Learning Materials by Lisachem

VCE PHYSICS 2008

YEAR 12 TRIAL EXAM UNIT 3

Reading Time: 15 minutes **Writing Time: 90 minutes**

Structure of Booklet

Section	No of Questions	No of Questions to be answered	No of Marks
A. Core Area of Study			
1. Motion in One & Two Dimensions	20	20	40
2. Electronic & Photonics	10	10	25
B. Detailed Study			
1. Investigating Materials & their uses in Structures.	11	11	25

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 answers booklet with detachable formula sheet.

Instructions
Detach the formula sheet during reading time.
Write your name in the space provided.
Answers all questions in the question and answers booklet when indicated.
Also show your workings where space is provided.
Where an answer box has a unit printed in it, give your answer in that unit.
All responses must be in English.

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Data Sheet VCE Physics 2008 Year 12 Trial Exam Unit 3

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	$F = G\frac{M_1 M_2}{r^2}$
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	AC voltage and current	$V_{RMS} = \frac{1}{2\sqrt{2}}V_{p-p}$ $I_{RMS} = \frac{1}{2\sqrt{2}}I_{p-p}$
15	voltage; power	$V = RI$ $P = VI$
16	resistors in series	$R_T = R_1 + R_2$
17	resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$
18	universal gravitational constant	$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
19	mass of Earth	$M_E = 5.98 \times 10^{24}$ kg
20	radius of Earth	$R_E = 6.37 \times 10^6$ m

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}

1 tonne = 10^{3} kg

VCE Physics 2008 Year 12 Trial Exam Unit 3

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

A truck is traveling along a straight horizontal section of freeway at a constant velocity of 80 km h $^{-1}$ north. The truck is overtaken by a car traveling at a constant velocity of 100 km h $^{-1}$ north.

Question 1
Calculate the relative velocity of the truck from the frame of reference of the car.

(2 marks)

Questions 2 and 3 refer to the following information.
The bumper car is a popular ride at many carnivals. There is a rubber bumper around the car that can absorb the energy of an impact. The rubber used for the bumper has force – compression characteristics as shown in **Figure 1**.

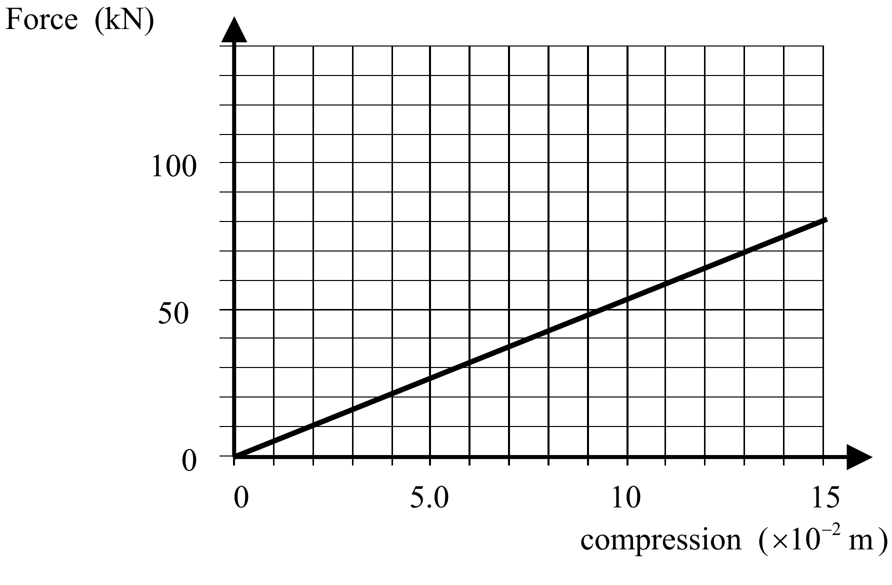


Figure 1

Linda is driving a bumper car at a speed of 2.5 m s $^{-1}$ and collides head on with a solid wall. The combined mass of Linda and the bumper car is 500 kg.

Question 2
Calculate the maximum distance, in mm, the rubber bumper is compressed.

mm

(2 marks)

Question 3
Calculate the work done by the rubber bumper on the bumper car as it is compressed.

J

(2 marks)

Questions 4 to 6 refer to the following information.
Two dynamics carts **A** and **B**, are pushed together and a spring between the carts is compressed. The system is held at rest, as shown in **Figure 2**. The spring is not attached to either cart. The carts are then released.
Figure 3 shows how the force exerted by the spring on the carts varies with time after release.

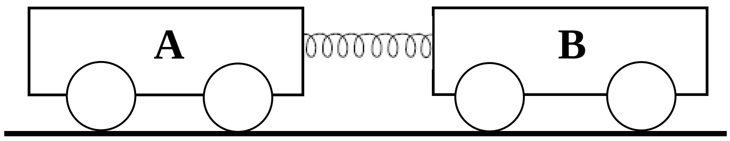


Figure 2

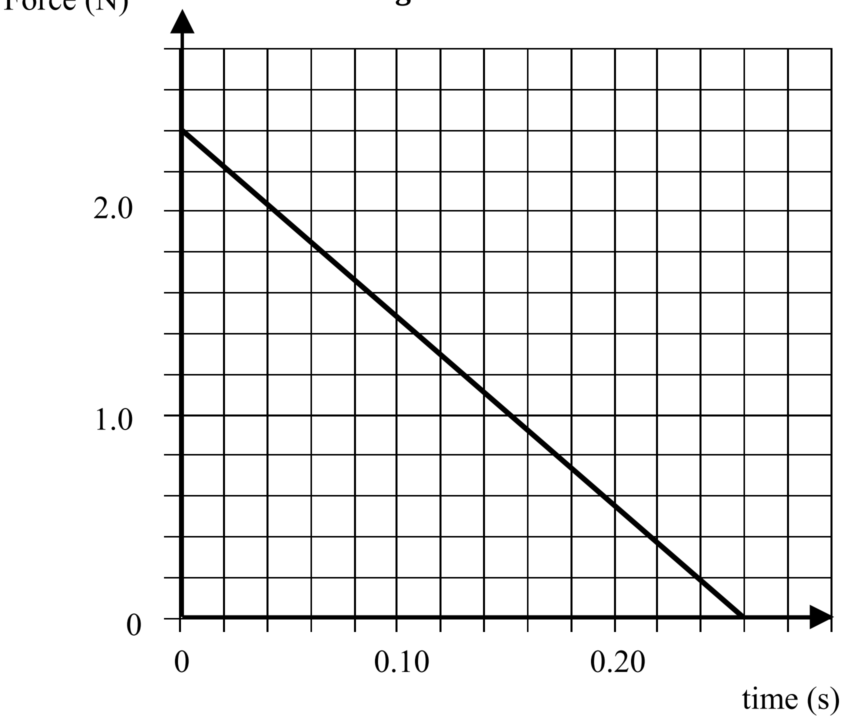


Figure 3

Question 4
Calculate the impulse, in Ns, experienced by each cart as the spring expands.

N s

(2 marks)

When the spring returns to its unstretched length and drops away, cart **A** is moving at 0.60 m s $^{-1}$.

Question 5
Calculate the mass, in kg, of cart **A**.

kg

(2 marks)

Question 6
State the final total momentum of the system at the instant the spring drops away.

kg m s $^{-1}$

(1 mark)

Questions 7 and 8 refer to the following information.

Figure 4

Figure 4 is an artist's conception of one of the planets that orbit the star 55 Cancri. This star is much like our own, but slightly fainter than the Sun.

The newly discovered planet may be similar to Saturn in its composition and appearance, and its location places the planet in the "habitable zone," a band around the star where the temperature would permit liquid water to pool on solid surfaces. The planet follows a circular path around 55 Cancri and completes one orbit every 260 days. The distance of this planet from 55Cancri is approximately 1.2×10^{11} m, slightly closer than Earth is to the Sun.

Question 7

Calculate the mass, in kg, of the star, 55 Cancri.

kg

(2 marks)

The masses of newly discovered planets are usually compared with the mass of the Earth. The gravitational force of attraction between 55 Cancri and the planet mentioned in the previous question is 2.7×10^{24} N.

Question 8

Calculate the value of the ratio;

$$\frac{\text{mass of the newly discovered planet}}{\text{mass of the Earth.}}$$

(3 marks)

The International Space Station (ISS) moves in a circular orbit around the Earth at a speed of 7.7 km s $^{-1}$ and at a height of 380 km above the Earth's surface.

Question 9
Calculate the period, in minutes, of the ISS.

minutes

(2 marks)

A space shuttle at a height of 300 km above the Earth's surface deploys a communication satellite of mass 900 kg that is to orbit at a height of 650 km above the Earth's surface. **Figure 5** shows the relationship between gravitational field strength and distance above the surface of the Earth.

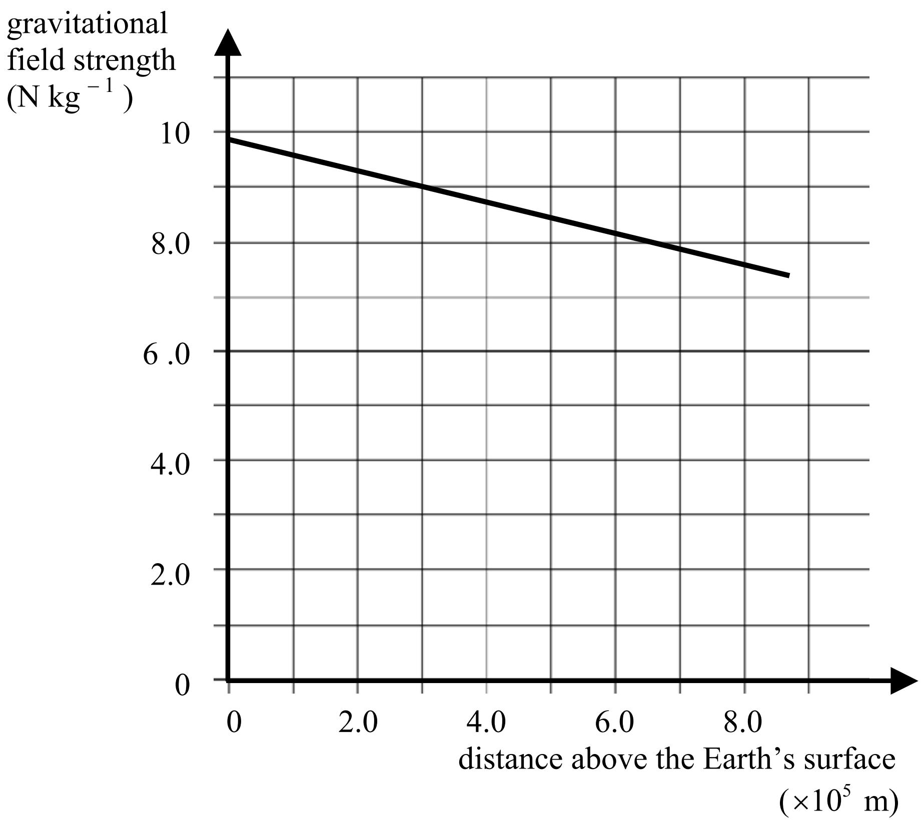


Figure 5

Question 10
Use **Figure 5** to estimate the work required, in J, to increase the gravitational potential energy of the satellite from 300 km to 650 km above the surface of the Earth.

J

(2 marks)

Questions 11 to 13 refer to the following information.
During a cycling race, a cyclist, starting from rest, applies a constant driving force and is travelling at a constant speed 16 metres from the start. The mass of the cyclist and bicycle is 80 kg. **Figure 6** shows the total resistive forces applied to the cyclist and the bicycle over the first 20 metres of the race.

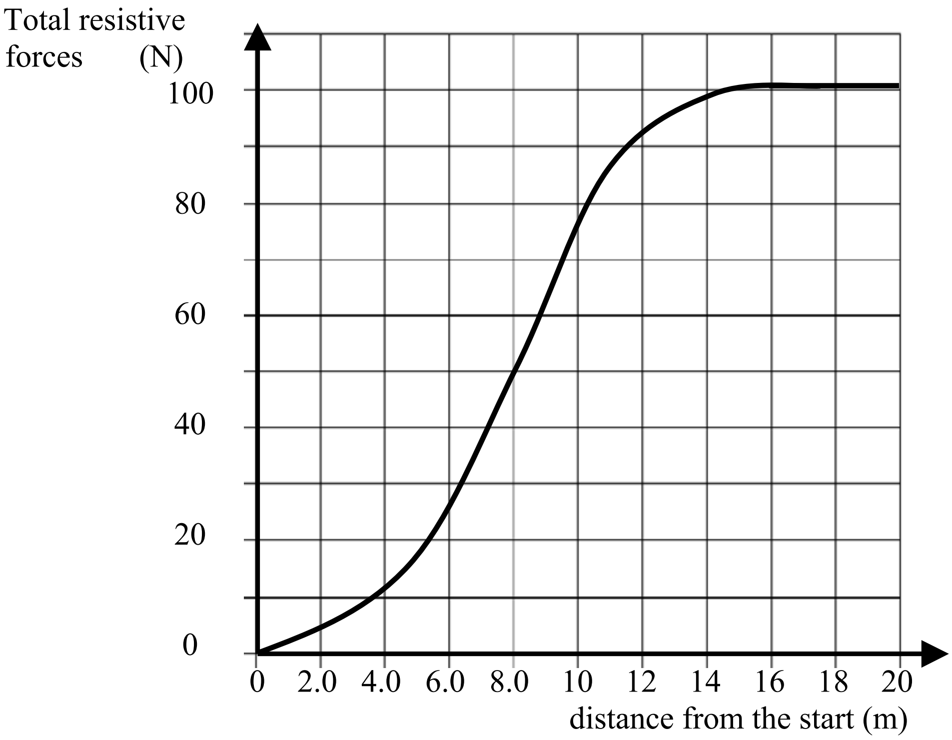


Figure 6

Question 11
Calculate the magnitude of the net force acting on the cyclist and bicycle at a distance of 18 m from the start. Justify your answer.

N

(2 marks)

Question 12
Calculate the magnitude of the constant driving force provided by the cyclist.

N

(2 marks)

Question 13
Calculate the magnitude of the acceleration of the cyclist and bicycle at a distance of 8.0 m from the start.

$m\ s^{-2}$

(2 marks)

Questions 14 and 15 refer to the following information.
Four graphs are shown below in **Figure 7**. Each one depicts some type of motion with respect to time.

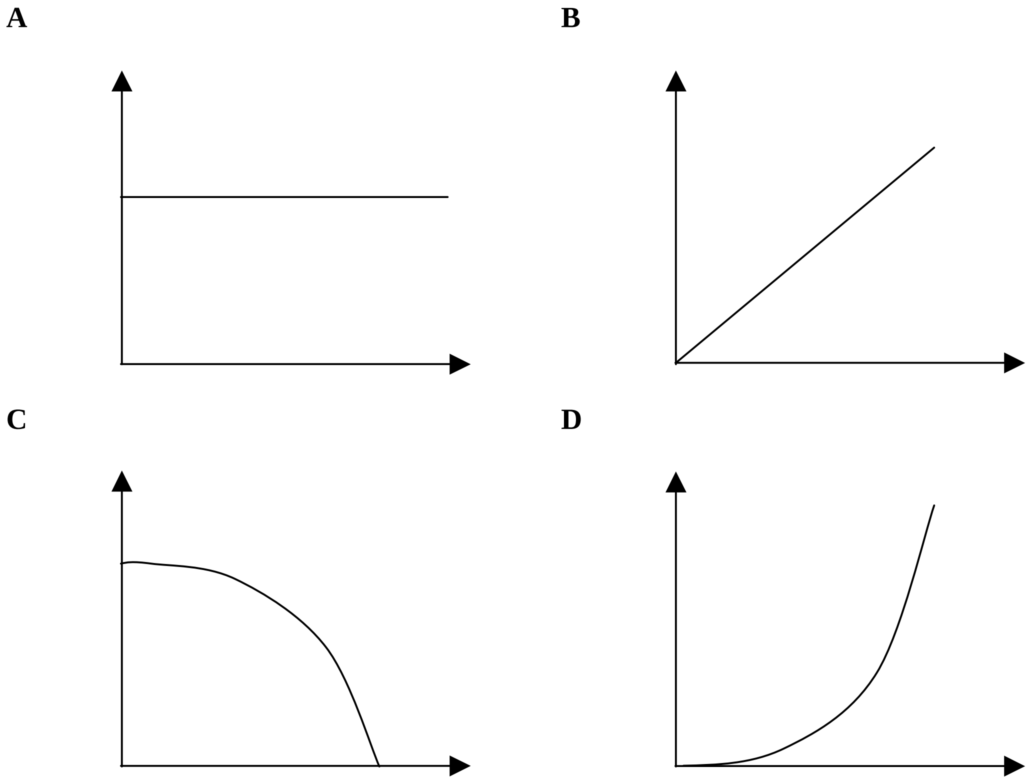


Figure 7

Question 14
Which one of the graphs, A – D, represents the distance moved in a vertical direction by a projectile launched horizontally from the top of a cliff?

(1 mark)

Question 15
Which one of the graphs, A – D, represents the acceleration of a moving projectile launched horizontally from the top of a cliff.

(1 mark)

Questions 16 and 17 refer to the following information.

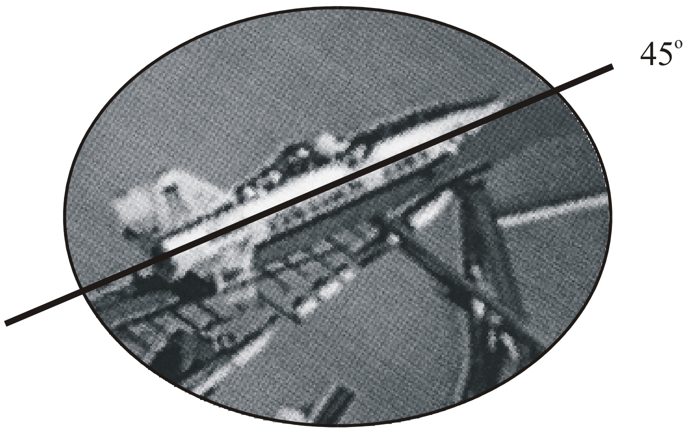


Figure 8

In 1974, Evel Knievel attempted a skycycle ride across the Snake River. The angle of the launching ramp was 45° to the horizontal, **(see Figure 8)**, and the horizontal distance the skycycle needed to travel was 1425 m.

Question 16
Calculate the launch speed, in km h^{-1} , required by Evel to leave the ramp and make it across the Snake River canyon?

km h^{-1}

(3 marks)

Question 17
Calculate the time of flight, in s, for this stunt.

s

(2 marks)

Questions 18 and 19 refer to the following information.

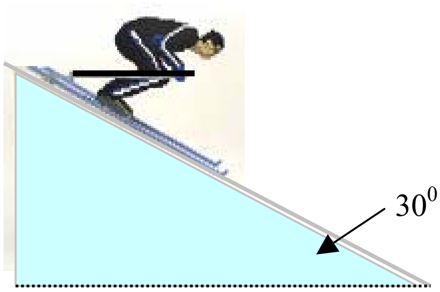


Figure 9

Tony has a mass of 70 kg and has just begun descending a 30° slope as shown in **Figure 9.** The magnitude of his acceleration down the slope is 4.0 m s^{-2}.

Question 18
Calculate the magnitude of the constant resistance force opposing Tony's motion down the slope.

N

(3 marks)

Question 19
Calculate Tony's speed down the slope after 6.0 s.

m s^{-1}

(2 marks)

After 6 seconds, Tony runs onto some soft snow and comes to rest over a distance of 45 m.

Question 20
Calculate the magnitude of the average retarding force, in N, that brings Tony to rest.

N

(2 marks)

End of Area of Study 1

Area of Study 2: Electronics and Photonics

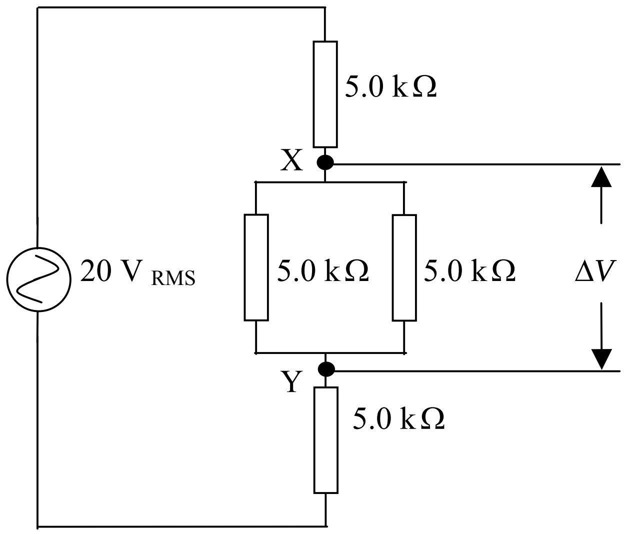


Figure 1

In **Figure 1**, four identical 5.0 kΩ resistors are used to construct a voltage divider. The voltage source across this voltage divider is an AC supply with an RMS voltage of 20 V.

Question 1
Calculate the RMS potential difference, ΔV, across points X and Y.

V

(3 marks)

Questions 2 to 4 refer to the following information.
An n-p-n transistor amplifier circuit, shown in **Figure 2**, is used to amplify a small, high frequency AC voltage from a microphone. The transistor is correctly biased.
The AC collector and base currents in **Figure 2** are indicated by i_C and i_B.

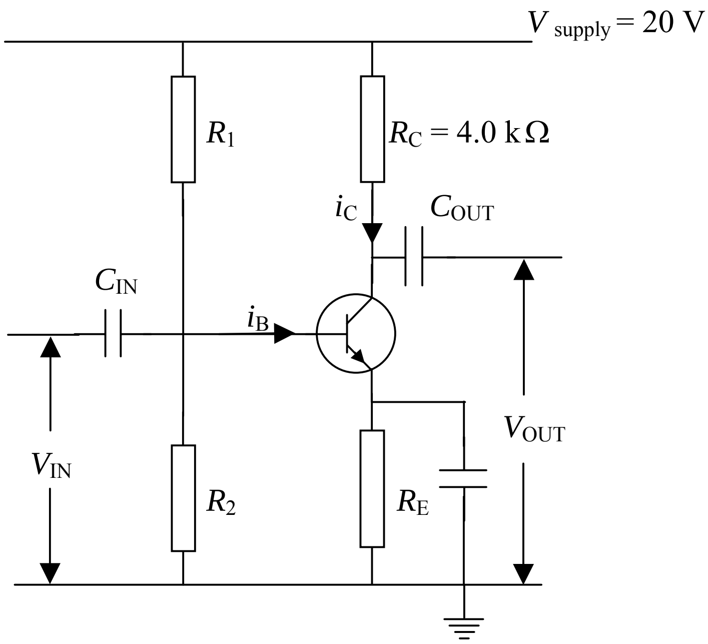


Figure 2

This transistor circuit has a current gain of 100.
A 10 mV (peak-to-peak) input voltage from the microphone gives rise to a time-varying base current of $i_B = 20\ \mu A$ (peak-to-peak).

Question 2
Calculate the peak to peak AC current flowing, in mA, in the collector resistor, R_C.

mA

(2 marks)

Question 3
Calculate the peak to peak AC potential difference, in V, across the collector resistor, R_c,

(2 marks)

V

Question 4
Calculate the magnitude of the voltage gain of this transistor amplifier.

(2 marks)

Questions 5 and 6 refer to the following information.
A light-emitting diode (LED), is connected in series with a resistor, R, as shown in **Figure 3**.

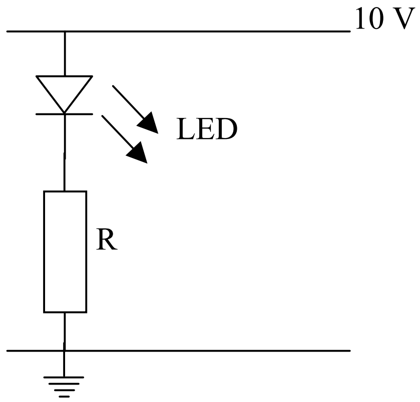


Figure 3

Figure 4 shows the current-voltage characteristics of the LED used in the circuit.
The optimum current through the LED is 40 mA for best results and longer life.

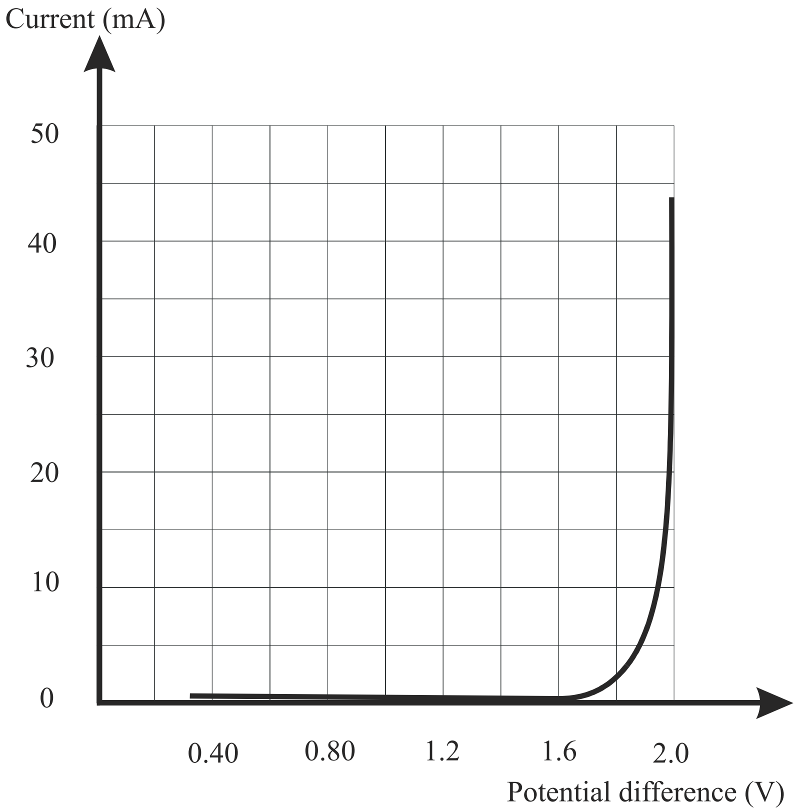


Figure 4

Question 5
Calculate the optimum value for resistor, R.

Ω

(3 marks)

The LED is difficult to see if the voltage across it is less than 1.9 V.
A 100 Ω resistor is used for R.

Question 6
Calculate the supply voltage required to allow the LED to be just visible.

V

(3 marks)

Questions 7 to 9 refer to the following information.
A light dependent resistor (LDR) can be used as part of a safety system circuit. **Figure 5** shows a resistor and LDR in series with an applied potential difference of 6.0 V. **Figure 6** shows the characteristics of the LDR.

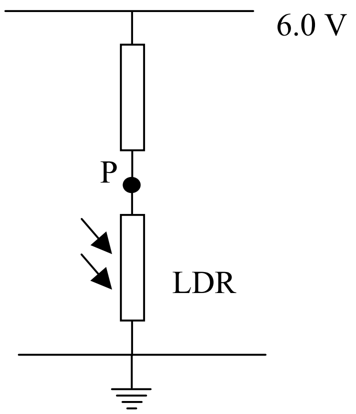


Figure 5

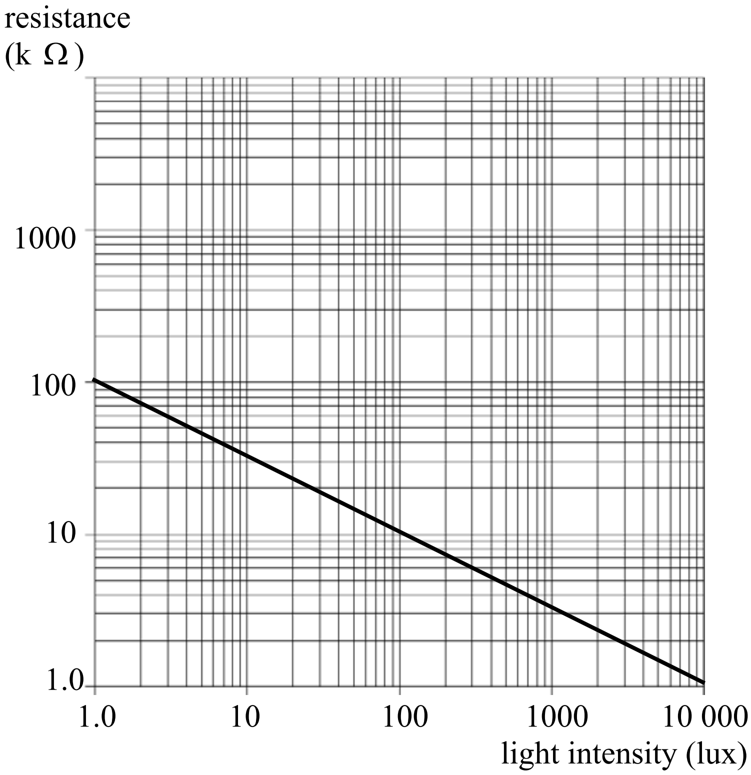


Figure 6

Question 7
Determine the resistance, in kΩ, of the LDR when the light intensity is 100 lux.

k Ω

(1 mark)

The light intensity is 100 lux and the resistance of the resistor is 200 k Ω.

Question 8
Calculate the potential, in V, at point P in the circuit.

V

(2 marks)

Question 9
Describe what happens to the potential at point P as the light intensity decreases.

____

____

____

(3 marks)

Optoisolators are circuit components that may contain both a light-emitting diode (LED) and a phototransistor (PT), where the input signal is electrically isolated from the output signal. **Figure 7** shows an optical switch consisting of an LED and a PT.

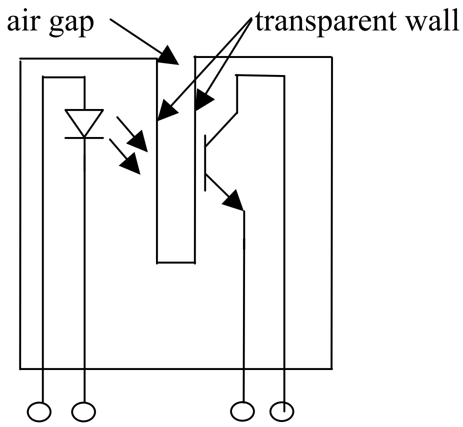


Figure 7

Question 10
Briefly describe the operation of the LED and the PT and explain how this combination of LED/PT in **Figure 7** could be used as a coin counter.

____

____

____

____

(4 marks)

End of Section A

SECTION B: Detailed Study

Instructions for Section B
Answer all the questions on this Detailed study.

Detailed Study 2: Investigating Materials and their use in Structures

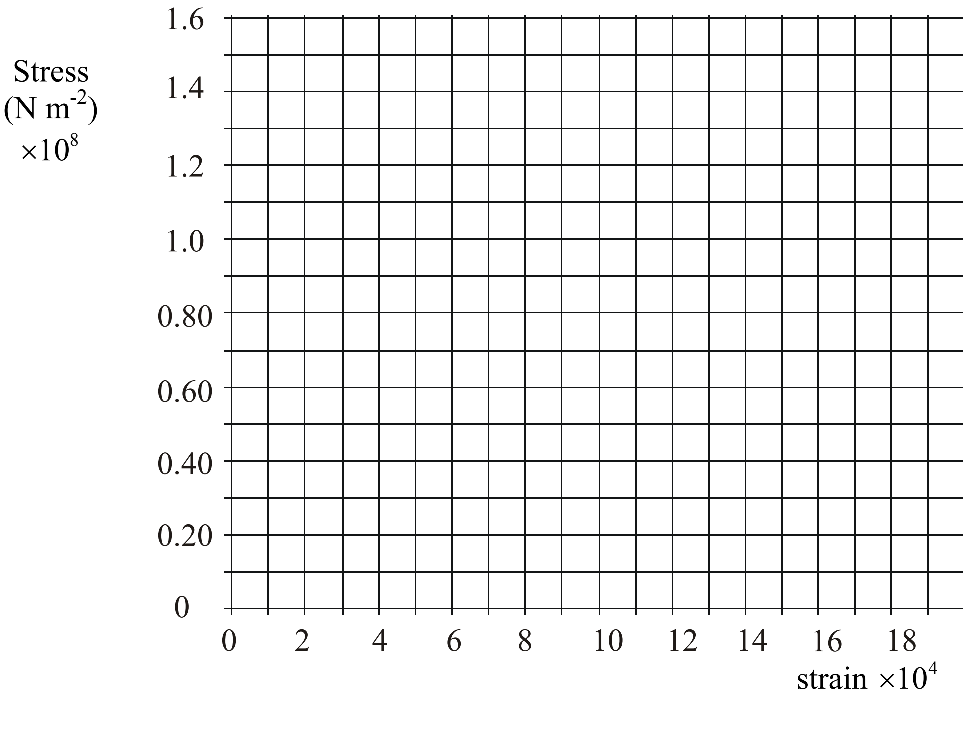
All materials have some inherent elasticity. When they are subjected to a force (or stress) they experience deformation (or strain), but recover their original shape when the stress is removed, unless the stress is too great. A student performs an experiment on some brass wire and obtains stress-strain data that is shown in **Table 1.**

Question 1
From the information given in **Table 1**, plot on the grid below a graph of stress v strain for a brass wire.

(2 marks)

Table 1

Stress $\times 10^8$ ($N\ m^{-2}$)	0.45	0.65	0.89	1.1	1.6
Strain ($\times 10^{-4}$)	4.5	6.6	8.9	11	16



Question 2
Use your graph to calculate a value for Young's modulus of elasticity for the brass wire.

$N\ m^{-2}$

(3 marks)

A force is used to rotate a beam in an anticlockwise direction. As the beam rotates from position 1 to position 4, as shown in **Figure 1**, the direction of the force changes as shown, but its magnitude remains constant.

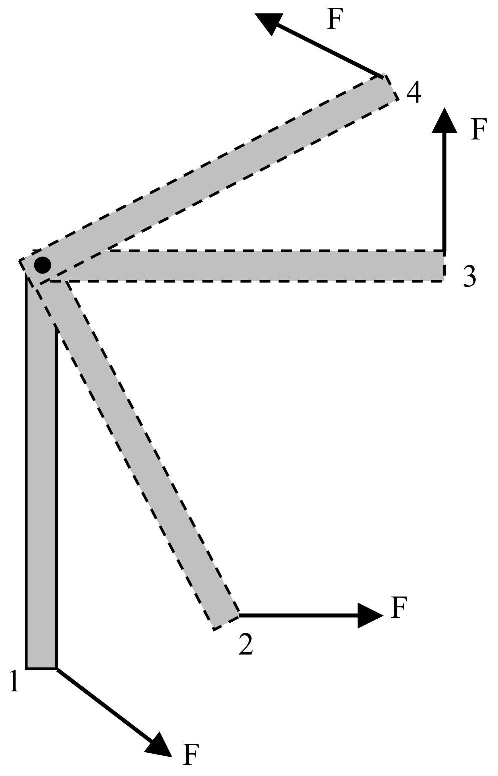


Figure 1

Question 3

From alternatives A – D, choose the one that describes how the magnitude of the torque of the force changes as the beam rotates from position 1 to position 4.

A. the torque is always increasing.
B. the torque is always decreasing.
C. the torque increases then decreases.
D. the torque decreases then increases.

(2 marks)

A painter of mass 80 kg stands 2.0 m from one end of a 5.0 m long board of mass 50 kg. The board is supported by two step-ladders, labeled as L and R, as shown in **Figure 2**.

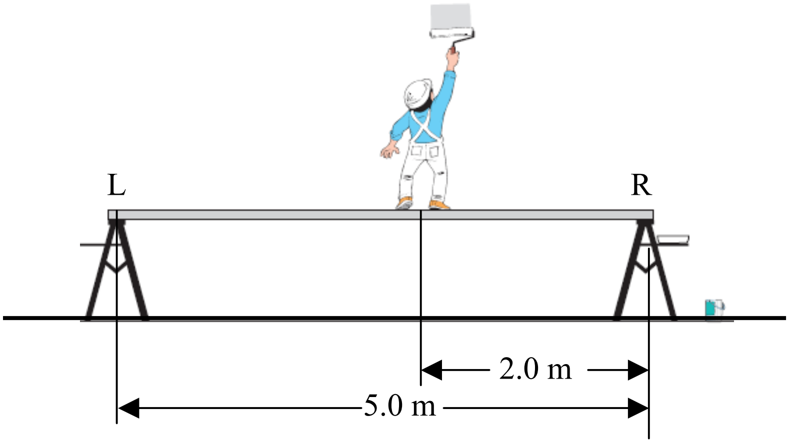


Figure 2

Question 4

Calculate the magnitude of the force exerted on the board by the left step-ladder, L.

N

(3 marks)

Questions 5 and 6 refer to the following information.

Figure 3 shows part of an apparatus that is used in an experiment to measure the value of *G*, the universal gravitational constant. The two lead spheres, each of mass 1.5×10^{-2} kg, have to be suspended from a tungsten wire that is as thin as possible. The Young modulus of tungsten is 4.1×10^{11} Pa and the breaking stress of tungsten is 1.2×10^{8} Pa. The mass of the brass rod and the wire may be ignored.

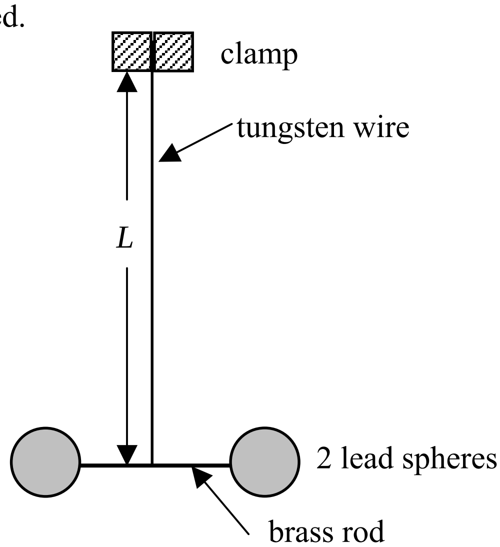


Figure 3

Question 5
Calculate the minimum cross-sectional area, in m^2, of the wire needed.

m^2

(2 marks)

In practice a wire of diameter 2.0×10^{-4} m is used. The original length, *L*, of the wire is 0.14 m.

Question 6
Calculate the extension, in mm, of the tungsten wire when the same two lead spheres are suspended from it.

mm

(2 marks)

A metal tie - rod is often used to tie together opposite walls of old buildings in order to prevent their collapse, as shown in **Figure 4**.
In one case a steel tie rod of diameter 19 mm is used as shown in **Figure 4** and when the nuts are tightened, the rod extends by 1.5 mm and the force exerted on the walls by the tie – rod is 20 kN. It may be assumed that the tie-rod behaves elastically.

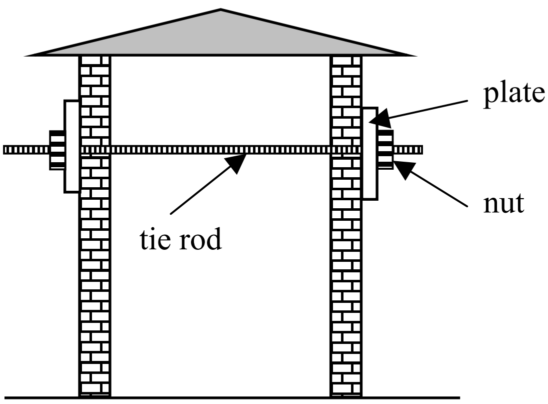


Figure 4

Question 7
Calculate the elastic strain energy in the tie - rod when it is extended by 1.5 mm.

J

(2 marks)

Question 8
Define each of the terms below as applied to materials and their use in structures.

i. strength of a material.

ii. plastic behaviour

(4 marks)

A stone slab is used to span a gap between two pillar supports. Small cracks appear after some time as shown in **Figure 5**.

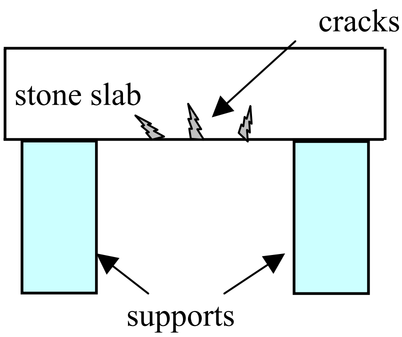


Figure 5

Question 9
Explain why the cracks appear on the underside of the stone slab.

(2 marks)

Questions 10 and 11 refer to the following information:

The stress–strain characteristics of a material are shown in **Figure 6** below. The fracture point is indicated by 'X'.

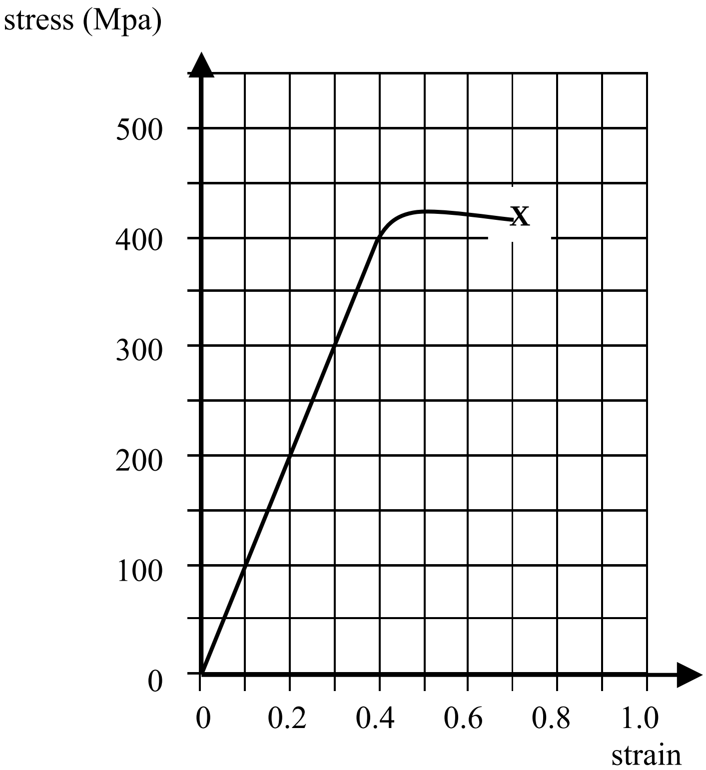


Figure 6

Question 10

Determine the elastic limit of this material? Include the unit.

(1 mark)

Question 11

Estimate the strain energy per unit volume required to fracture this material.

$J\ m^{-3}$

(2 marks)

End of Detailed Study

End of Trial Exam

Suggested Answers VCE Physics 2008 Year 12 Trial Exam Unit 3

Question	Section A – Core	Suggested Mark Allocation
Area of Study 1: Motion in One and Two Dimensions		
Question 1	$v_{T,C} = v_T - v_C$ $= 80\ km h^{-1}$ north $- 100\ km\ h^{-1}$ north $= -20\ km\ h^{-1}$ north $= 20\ km\ h^{-1}$ south	1 1
Question 2	Use: Loss of E_k = gain in U_S $\frac{1}{2}mv^2 = \frac{1}{2}kx^2$ $x^2 = \frac{(500 \times 2.5^2)(15 \times 10^{-2})}{80\,000}$ $x = 0.00586\ m$ $x = 5.9\ mm$	1 1
Question 3	Use; Loss in E_k = work done to compress the rubber $\frac{1}{2}mv^2 = work\ done$ $work\ done = \frac{1}{2}(500)(2.5)^2$ $= 1563\ J$ $= 1.6 \times 10^3\ J$	1 1
Question 4	Use; Area under the F-t graph is numerically equal to impulse. $area = \frac{1}{2} \times 2.4 \times 0.26$ $= 0.312\ N s$ $= 0.31\ N s$	1 1
Question 5	Given; u = 0 v = 0.60 m s $^{-1}$ $impulse = \Delta p$ $0.312 = p_f - p_i$ $0.312 = (m \times 0.60) - 0$ $m = \frac{0.312}{0.60}$ $m = 0.52\ kg$	1 1
Question 6	Momentum is conserved. The total initial momentum is zero. The total final momentum is zero.	1

Question 7	Use; $\frac{GM}{R^2}=\frac{4\pi^2R}{T^2}$ $M=\frac{4\pi^2R^3}{T^2G}$ $=\frac{4\pi^2(1.2\times10^{11})^3}{(260\times24\times3600)^2(6.67\times10^{-11})}$ $=2.0\times10^{30}$ kg	1 1
Question 8	Use; $F=\frac{GMm}{R^2}$ $M=\frac{FR^2}{GM}$ $\frac{(2.7\times10^{24})\times(1.2\times10^{11})^2}{6.67\times10^{-11}\times 2.0\times10^{30}}$ $= 2.9\times10^{26}$kg $\frac{\text{mass of planet}}{\text{mass of earth}}=\frac{2.9\times10^{26}}{5.98\times10^{24}}= 49$	1 1 1
Question 9	Use; $R=(3.8\times10^5)+6.37\times10^6$ m $v=\frac{2\pi R}{T}$ so; $T=\frac{2\pi R}{v}$ $=\frac{2\times\pi\times6.75\times10^6}{7700}$ $= 5510$ s $=92$ minutes	1 1
Question 10	Work/kg required is numerically equal to the area under the graph. Area = ½ (9.0 – 8.0) x (6.5 – 3.0) x 10^5 + (8.0 x (6.5 – 3.0) x 10^5 $=3.0\times10^6$ J work done $= 3.0\times10^6$ x 900 $=2.7\times10^9$	1 1

Question 11	The cyclist is traveling at constant speed 18 m from the start so the applied force must be the same magnitude as the resistive force. The net force acting is zero.	1 1
Question 12	Since the total resistive forces are 100 N, then the constant driving force exerted by the cyclist is 100 N also.	2
Question 13	Resistive forces at 8.0 m = 50 N = F_r Driving force must = 100 N So, $\sum F = 100 - 50$ $= 50$ N Use; $a = \frac{F}{m}$ $= \frac{50}{80}$ $= 0.63 \text{ m s}^{-2}$	1 1
Question 14	Vertical distance moved = ½ gt^2. This is a square relationship. Answer : graph **D**	1
Question 15	The projectile will have a constant acceleration. Answer: graph **A**	1
Question 16	Let u = initial velocity initial vertical velocity $= u \sin 45^{O}$ time to reach highest point $= \frac{u \sin 45^{O}}{10}$ so; time of flight $= \frac{2u \sin 45^{O}}{10}$ s for the horizontal motion; $x = u_H \times t$ $x = u \cos 45^{0} \times \frac{2u \sin 45^{O}}{10}$ $1425 = 0.10u^2$ $u = 119.3 \text{ m s}^{-1}$ $u = 1.2 \times 10^2 \text{ m s}^{-1}$	1 1 1
Question 17	time of flight $= \frac{2u \sin 45^{O}}{10}$ $= \frac{2 \times 119.3 \times 0.707}{10}$ = 16.9 s = 17 s	1 1

Question 18	Resolving forces along the plane; $mg\sin 30^0 - F_R = ma$ $F = mg\sin 30^0 - ma$ $= (70\times10\times0.50) - (70\times4.0)$ $= 350 - 280\ \text{N}$ $= 70\ \text{N}$	1 1 1
Question 19	Use; $v = u + at$ $v = 4.0\times6.0\ \text{m s}^{-1}$ $v = 24\ \text{m s}^{-1}$	1 1
Question 20	Work done to stop = loss in kinetic energy $F\times x = \frac{1}{2}mv^2$ $F = \frac{mv^2}{2x}$ $= \frac{70\times24^2}{2\times45}$ $= 448\ \text{N}$ $= 4.5\times10^2\ \text{N}$	1 1
Area of Study 2: Electronics and Photonics		
Question 1	Resistance of parallel resistors, Rp. Rp $= 2.5\ \text{k}\Omega$ Total resistance $= 5.0 + 5.0 + 2.5\ \text{k}\Omega$ $= 12.5\ \text{k}\Omega$ $\Delta V = \frac{2.5\,\text{k}}{12.5\,\text{k}}\times20$ $= 4.0\,\text{V}$	1 1 1
Question 2	Use; $i_C = 100 i_b$ $= 100\times20\times10^{-6}\text{A}$ $= 2.0\ \text{mA}$	1 1
Question 3	Use; $V = IR$ $= 2.0\times10^{-3}\times4\,000$ $= 8.0\ \text{V}$	1 1
Question 4	Use; $\frac{\Delta V_{OUT}}{\Delta V_{IN}} = \frac{8.0}{10\times10^{-3}}$ $= 800$	1 1

Question 5	The optimum current = 40 mA Potential difference across LED is 2.0 V for this current. There will be a potential difference across resistor R of (10 – 2) V = 8.0 V to calculate R; use $R=\frac{V}{I}$ $=\frac{8.0}{40\times10^{-3}}\ \Omega$ $=200\ \Omega$	1 1 1
Question 6	When the potential difference across the LED is 1.9 V, the current flowing is 5.0 mA (from graph). The potential difference across the resistor then will be; $V=IR$ $=5.0\times10^{-3}\times100$ $=0.50\ V$ so the supply voltage will need to be (1.9 + 0.50) = 2.4 V	1 1 1
Question 7	Reading from the graph; When light intensity = 100 lux; the resistance of the resistor is 10 kΩ	1
Question 8	Use; $V_{LDR}=\frac{10\,000}{(200\,000+10\,000)}\text{ x }6.0$ $=0.29\text{ V}$	1 1
Question 9	As the light intensity decreases, the LDR resistance increases. As the LDR resistance increases, the potential difference across the LDR increases. The potential at point P will increase.	1 1 1
Question 10	The LED emits light when connected to the circuit. The light from the LED passes through the transparent wall and strikes the phototransistor, thus causing a current to flow in the PT circuit. When a coin enters the air gap, the light is momentarily prevented from reaching the PT, and the circuit is broken. The number of times the circuit is broken by a coin can be recorded.	1 1 1 1
Detailed Study 2: Investigating Materials and their use in Structures		
Question 1	The graph is linear and should pass through the origin.	2
Question 2	The Young modulus of elasticity is numerically equal to the gradient of the graph. $E = 1.1 \times 10^{11}\ N\ m^{-2}$.	2 1
Question 3	The torque is at first increasing, then decreasing. Answer **C**	2

Question 4	To calculate the reactive force, F_L, at the left hand support; Take torques about the point of application of F_R, $\Sigma\tau_{CW} = \Sigma\tau_{ACW}$ $\tau_{CW} = 5.0 \times F_L$ $\tau_{ACW} = (80\times10\times2)+(50\times10\times2.5)$ $= 1600 + 1250$ so; $F_L = \frac{2850}{5.0}$ $F_L = 570\ N$	1 1 1
Question 5	Use; $stress = \frac{force}{area}$ $area = \frac{2\times1.5\times10^{-2}\times10}{1.2\times10^{8}}$ $= 2.5\times10^{-9}\ m^2$	1 1
Question 6	diameter = 2.0×10^{-4} m so the area is; $\frac{\pi d^2}{4} = \frac{3.142\times(2.0\times10^{-4})^2}{4}$ $= 3.14\times10^{-8}\ m^2$ $E = \frac{FL}{A\Delta L}$ $\Delta L = \frac{FL}{EA}$ $= \frac{2\times1.5\times10^{-2}\times10\times0.14}{3.14\times10^{-8}\times4.1\times10^{11}}$ $= 3.3\times10^{-6}\ m$ $= 3.3\times10^{-3}\ mm$	1 1
Question 7	Elastic strain energy; $U_s = \frac{1}{2}k\times^2$ $k = \frac{F}{\Delta x}$ $Us = 0.5\times\frac{20\,000}{0.0015}\times(0.0015)^2$ $= 15\ J$	1 1

Question 8	Strength of a material; The strength of a material is the largest stress that it achieves up to fracture. Plastic behaviour; is when the material does not return to its original dimensions when the force is removed. The material has suffered permanent distortion.	1 1 1 1
Question 9	The stone slab will suffer compression on the top surface but tension forces on the underside as it is positioned. Stone is weak in tension and will crack.	1 1
Question 10	The elastic limit of this material occurs at a stress of 400 MPa.	1
Question 11	Strain energy per unit volume; is the area under the graph up to the fracture point. $\text{area} = (\frac{1}{2}\times 0.40\times 400\times 10^{6}) + (0.30\times 420\times 10^{6})$ $= 2.1\times 10^{8}\ \text{J m}^{-3}$	1 1

End of Suggested Answers