Neap

Trial Examination 2021

VCE Physics Unit 2

Written Examination

Question and Answer Booklet

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

Student's Name: _____

Teacher's Name: _____

Structure of booklet

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	10	10	10
B	9	9	80
			Total 90

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, pre-written notes (one folded A3 sheet or two A4 sheets bound together by tape) and one scientific calculator.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied

Question and answer booklet of 22 pages

Formula sheet

Answer sheet for multiple-choice questions

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

At the end of the examination

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

You may keep the formula sheet.

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

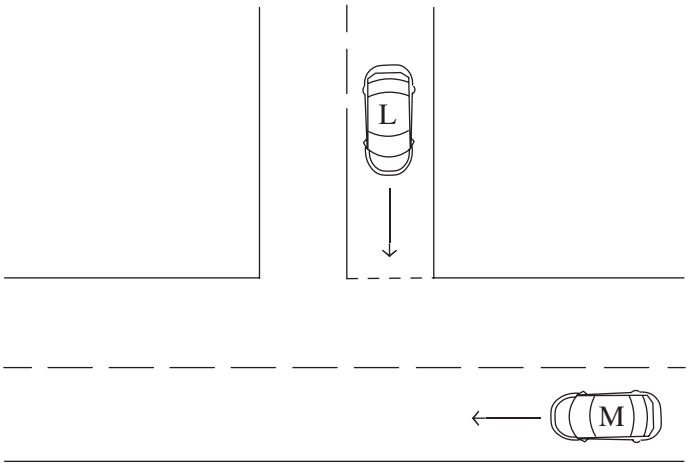
SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the questions.
A correct answer scores 1; and incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.
Take the value of g to be 9.8 m s^{-2}.

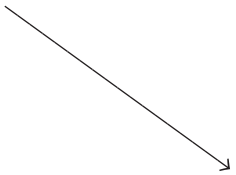
Question 1

Two cars, L and M, are travelling towards an intersection, as shown in the diagram below.

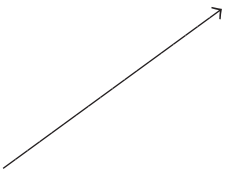


The velocity of car L is v_L, and the velocity of car M is v_M.
Which one of the following vectors best represents the velocity of car M relative to car L, that is, $v_L - v_M$?

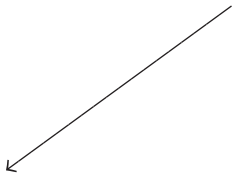
A.



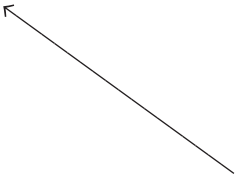
B.



C.

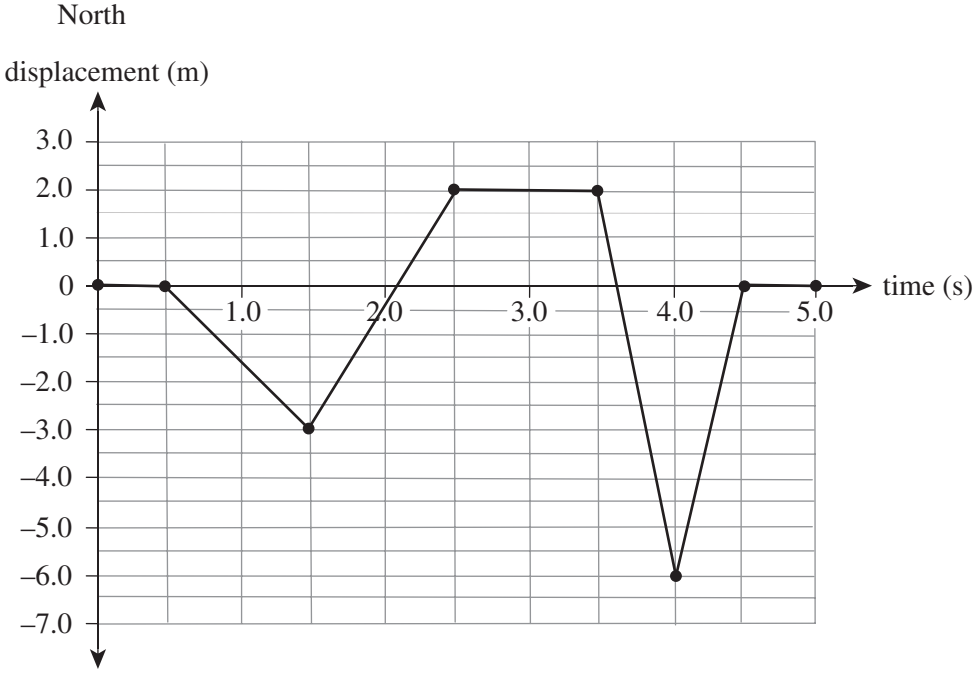


D.



Question 2

The following displacement versus time graph represents the behaviour of a glider along a linear air track.



The total distance travelled by the glider is

A. 0.0 m

B. 13.0 m

C. 19.0 m

D. 22.0 m

Question 3

Which one of the following statements is correct?

A. A 2 kg bag of rice has more inertia than a 10 kg bag of rice.

B. A bowling ball has the same amount of inertia as a pencil.

C. A feather has less inertia than a hammer.

D. All bodies have the same inertia if they are close to the surface of the Earth, as they all have the same acceleration of 9.8 m s^{-2} due to gravity.

Question 4

A chair of mass 20.0 kg is pushed to the right by an unknown applied force, *F*. A friction force of 15.0 N acts on the chair.

If the chair is accelerating at 2.0 m s^{-2}, what is the value of *F*?

A. 25.0 N

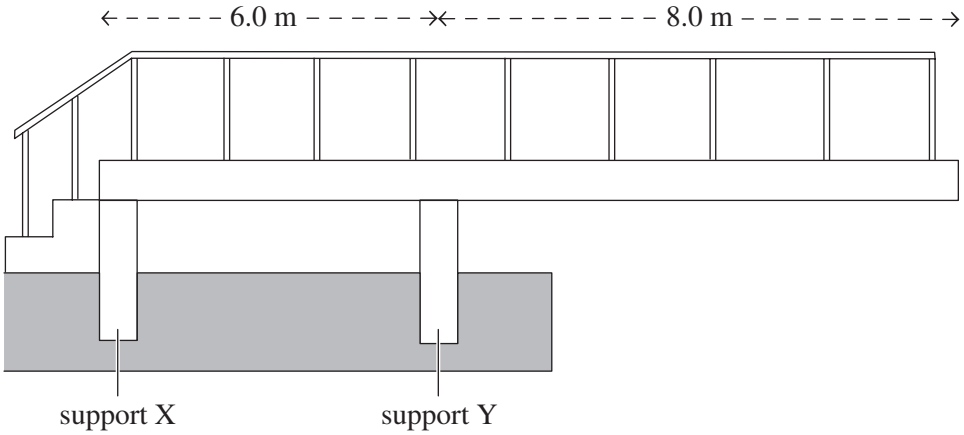
B. 30.0 N

C. 40.0 N

D. 55.0 N

Question 5

A viewing platform is installed at a national park. The platform can be considered as a long beam of uniform mass that extends 8.0 m beyond two vertical supports to which it is attached, as shown in the diagram below. The supports, X and Y, are 6.0 m apart.



Which one of the following statements is correct?

A. Support X is under compression, and support Y is under tension.

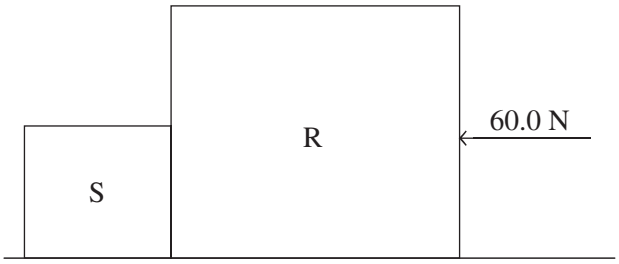
B. Support X is under tension, and support Y is under compression.

C. Both supports X and Y are under tension.

D. Both supports X and Y are under compression.

Question 6

Two boxes, S and R, are in contact with each other on a frictionless surface. A constant horizontal force of 60.0 N is applied to box R, as shown in the diagram below. Box S has a mass of 2.0 kg, and box R has a mass of 4.0 kg.



What is the magnitude of the force exerted by box R on box S?

A. 0.0 N

B. 20.0 N

C. 40.0 N

D. 60.0 N

Question 7

Which one of the following best describes a dependent variable?

A. a variable that is fixed by a scientist in an experiment

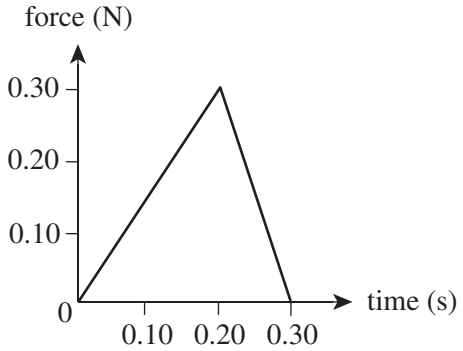
B. a variable that is selected and changed by a scientist in an experiment

C. a variable measured by a scientist in an experiment

D. a variable determined by a scientist to be unrelated to their experiment

Question 8

A ball of mass 2.00 kg is dropped on a patch of grass. The following graph shows the net force acting onto the ball when it hits grass.



The magnitude of the impulse on the ball is closest to

A. 4.5×10^{-2} N s

B. 9.0×10^{-2} N s

C. 1.8×10^{-1} N s

D. 6.0×10^{-1} N s

Question 9

Cameron drags a cricket bag of mass 5.0 kg for 10.0 m across a rough surface with a force of 50.0 N. A frictional force of 20.0 N acts on the bag.

The work done by Cameron to oppose the bag's weight force is closest to

A. 0.0 N

B. 200 N

C. 300 N

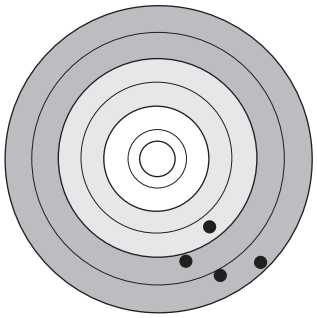
D. 500 N

Question 10

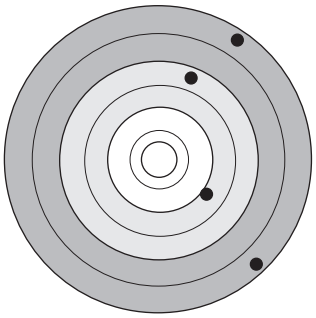
Four students attend an archery class. They each shoot four arrows at their targets, then remove the arrows to check their results.

Which one of the following sets of results can be described as accurate but not precise?

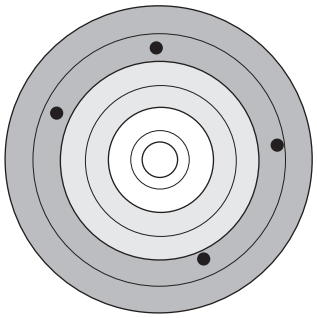
A.



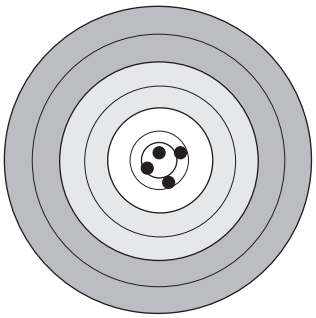
B.



C.



D.



SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.

Where an answer box is provided, write your final answer in the box.

If an answer box has a unit printed in it, give your answer in that unit.

In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Take the value of g to be 9.8 m s^{-2}.

Question 1 (3 marks)

Ethan sits stationary on a park bench. His weight pulls him downwards, and the park bench pushes upwards against him.

Explain whether the force of Ethan's weight pulling him downwards and the force of the park bench pushing upwards against him are or are not an action–reaction pair in terms of Newton's third law.

Question 2 (11 marks)

A ball is projected vertically upwards at an initial velocity of 20.0 m s^{-1} from the top of an 80.0 m high lookout point on a cliff, as shown in Figure 1. The ball lands on the ground below the lookout point. Ignore air resistance.

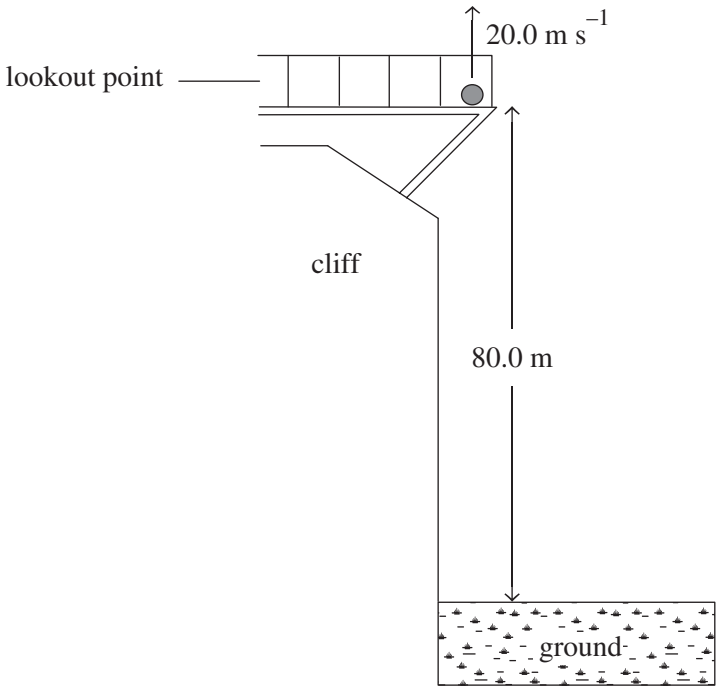


Figure 1

a. Calculate the time it takes the ball to reach its maximum height. Show your working. 2 marks

s

b. Determine the maximum height that the ball reaches above the ground.
Show your working. 3 marks

m

c. Calculate the ball's time of flight. Show your working. 3 marks

s

d. Determine the magnitude and direction of the ball's velocity when it hits the ground.
Show your working. 3 marks

m s^{-1}	

Question 3 (13 marks)

On a main road, a car of mass 1.0×10^3 kg and a minibus of mass 6.0×10^3 kg are travelling south. The car is travelling at a velocity of 25.0 m s^{-1}, and the minibus is travelling at a velocity of 11.0 m s^{-1} in front of the car, as shown in Figure 2a. The car collides with the back of the minibus, and the vehicles become coupled after the minor rear-end collision, as shown in Figure 2b.

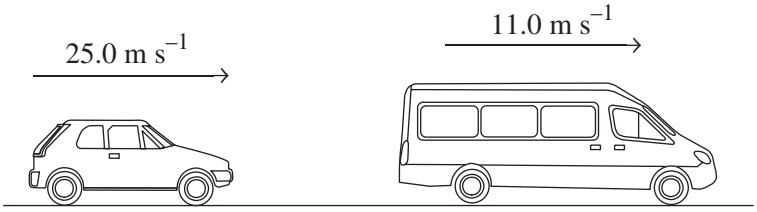


Figure 2a

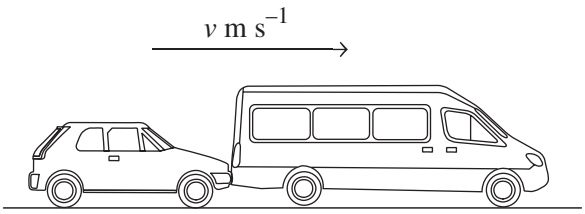


Figure 2b

a. Show that the common velocity of the coupled vehicles is 13 m s^{-1}.
Show your working. 2 marks

b. **i.** Calculate the change in momentum of the car. Show your working. 2 marks

kg m s^{-1}

ii. Calculate the change in momentum of the minibus. Show your working. 2 marks

kg m s^{-1}

c. Show that the momentum of the system is constant. 1 mark

d. The coupled vehicles eventually come to rest.

Explain where the momentum of the coupled vehicles is transferred. 2 marks

Modern vehicles have design features that extend collision time.

A vehicle safety authority conducts a crash test for a new car model. A crash test dummy is placed in the driver's seat, and the car is crashed into the wall under controlled conditions.

e. **i.** If the time of impact of a collision were increased by a factor of 4, explain how the force of impact acting on the crash test dummy would be affected for the same change in momentum. Explain your reasoning. 2 marks

ii. In terms of momentum, explain how crumple zones work and how they can reduce the severity of injuries inflicted on a car's occupants in a collision. 2 marks

Question 4 (10 marks)

At a mail sorting centre, large packages are slid down a ramp onto a conveyor belt for sorting. A 5.0 kg box slides down the ramp, which is a plane inclined at an angle of 30°, as shown in Figure 3. The magnitude of the frictional force acting on the box is 10.0 N.

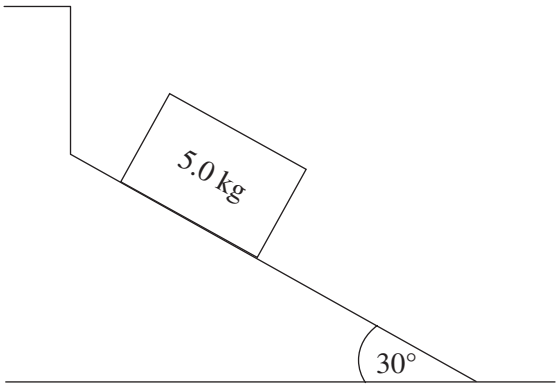


Figure 3

a. On Figure 3, draw and label the forces acting on the box. 3 marks

b. Calculate the magnitude of the normal force acting on the box. Show your working. 2 marks

N

c. Determine the magnitude of the average acceleration of the box. Show your working. 3 marks

m s^{-2}

d. Determine the work done by the frictional force in slowing down the box over a distance of 5.0 m. Show your working. 2 marks

J

Question 5 (7 marks)

Ziqi is skateboarding at a skate park. She rolls from rest down a curved ramp with a vertical drop of 2.0 m, as shown in Figure 4.

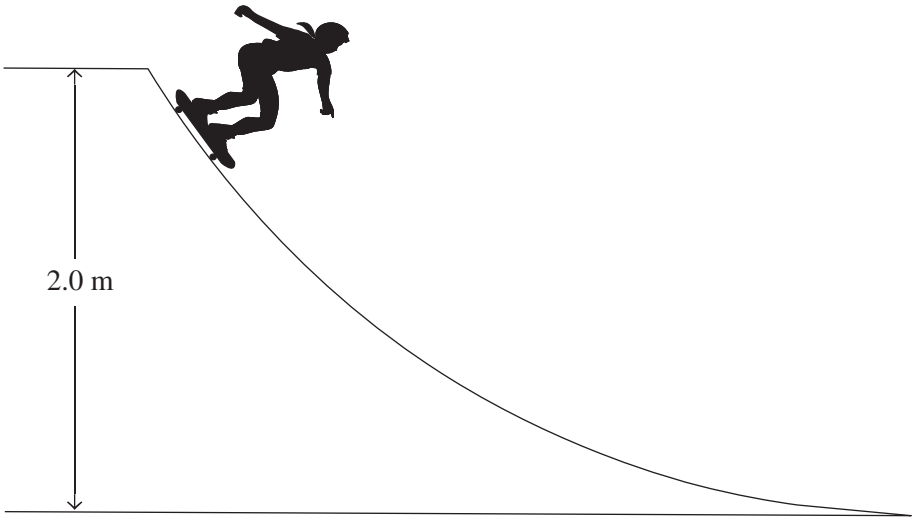


Figure 4

a. Calculate Ziqi's speed at the bottom of the curved ramp. Ignore the effects of friction. Show your working. 4 marks

m s^{-1}

b. If friction were significant, explain how the result from **part a.** would change. 3 marks

Question 6 (16 marks)

Figure 5 shows how velocity varies with time for a model car travelling back and forth along a straight line. Travelling West is positive in direction.

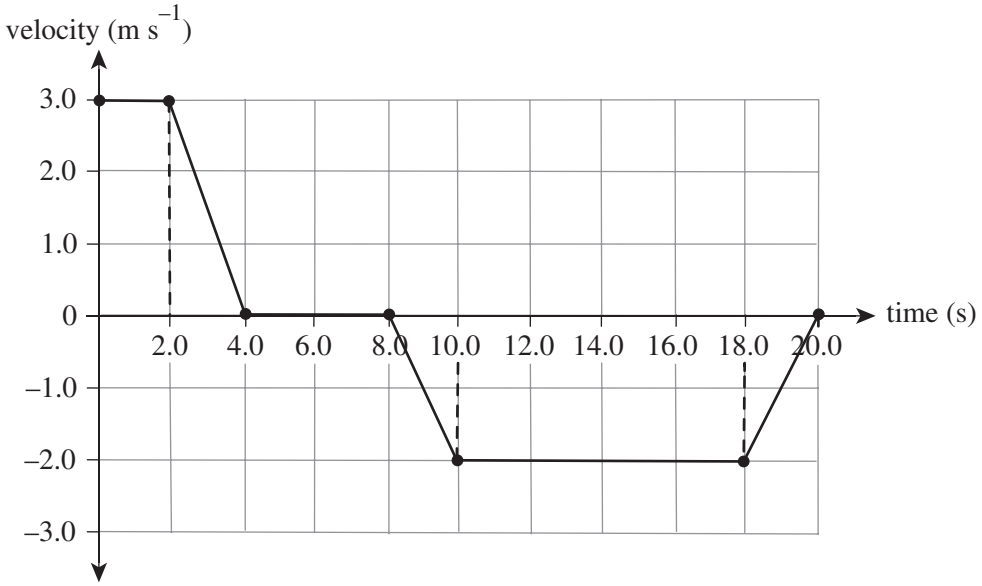


Figure 5

a. Determine the magnitude and direction of the model car's velocity 11.0 s after starting its motion. If the direction is not applicable, write N/A in the answer box. 2 marks

m s^{-1}	

b. Determine the magnitude and direction of the model car's acceleration 19.0 s after starting its motion. Show your working. If the direction is not applicable, write N/A in the answer box. 3 marks

m s^{-2}	

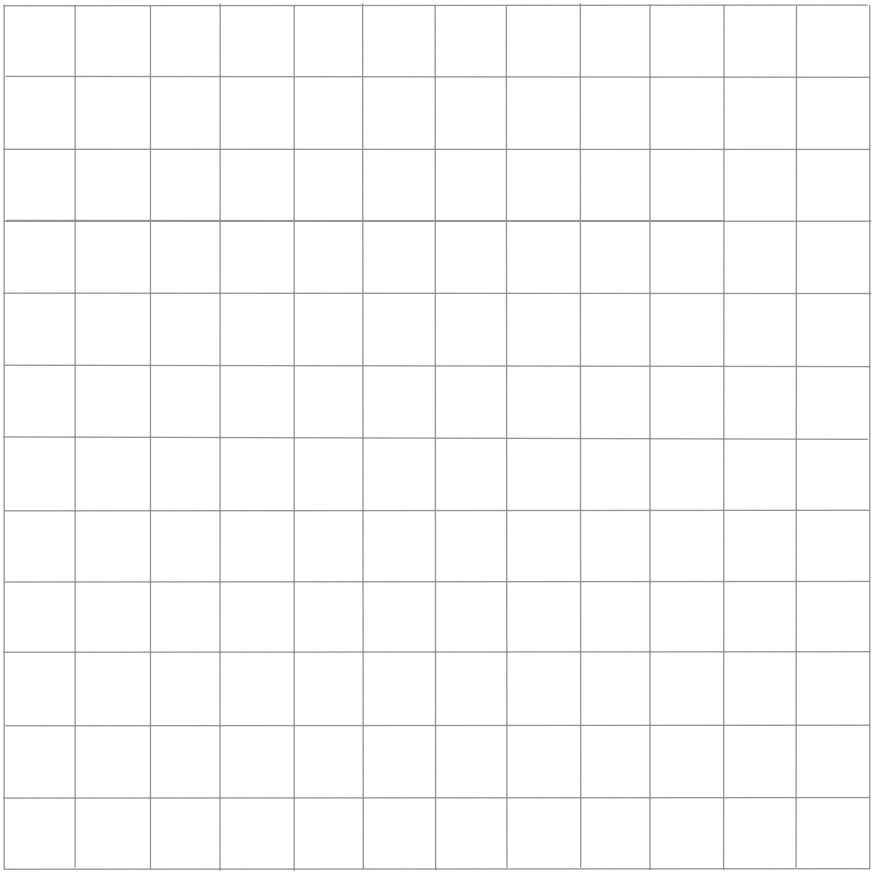
c. Determine the magnitude and direction of the distance that the model car travels in 20.0 s. Show your working. If the direction is not applicable, write N/A in the answer box. 3 marks

m	

d. Determine the magnitude and direction of the object's final displacement from its starting point. Show your working. If the direction is not applicable, write N/A in the answer box. 3 marks

m	

e. On the grid provided below, sketch a corresponding acceleration versus time graph for the model car's motion. Include appropriate axis labels, scales and units. 5 marks



Question 7 (3 marks)

A forest walk consists of an elevated walkway high above the ground. A uniform cantilever is located at one point along the walkway so that people can walk out above a section of a river. Figure 6a shows the cantilever from the side, and Figure 6b shows the same cantilever from above. The cantilever is 20.0 m in length and designed to support an additional load of 10.0 tonnes. Two steel cables support the cantilever and are attached 5.0 m from the end of the cantilever at an angle of 45°. The cantilever has a mass of 0.8 tonnes.

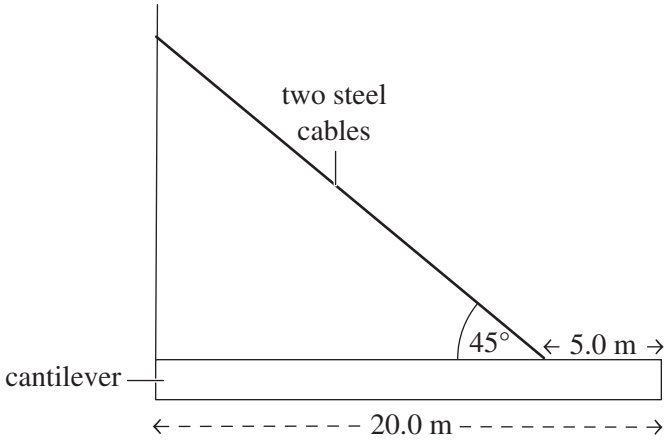


Figure 6a

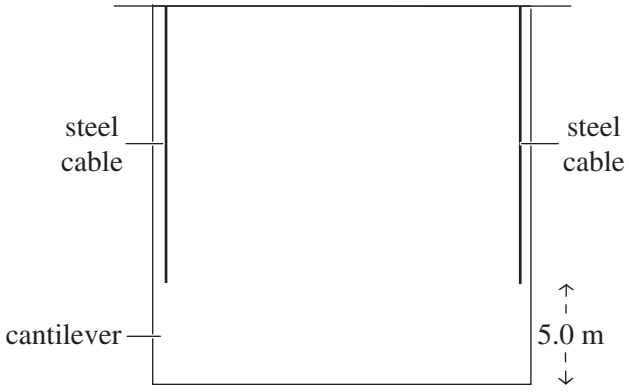


Figure 6b

If the maximum additional load of 10.0 tonnes is distributed evenly over the cantilever, calculate the tension in **one** cable. Show your working.

N

Question 8 (14 marks)

A student conducts an experiment where they attach various hanging masses to a suspended spring and measure the resulting total length of the spring. Table 1 shows some of the data for the experiment.

Table 1

Hanging mass (g)	Weight of hanging mass (N)	Total length of spring (cm) ± 1.0 cm
50.0	0.49	37.0
100.0		42.0
150.0		49.0
200.0		54.0
250.0		61.0
300.0		70.0

a. In the table below, identify the variables in the experiment. 3 marks

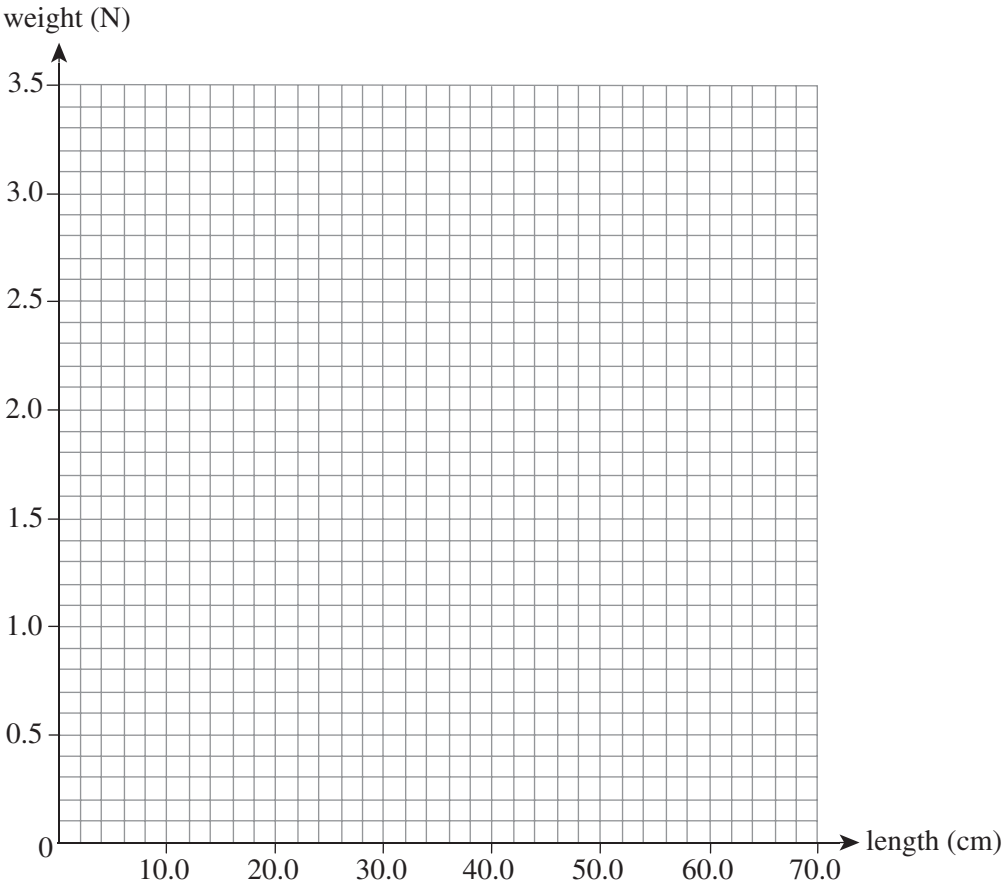
Classification	Variable
independent	
dependent	
controlled	

b. **i.** Show that the weight of the 50.0 g hanging mass is 0.49 N. Show your working. 1 mark

ii. Calculate the weights of the hanging masses and write them in the spaces provided in Table 1. 3 marks

c. Plot a graph of the weights of the hanging masses on the *y*-axis against the total spring length on the *x*-axis. On your graph:

- draw a line of best fit through the plotted points
- include uncertainty bars (± *x*-direction only) of ± 1.0 cm.
  (Uncertainty bars in the *y*-direction are not required.) 3 marks



d. Use the graph drawn in **part c.** to find the original length of the spring before any mass was attached to it. 1 mark

cm

e. Calculate the spring constant of the spring. Show your working, Do not calculate any uncertainties. 2 marks

N m^{-1}

f. What would be the force in the spring if it were stretched by 20 cm? Do not calculate any uncertainties. 1 mark

N

Question 9 (3 marks)

A ball of mass 100.0 g compresses a spring by 10.0 cm. When the spring is released, the ball is projected forward, as shown in Figure 7.

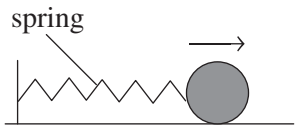


Figure 7

The spring constant is 100.0 N m^{-1}.

Determine the projection speed of the ball. Ignore friction. Show your working.

m s^{-1}

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2021

VCE Physics Unit 2

Written Examination

Formula Sheet

Instructions

This formula sheet is provided for your reference.
A question and answer booklet is provided with this formula sheet.

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

PHYSICS FORMULAS

velocity; acceleration	$v = \frac{\Delta s}{\Delta t}; \quad a = \frac{\Delta v}{\Delta t}$
equations for constant acceleration	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $s = vt - \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ $s = \frac{1}{2}(v + u)t$
Newton's second law	$\Sigma F = ma$
gravitational potential energy near the surface of Earth	$mg\Delta h$
kinetic energy	$\frac{1}{2}mv^2$
mechanical work	$W = Fs$
power	$P = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t}$
Hooke's law	$F = -k\Delta x$
elastic potential energy	$\frac{1}{2}k\left(\Delta x\right)^2$
torque	$\tau = F \times r$
momentum	mv
impulse	$F\Delta t$
efficiency	$\text{efficiency (\%)} = \frac{\text{useful energy output}}{\text{energy input}} \times 100$

Data

acceleration due to gravity at Earth's surface	$g = 9.8 \text{ m s}^{-2}$

Prefixes/Units

p = pico = 10^{-12}	n = nano = 10^{-9}	μ = micro = 10^{-6}	m = milli = 10^{-3}
k = kilo = 10^{3}	M = mega = 10^{6}	G = giga = 10^{9}	t = tonne = 10^{3} kg

END OF FORMULA SHEET

Neap

Trial Examination 2021

VCE Physics Unit 2

Written Examination

Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out. Marks will **not** be deducted for incorrect answers.
No mark will be given if more than **one** answer is completed for any question.

All answers must be completed like this example: **A** B C D

Use pencil only

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D