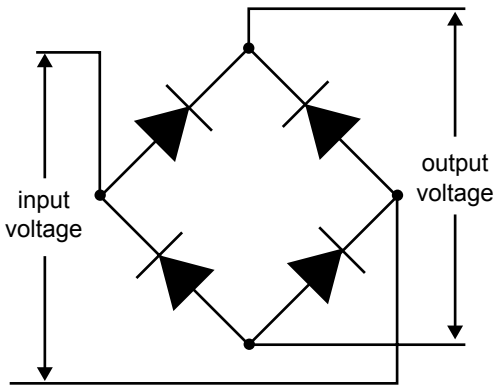
A.



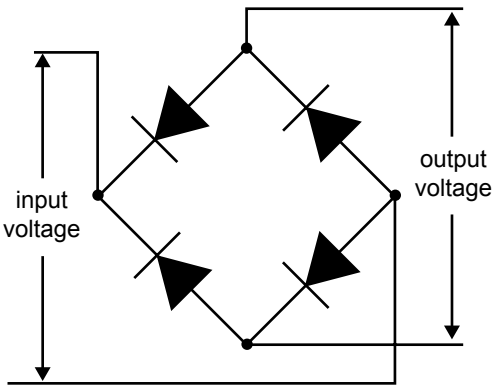
B.



C.



D.



2 marks

To test the smoothing components of a 1000 μF capacitor, you connect a switch and a 100 Ω resistor across the output side of a full-wave rectifying diode bridge circuit as shown in Figure 3.

Note that the switch is **open** so the resistor is effectively disconnected at this time.

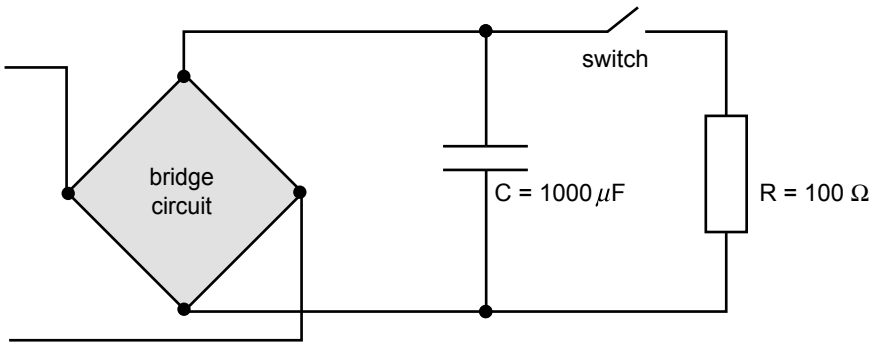


Figure 3

Question 5

You measure the time constant of this arrangement to be 1 ms. Calculate the effective resistance of the diode bridge circuit. Show your working.

Ω

2 marks

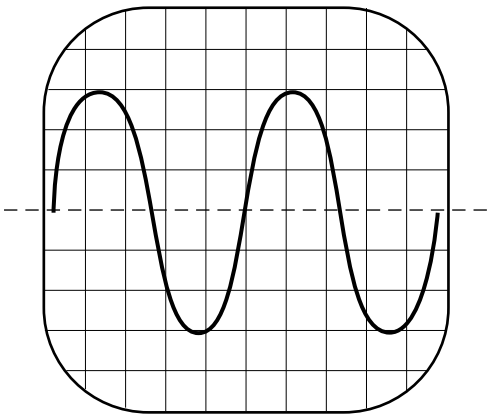
You now connect the 100 Ω resistor into the circuit by closing the switch in Figure 3. The voltage across the 100 Ω resistor is measured using a CRO.

Question 6

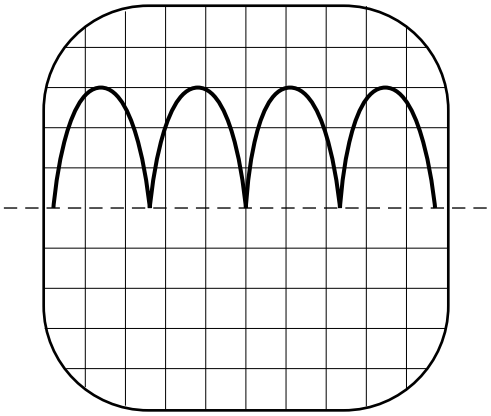
Which one of the following CRO traces **(A. – D.)** correctly shows the voltage across the resistor for the circuit depicted in Figure 3 with the switch **closed**?

All CRO settings are identical and the horizontal dashed line indicates the zero volt level.

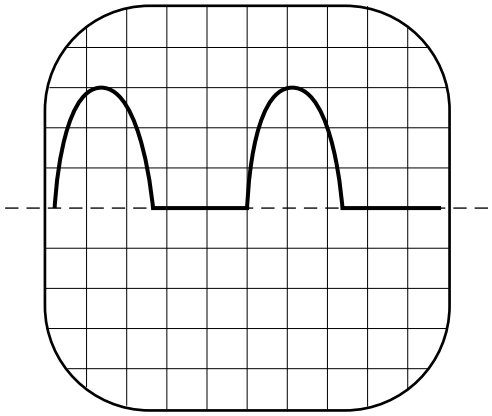
A.



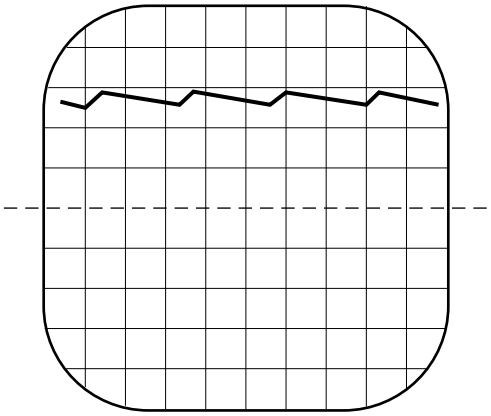
B.



C.



D.



2 marks

Prior to adding the voltage regulator to the circuit you use the unregulated DC power supply and connect to it the 100 Ω resistive load. Using a multimeter you determine the voltage across the load as +14 V DC with a peak-to-peak ripple of 1.0 V AC. The power supply is based on a full-wave bridge-rectifier design, and the period of the mains supply is 20 ms. You check these values using a CRO.

Question 7

Figure 4 shows a CRO screen.

On Figure 4

i. sketch the voltage trace you would expect across the resistive load using the voltage and time scales indicated

ii. clearly mark on the CRO screen a horizontal line to represent the zero volt level you are using in your answer.

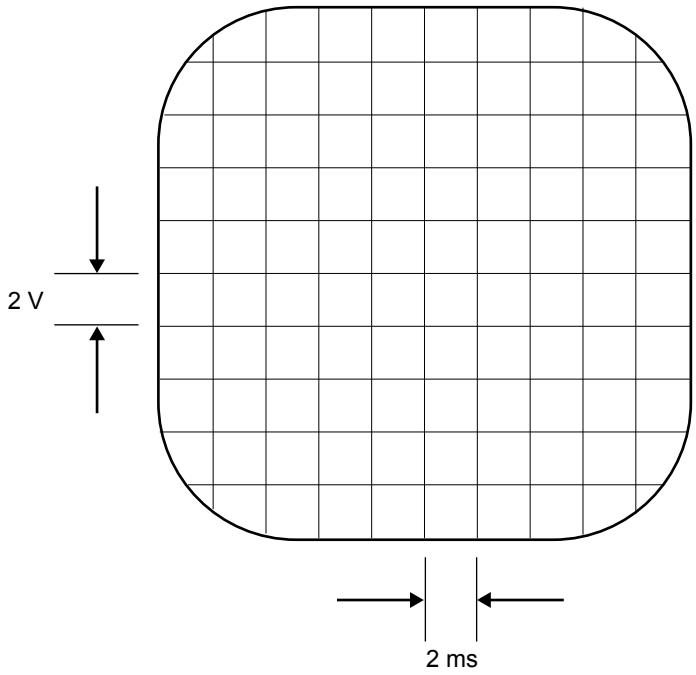


Figure 4

2 marks

You finally include a voltage-regulator device in your DC power supply that is designed to provide a 9 V DC voltage across the 100 Ω load. You confirm this DC voltage value using the multimeter. The current through the load resistor is thus 90 mA.

The voltage regulator can be considered a constant voltage device whose characteristics are shown in Figure 5, in series with an input resistor, R_{IN}.

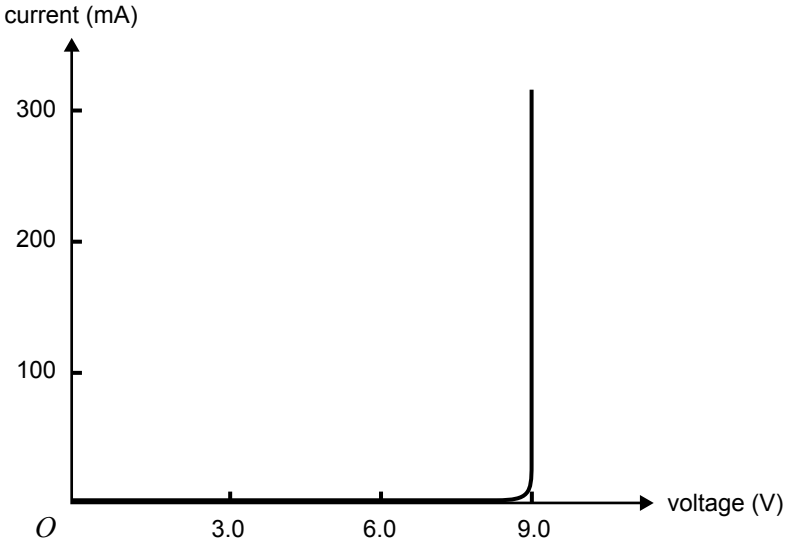


Figure 5

Question 8

You calculate the current through the input resistance, R_{IN}, of this regulator to be 200 mA. What is the current through the constant-voltage device of Figure 5?

mA

1 mark

Question 9

Two parameters that may change when using your regulated DC supply are the AC domestic line voltage and the load resistance.

For a voltage-regulated DC power supply, which one of the following statements **(A. – D.)** is correct?

A. The output voltage will change if the line voltage is altered.

B. The output voltage will change if the load resistor is changed.

C. The output current will change if the line voltage is altered.

D. The output current will change if the load resistor is altered.

2 marks

Question 10

Your power supply circuit will require a heat sink. Explain why a heat sink is used in this power supply circuit and what part of the circuit needs to be attached to this heat sink.

3 marks

Question 11

For general test measurements and fault diagnosis you have at your disposal a battery-powered multimeter (MM) and a cathode ray oscilloscope (CRO) powered from the mains.

Which one of the following statements is true?

A. The MM (in AC voltage mode) is the most sensible choice to measure the ripple voltage across a component compared to a CRO because it is less likely to affect the power supply circuit.

B. The CRO is the better voltage measuring instrument in this situation as it can measure both AC and DC voltages while a MM can only measure AC voltages.

C. The MM is the better test instrument to use as the only way to measure a current in a resistor is by using a MM (in AC or DC current mode). In using a CRO there is no way that the current in the resistor can be determined.

D. The CRO is the better instrument for test measurements and fault diagnosis as it can be used to fully describe the AC and DC ripple voltage, while the MM cannot.

2 marks

Question 12

You finally have a fully working, regulated, DC power supply. You make one further change: you replace the bridge, full-wave rectifier with a half-wave rectifier. You make no other changes and the circuit works satisfactorily, in that you measure 9 V DC across the 100-Ω load. However, you notice the ripple voltage approximately doubles.

Which one of the following statements is correct?

A. The ripple voltage has increased because the time constant has increased as there are fewer diodes used.

B. The ripple voltage had increased because the time constant has decreased as there are fewer diodes used.

C. The ripple voltage has increased because time between voltage maxima at the output of the rectifier has increased.

D. The ripple voltage has increased because time between voltage maxima at the output of the rectifier has decreased.

2 marks

END OF QUESTION AND ANSWER BOOK