Year 11 **Physics**

Student Name: ______________________

Practice Exam 1 (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	37
How do electric circuits work?	6	6	40
What is matter and how is it formed?	10	10	33
How can motion be described and explained?	7	7	40
		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

When a substance is heated, it will experience changes in internal energy. Complete the information given below, about how changes in the following will affect a substance.

a A change in the potential energy of the particles in a substance can lead to: (2 marks)

b A change in the average kinetic energy of the particles in a substance leads to: (1 mark)

Question 2

An electrical kettle contains a heating element, which is used to heat water inside.

a The heating element does 150 kJ of work on the water. Assuming that 10 kJ of heat is transferred away from the water through the spout, use the first law of thermodynamics to calculate the change in internal energy of the water. (2 marks)

b The heating element is turned off. Some of the hot water, now at 90°C, is poured into a cup containing a small amount of cold water at 20°C. Describe the energy transfers that occur in this situation and explain why the energy transfer will eventually cease. Include the effect of surrounding air in your explanation. (3 marks)

c Imagine that the remaining hot water from the kettle, still at 90°C, is placed into a black plastic container with emissivity, *e*, of 0.95. The container is a cube with side lengths of 10 cm. Calculate the rate of heat loss from the container, in watts, if the surrounding air is at 20°C. (3 marks)

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Question 3

James Bond likes to drink cocktails. On a warm afternoon (26°C), he is mixing cocktails whilst the ice is melting (0°C) in a bowl. Note: the specific heat capacity of the cocktails is 2.7×10^3 J $kg^{-1}°C^{-1}$ and of water is 4.2×10^3 J $kg^{-1}°C^{-1}$. The latent heat of fusion of water is 3.34×10^5 J kg^{-1}.

a Matthew, a colleague of James, likes his cocktails served at 0°C. What is the minimum mass ice cube he should select to cool his 60-gram cocktail from 26°C to 0°C? (3 marks)

b James prefers his 60-gram cocktail served at 10°C and shaken, not stirred! What mass of ice cube will he need to cool his drink from 26°C to this temperature? (4 marks)

c Pablo, another colleague, decides he wants a cup of tea. He uses a 2000 W mains operated kettle filled with 1.20 kg of water at room temperature (26°C). How long will he have to wait for the water to reach boiling point (100°C)? Give your answer in minutes. (2 marks)

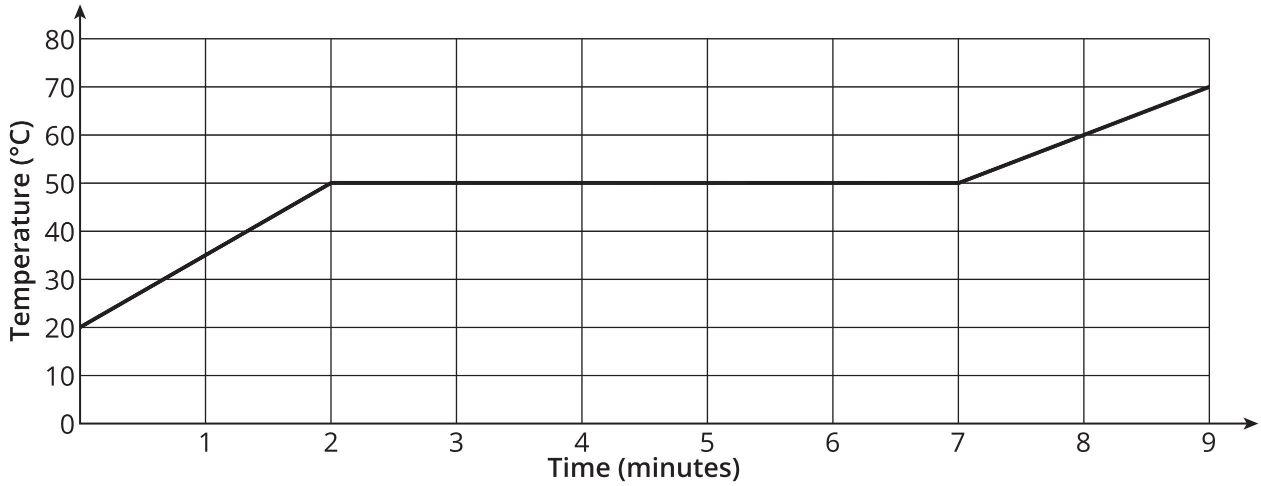
d After several minutes it is noticed that there are drops of liquid water on the outside surfaces of the cold cocktail glasses. Explain why this effect occurs and describe what thermal effect this will have on the remaining contents of the glass.

Explanation (2 marks)

Description: (2 marks)

Question 4

The graph below shows the temperature–time relationship for the heating of 0.25 kg of soft wax by an electrical heater supplying 50 J of heat energy per second.



a Determine the wax's melting temperature. (1 mark)

b Find the latent heat of fusion of the wax. (2 marks)

Question 5

Two stars, A and B, emit light of various wavelengths. The peak wavelength emitted by star A is 700 nm. The peak wavelength emitted by star B is 620 nm. Calculate the temperature at the surface of each star. (3 marks)

Question 6

a Explain why the greenhouse effect is essential for life on Earth. (2 marks)

b Explain why the enhanced greenhouse effect is undesirable. (2 marks)

Question 7

The transfer of thermal energy around and through the Earth is carried out by different processes depending on the substance the energy is transferred through. Which of the following statements is true about the way thermal energy moves around the Earth? (1 mark)

A As the mantle is a fluid, thermal energy flows through it mainly via conduction.

B As the crust is a solid, thermal energy is transferred from the mantle to the crust mainly via radiation.

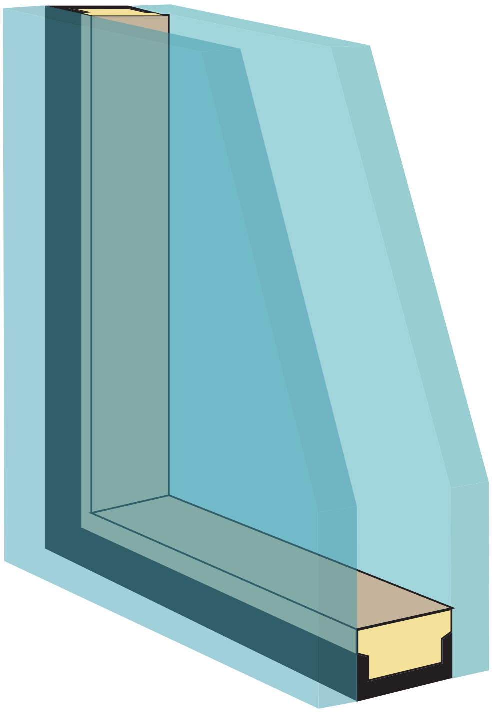
C As the atmosphere is a fluid, thermal energy flows through it mainly via convection.

D As air is a good conductor of heat, heat moves through the atmosphere mainly via conduction.

Question 8

There are a number of ways in which passive design features can be incorporated into housing design, for example, the inclusion of double-glazed windows. These offer more effective insulation than single-glazed windows. Explain how double-glazed windows achieve this.

(2 marks)



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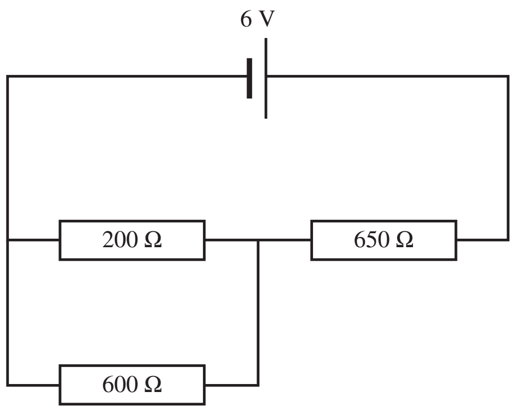
Area of Study 2 **How do electric circuits work?**

Question 9

This question refers to the following circuit.

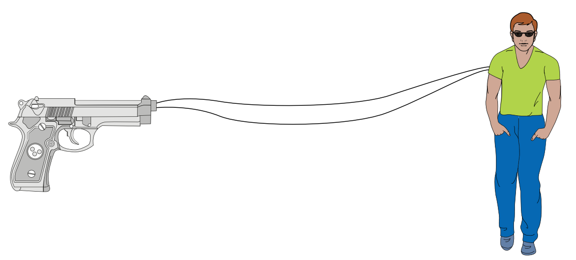


a Show, by calculation, that the total resistance of the circuit is 800 Ω. (3 marks)

b Calculate the current that flows through the 600 Ω resistor. (3 marks)

Question 10

The diagram below shows the X-26 Taser that is sometimes used by police. A taser is a device designed to subdue a person by making them part of an electric circuit and then sending pulses of electrical current into their body.



When operating:

- the X-26 Taser sends 10 pulses of electric current each second
- each pulse of current lasts for 1.00×10^{-4} seconds
- during each pulse 1.90×10^{-3} A of current flows
- during each pulse the potential difference across the circuit at the points of contact is 350 V.

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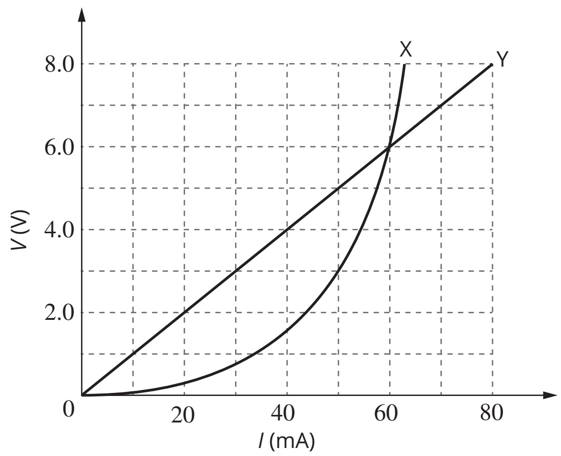
a How much charge passes through the offender's body during a single pulse from the Taser X-26? (2 marks)

b How many electrons would flow through the wires of the X-26 Taser during a single pulse? (2 marks)

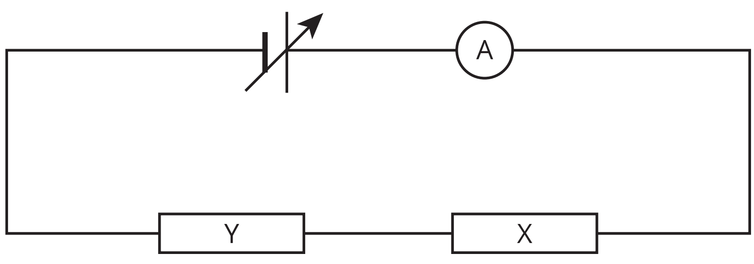
c How much electrical energy is delivered in 2.00 seconds? (3 marks)

Question 11

As part of their studies in electricity, Paul and Natasha investigated the behaviour of two different types of conductors, X and Y. The graph below shows the voltage and current characteristics for each of the two conductors.



The students then set up the circuit shown below. The internal resistance of the variable power supply can be ignored. The variable power supply was set so that the current flowing in the ammeter was 50 mA.



a Use the graph to determine what electrical potential was supplied to the circuit. (3 marks)

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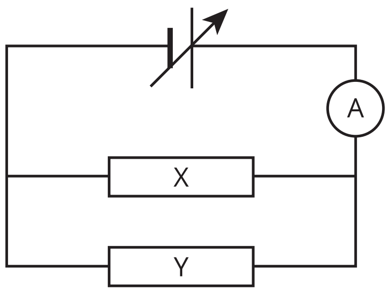
b Determine the resistance of conductor X when 50 mA of current is flowing through it. (2 marks)

c Is conductor X an example of an ohmic, or a non-ohmic conductor? Explain your answer and support it with appropriate reasoning. (2 marks)

The students then set up the circuit shown below. The variable power supply was set at 6.0 V.

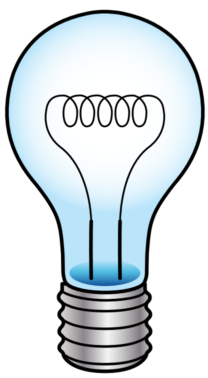
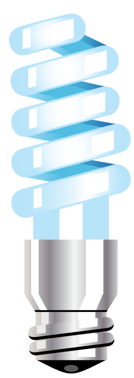


d What current now flows through the ammeter? (2 marks)

e What power is dissipated in conductor X? (2 marks)

Question 12

A student wanted to investigate the differences in energy usage and running costs between two different types of light globes that emit the same amount of light. The results of the investigation are shown below.

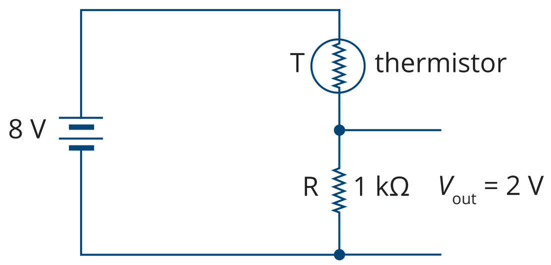
 Globe 1 – Incandescent light globe V = 240 volts P = 100 watts Average globe life = 1000 hours Purchase cost = $1.20	 Globe 2 – Compact fluorescent light (CFL) globe V = 240 volts P = 20 watts Average globe life = 10 000 hours Purchase cost = $5.60

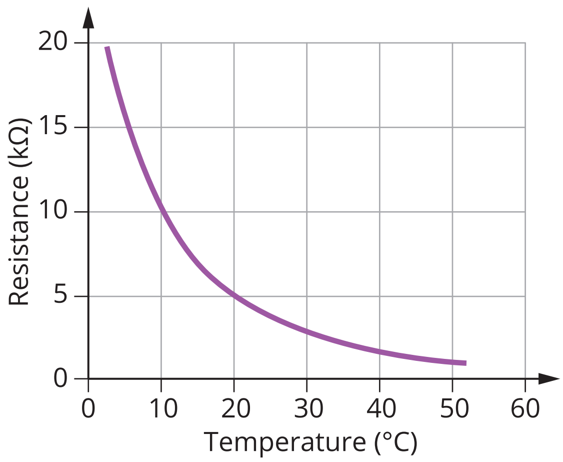
a How much energy would each globe use in 1.0 hour? (2 marks)

b If electrical energy costs $0.208 for every kWh of energy used, determine, using appropriate calculations, which of the two globes is the most economical to run. Remember to include the purchase cost of each globe in your calculations. (6 marks)

Question 13

The graph below shows the resistance versus temperature characteristics for a particular thermistor and the circuit in which the thermistor is placed.





a Determine the approximate temperature at the thermistor when V_{out} is 2 V. (3 marks)

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b It is a requirement of the circuit above that the value of V_{out} is 3 V when the temperature at the thermistor is 20°C. To do this, the fixed resistor, *R*, is replaced with a new one. (The thermistor and power source remain unchanged.) What is the value of the new resistor? (3 marks)

Question 14

A residual current device (RCD) compares the current in the active and neutral wires. What will the RCD detect in a properly functioning circuit compared with one that is not functioning correctly? (2 marks)

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Unit 1

Area of Study 3 What is matter and how is it formed?

Question 15

All matter was created in the early universe, yet very few different elements existed at this time. Explain how heavier elements first came into being. (3 marks)

Question 16

For every elementary matter particle there exists an antimatter particle.

How do the masses and charges compare between a matter and antimatter particle? (2 marks)

Question 17

$^{63}_{28}Ni$ is a radioisotope of nickel. Explain what the term 'radioisotope' means. Explain why Ni-63 is radioactive and Ni-58 is not radioactive. (2 marks)

Question 18

Give a definition of nuclear binding energy. (2 marks)

Question 19

In the nuclear equation: $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{236}_{92}U \rightarrow ^{91}_{36}Kr + ^{142}_{56}Ba + X$ + energy, what would *X* be? (2 marks)

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Question 20

a Complete the nuclear decay equation for Ni-63 when it emits a β⁻-particle by placing the appropriate numbers and symbols in the boxes below: (4 marks)

$$^{\square}_{\square}\square \rightarrow {}^{\square}_{\square}\square + {}^{\square}_{\square}\beta + \text{energy}$$

b Explain where the emitted β⁻-particle has come from. (2 marks)

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Question 21

Polonium-215 atoms decay into atoms of lead-211 by emitting an α-particle.

The average kinetic energy of the emitted α-particle is 7.39 MeV.

Polonium-215 has a half-life of 1.78×10^{-3} seconds.

$1.00 \text{ eV} = 1.6 \times 10^{-19}$ J

a What is the average kinetic energy of an emitted α-particle in joules? (2 marks)

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As an α-particle travels through air it will ionise about 100 000 atoms for every centimetre travelled. Each time an α-particle ionises an atom, the α-particle will lose about 34 eV of its kinetic energy.

b Approximately how much energy would an α-particle lose as it passes through 1.0 cm of air? Give your answer in eV. (2 marks)

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c Calculate the approximate distance that an α-particle with a kinetic energy of 7.39 MeV will travel in air before it loses all of its energy. Give your answer to the nearest millimetre. (2 marks)

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d What percentage of the original sample of polonium-215 would be left after 4.13×10^{-3} seconds? (3 marks)

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Question 22

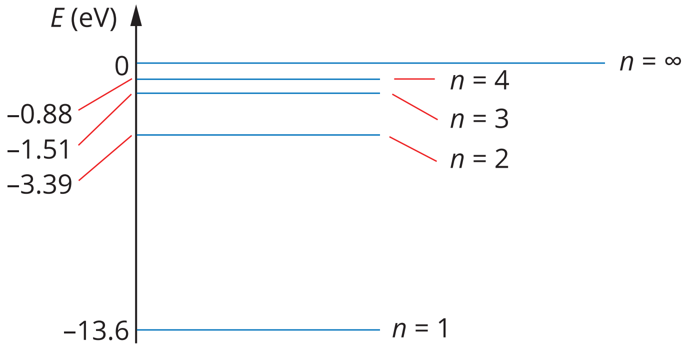
During a single fission reaction of a plutonium nucleus, a mass defect of 2.09×10^{-28} kg was detected. How much energy was released in this single fission reaction? Answer in joules and MeV. (3 marks)

Question 23

Consider two hydrogen nuclei approaching each other at very high speeds. Describe the forces that act on these nuclei as they move closer together and eventually fuse. (2 marks)

Question 24

Some of the energy levels for hydrogen are shown in the graph below. An electron is in the $n = 3$ excited state. What is the energy of the photon that is released as the electron drops back to the $n = 2$ excited state? (2 marks)



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Area of Study 1 How can motion be described and explained?

Question 25

Sally was driving her car at a constant speed of 15 m s^{-1} along a straight stretch of road. The total mass of the car and driver is 1600 kg. Sally saw a traffic light in front of her change from green to red. It took her 1.2 s to see the light change and make the decision to apply her brakes in order to stop the car.

a From the moment she sees the traffic light turn red, what distance did the car travel before Sally applied the brakes. (2 marks)

b Once Sally applied the brakes it took the car 4.4 seconds to come to a stop. Assuming the deceleration is constant, what was the magnitude of the car's deceleration? (2 marks)

c If Sally's car came to a stop next to the traffic light, how far from it had she been when she first saw it change from green to red? (3 marks)

d Calculate the force required to stop the car and hence the work done by the car's brakes in bringing the car to a stop. (3 marks)

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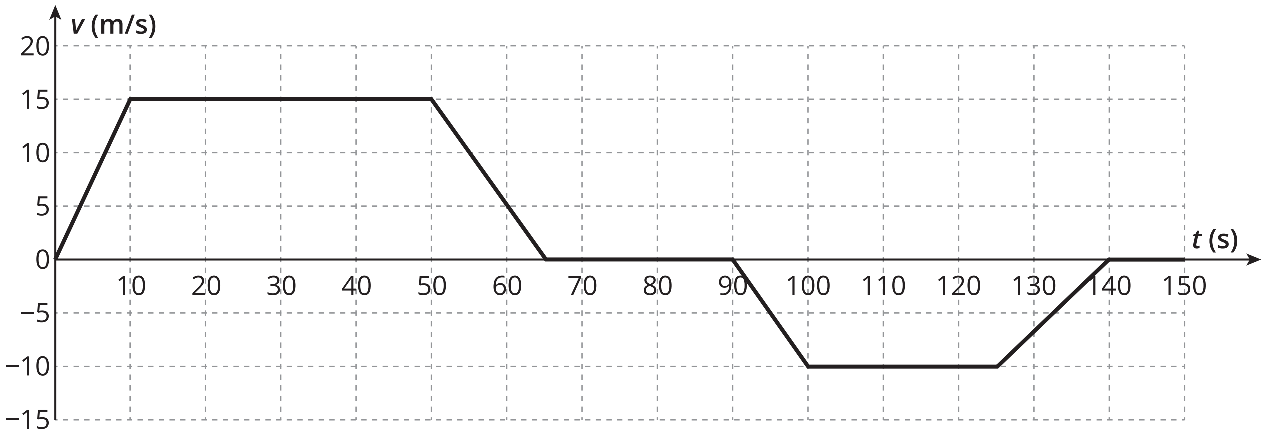
Question 26

The graph below shows part of a journey taken by a student on a bus. The bus and its passengers have a combined mass of 32 000 kg.



a What was the magnitude of the bus's acceleration at t = 60 seconds? (2 marks)

b What was the size of the net force acting on the bus at t = 110 seconds? (1 mark)

c If the driving force provided by the bus's motors during the first 10 seconds of the journey was a constant 61.3 kN, what average resistive force acted against the bus during this time? (3 marks)

d What was the bus's average speed for the 150-second journey as shown by the graph? (3 marks)

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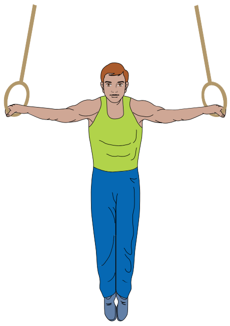
Question 27

The diagram shows a stationary gymnast hanging from a set of rings.



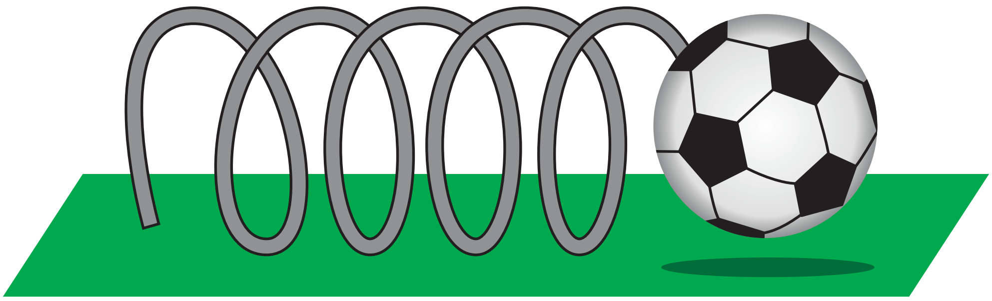
Describe the reaction force to the action of the force due to gravity on the gymnast. (2 marks)

Question 28

A 1000 kg vehicle is accelerated from rest to a speed of 17.8 m s^{-1} over 9.4 s. Determine the size of the net force acting on the vehicle during this time. (3 marks)

Question 29

Consider the situation below where a ball (m = 0.1 kg) is launched horizontally along a track via a compressed spring. The spring has a spring constant, k, of 500 N m^{-1}. To launch the ball, the spring is compressed by 10 cm. Assume negligible friction along the track.



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

b Assume that all of the energy from the spring is converted to kinetic energy when the ball is released. How fast does the ball travel as it leaves the spring? (2 marks)

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c The track begins flat, but then curves upward. Assuming no energy losses by friction, how far, vertically, will the ball rise up the curved section of track? (2 marks)

Question 30

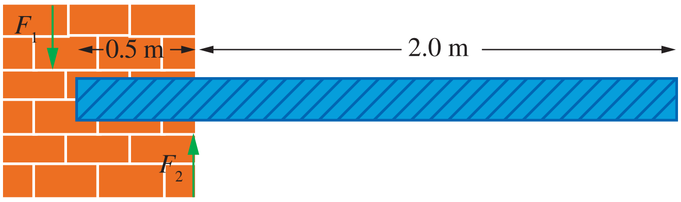
Two air-track gliders, both travelling at 2 m s⁻¹, approach each other on the air track. One of the gliders (m = 300 g) is travelling east and the other (m = 100 g) travels west. Both gliders are fitted with Velcro strips so that when they collide, they stick together and move off with a common velocity.

a Calculate the common velocity at which they move off with. (2 marks)

b What is the energy efficiency of this collision? Express your answer as a percentage. (3 marks)

Question 31

An awning of mass 25 kg protrudes from the side of a building as shown. The awning is supported by the wall, which exerts forces F_1 and F_2.



a Write an equation showing the relationship between all of the vertical forces on the awning. (1 mark)

b Write an expression for the torques that act around F_2. (1 mark)

c Calculate the size and direction of F_1 and F_2. (3 marks)

