Year 11 Physics

Student Name: _____

Practice Exam 2 (Unit 1 & 2)

Time allowed

Reading time: 15 minutes
Working time: 150 minutes

Structure of this paper

Section	Number of questions	Number of questions to be answered	Marks
How can thermal effects be explained?	8	8	36
How do electric circuits work?	5	6	38
What is matter and how is it formed?	8	10	33
How can motion be described and explained?	7	7	43
		Total	150

Notes to students

- Write your name in the space provided above.
- A formulae and data booklet has been provided.
- The following items are approved for use in the examinations:
  - Standard items: pens (blue/black preferred), pencils, highlighters, erasers, sharpeners, rulers, pre-written notes (one folded A3 sheet or two A4 sheets bound together by tape)
  - Special items: one scientific calculator. Check with your teacher which calculators are approved to use in this examination.
- Answer all questions in the spaces provided using black or blue pen.
- You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
- Diagrams are not drawn to scale (unless otherwise stated).
- Assume the value of g to be 9.8 m s^{-2}.

Disclaimer

This is a practice examination. It represents Pearson Australia's view only of what would be useful preparation material for the VCE Units 1 and 2 externally assessed examination.

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Unit 1

Area of Study 1 How can thermal effects be explained?

Question 1

"Close the door, you are letting the cold in!"

a What is wrong with this statement? (1 mark)

b Re-write the sentence so that it is correct. (1 mark)

Question 2

Consider a bucket of water and a swimming pool both at the same temperature. Fill in the following table using the words 'same', 'less' or 'more'. (4 marks)

	Average kinetic energy	Internal energy
bucket		
pool		

Question 3

500 g of water at 25.0°C in a plastic beaker is placed in a freezer, which coverts it to ice in 8.00 minutes. (Assume the heat capacity of the plastic beaker is negligible, the specific heat capacity of water is 4200 J kg^{-1} K^{-1} and the latent heat of fusion of water is 3.34 × 105 J kg^{-1}.)

a Calculate the heat transfer, Q_1, from the water as its temperature falls from 25°C to 0°C. (2 marks)

b Calculate the heat transfer, Q_2, from the water as it changes from 0°C water to 0°C ice. (2 marks)

c Calculate the rate of heat transfer from the water. (3 marks)

d An immersion heater rated at 1200 W is placed into 0.75 kg of water at 10°C for 2.00 minutes. What is the final temperature of the water? (4 marks)

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Question 4

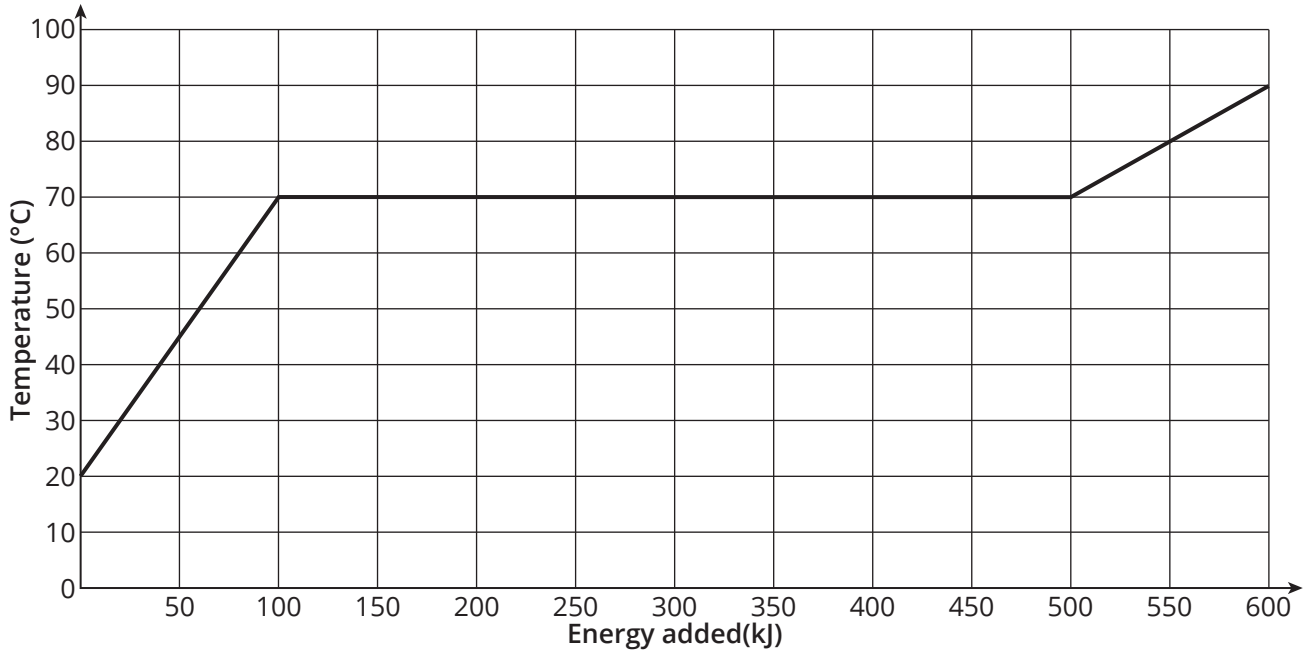
A substance is stirred vigorously and in doing so, the internal energy of the substance increases by 700 J.

a If 1 kJ of work was done on the substance by the stirring mechanism, how much thermal energy was lost to the surroundings from the substance? (2 marks)

b In the instance described in part **a**, are the substance and its surroundings in thermal equilibrium? Explain. (2 marks)

Question 5

The graph below shows the curve for a 2.0 kg sample of material that begins as a solid at room temperature and finishes as a hot liquid. Energy is added at a constant rate.



a State the temperature at which the substance melts. (1 mark)

b What is the specific heat capacity of the material in its solid form? (2 marks)

c What is the specific latent heat of fusion of the material? (2 marks)

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Question 6

The wavelength of visible light falls between 700 nm and 400 nm (approx.).

a Object *X* in outer space has a temperature of 5000 K. Does its peak wavelength fall within the visible spectrum? (3 marks)

b Another object, *Y*, emits light at a peak wavelength of 500 nm. Does object *Y* emit light of a higher or lower frequency than object *X*? Justify your answer. (3 marks)

Question 7

The temperature of a metal rod increases from 300 K to 900 K. How much greater is the rate of transmission of radiant energy at the higher temperature? (1 mark)

A 3 times as much

B 9 times as much

C 27 times as much

D 81 times as much

Question 8

The use of heavy curtains with a pelmet on windows can reduce the transfer of thermal energy into and out of a house and thus contribute to its energy efficiency. With reference to conduction, convection and radiation, describe how heavy curtains reduce heat transfer. (3 marks)

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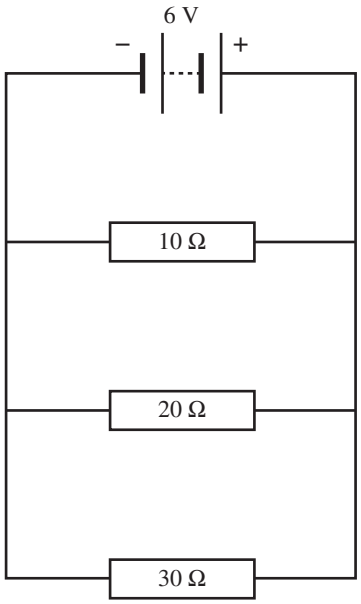
Question 9

Three resistors are connected in parallel as shown below.



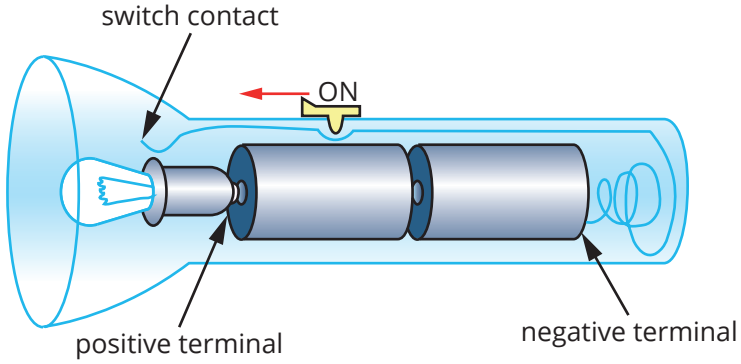
a What is the value of the ratio $\frac{\text{potential difference across the 20 Ω resistor}}{\text{potential difference across the 10 Ω resistor}}$? (2 marks)

b What is current in amperes through the 30 Ω resistor? (2 marks)

c What is the effective resistance of the circuit? (3 marks)

Question 10

A typical torch uses two 1.50 V batteries in series and is rated 0.900 W. Calculate the resistance. (2 marks)



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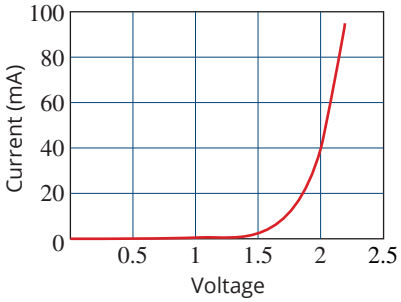
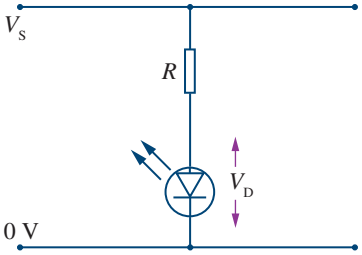
Question 11

The graph below shows the characteristics of an LED, which is to be used in the circuit shown. For optimum life and light efficiency, the current through the LED should be 40 mA. At higher currents the LED will be brighter but its life is shortened and it will burn out rapidly if the current exceeds 90 mA.





a With a supply voltage V_s of 10 V, what is the optimum value for R? (3 marks)

b What is the minimum possible value for R if the LED is not to burn out rapidly? (3 marks)

c If the voltage across the LED is less than 1.7 V, it will be too dim to see. What is the minimum value of the supply voltage that could be used with the 100 Ω resistor if the LED is to be just visible? (3 marks)

Question 12

Consider two resistors, one with resistance 100 Ω and the other with resistance of 400 Ω. The resistors are connected in a circuit with a 10 V power supply.

a Two types of circuit could be constructed with these resistors—a series or a parallel circuit. Which of these circuits would have the greater total resistance? Use calculations to justify your answer. (4 marks)

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b Compare the current drawn when the resistors are connected in parallel with the resistors connected in series. Which draws the greater current? Use calculations to justify your answer. (3 marks)

c Compare the power drawn when the resistors are connected in parallel with the resistors connected in series. Which draws the greater power? Use calculations to justify your answer. (3 marks)

d The circuits in homes are mostly parallel circuits. Give two reasons why this is the case. (2 marks)

Question 13

A 2 kΩ resistor is placed in a circuit. A voltmeter is connected across it and shows a reading of 6 V.

a What is the current that flows through the resistor? (2 marks)

b What charge flows through the resistor in a one minute period? (2 marks)

c How many electrons flow the resistor in one minute? (2 marks)

d How much electrical potential energy was transferred to the resistor in this time? (2 marks)

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Question 14

For every elementary matter particle there exists an antimatter particle. What happens when a particle and its antiparticle come into contact? (2 marks)

Question 15

Use the following multiple choice key to answer these questions.

A quarks
B leptons
C baryons
D strong nuclear force
E weak nuclear force

a Which group of particles are electrons a type of? (1 mark)

b Protons and neutrons are made up of elementary particles. Which of the above make up protons and neutrons? (1 mark)

c Which group of composite subatomic particles are protons a type of? (1 mark)

d Quarks are the only things to interact using which of the above? (1 mark)

e Leptons interact by exchanging W and Z bosons. Which of the above do these bosons mediate? (1 mark)

Question 16

Plutonium-239 is a fissile material. A particular plutonium-239 nucleus is struck by a fast moving neutron in a fast breeder reaction it splits into barium-145 and strontium-93 and releases some neutrons. The nuclear equation for this is:

$${}^{1}_{0}\text{n} + {}^{239}_{94}\text{Pu} \rightarrow {}^{145}_{56}\text{Ba} + {}^{93}_{38}\text{Sr} + X{}^{1}_{0}\text{n} + \text{energy}$$

a Determine the number of neutrons released. (1 mark)

Number of neutrons = _____

The energy released during the fission of this plutonium nucleus is 2.76×10^{-11} J.

b Calculate the loss in mass (mass defect) during this fission reaction. (3 marks)

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Question 17

Not all of the elements of the periodic table are naturally occurring. Some have been man-made, often by neutron bombardment. This is known as artificial transmutation.

Enrico Fermi was the first to perform this. He bombarded uranium-238 with high energy neutrons.

a Write a nuclear equation to show the neutron absorption of a uranium-238 atom. (2 marks)

This new nuclide is unstable and was found to undergo beta-minus decay to form a new element.

b By referring to the periodic table supplied, write a nuclear reaction for the beta-minus decay of this new nuclide. (2 marks)

c Uranium-238 is the most abundant isotope of uranium, however it is non-fissile. What does fissile mean? (3 marks)

Question 18

There are four naturally occurring stable isotopes of strontium. There are many unstable isotopes of strontium that are known to exist, the longest-lived of which is strontium-90. It decays through β-minus emissions and has a half-life of 29 years.

a Explain what is meant by the term 'isotope'. (2 marks)

b Write a beta decay equation for strontium-90. (2 marks)

c Another radioisotope of strontium, strontium-89, which is an artificial radioisotope that is used in the treatment of bone cancers. Typically, cancer treatments will be treated with a dose of 150 MBq. Pellets of this isotope are embedded near the tumour. Strontium-89 has an approximate half-life of 50.5 days. A particular patient feels relief from such a dose for 202 days. Calculate the activity of this dose after 202 days. (3 marks)

Question 19

Define synchrotron light. (1 mark)

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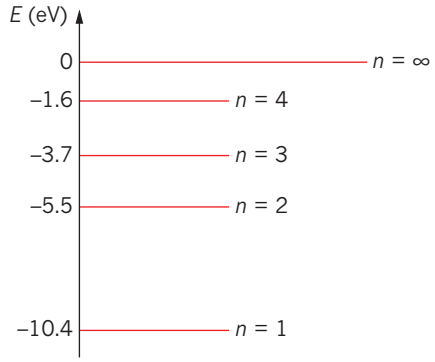
Question 20



The graph above shows the energy levels for mercury gas.

Compare the energy released by an electron jumping from the $n = 3$ level to ground with one jumping from the $n = 2$ level to ground. How many times greater is one compared to the other?

(3 marks)

Question 21

For each of the following sentences fill in the blank using the terms 'greater than', 'less than' or 'the same as'.

a The speed of gamma rays is _____ the speed of ultra violet light in a vacuum. (1 mark)

b The frequency of ultraviolet is _____ the frequency of infrared light. (1 mark)

c The wavelength of visible light is _____ the wavelength of ultraviolet light. (1 mark)

d The energy of radio waves is _____ the energy of visible light. (1 mark)

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Question 22

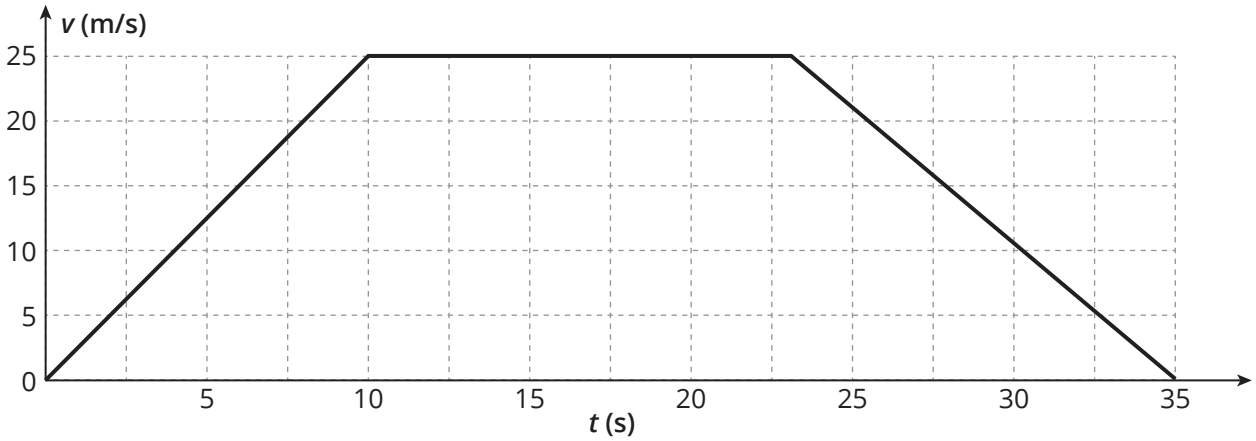
A typical train on a rural railway line travels at 110 km h^{-1}. When the brakes are applied it will travel 1500 m before it stops. What is the average deceleration of such a train? (3 marks)

Question 23

The two largest male lions at the zoo have an approximate weight of 1764 N each. Calculate their approximate mass. Include the correct units in your answer. (2 marks)

Question 24

A driver accelerates uniformly away from a set of traffic lights in a 1200 kg car. The velocity versus time graph for this motion is shown below.



a What is the initial acceleration of the car? Give an appropriate unit with your answer. (3 marks)

b What is the total distance travelled, in metres, in the 35 s? (3 marks)

c What is the net force acting on the car at time t = 30 s? (3 marks)

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d What is the net force acting on the car at time t = 20 s? Explain your answer. (2 marks)

Question 25

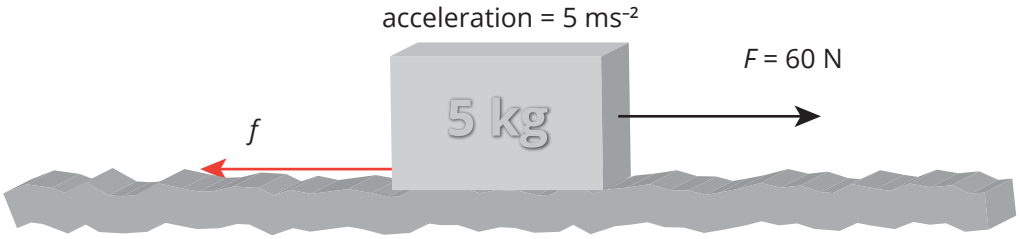
A 150 g ice puck collides head on with a smaller 100 g ice puck, initially stationary, on a smooth, frictionless surface. The initial speed of the 150 g puck is 2 m s^{-1}. After the collision the 150 g ice puck moves off at 0.5 m s^{-1} in the same direction as its initial direction of motion.

a What is the velocity of the 100 g puck after the collision? (2 marks)

b Is this collision elastic or inelastic? Use calculations to justify your answer. (5 marks)

Question 26

The diagram below shows a 5.0 kg object accelerating at 5 m s^{-2} on a rough horizontal surface.



a What is the net force acting on the 5 kg mass? (2 marks)

b What is the magnitude of the force of friction, f? Include a unit. (2 marks)

c The 5 kg mass accelerates from rest for 2 seconds. How far did the 5 kg mass travel? (2 marks)

d What is the work done by the applied force on the mass? Include a unit. (2 marks)

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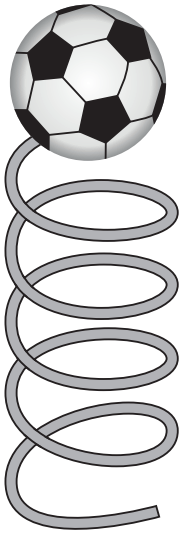
e How much energy has been dissipated as heat during this time? Include a unit. (3 marks)

Question 27

Consider the situation below where a ball (m = 0.2 kg) is launched vertically via a compressed spring. The spring has a spring constant, k, of 600 N m^{-1}. To launch the ball, the spring is compressed by 10 cm. Assume negligible air resistance.



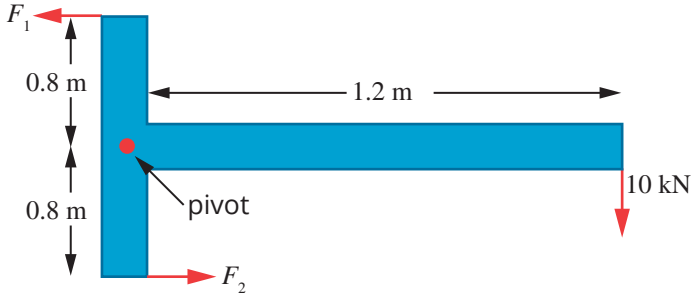
a How much energy is stored in the spring when it is compressed by 10 cm? (2 marks)

Assume that all of the energy from the spring is converted to kinetic energy when the ball is launched into the air.

b There is a target placed 1.5 m above the ground, directly over the spring. Will the ball hit the target? Use calculations to support your answer. (3 marks)

Question 28

A T-shaped member has a pivot point as shown in the diagram below. The member is subjected to a 10 kN force at one end. Ignoring the mass of the member and assuming that $F_1 = F_2$, calculate the values of F_1 and F_2 necessary to keep it in equilibrium. (4 marks)



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