Name:_____

Class:_____

PRELIMINARY

2023 EXAMINATION

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen.
- Draw diagrams using pencil.
- NESA approved calculators may be used.
- A data sheet, formulae sheet and Periodic Table are provided at the back of this paper.
- For questions in Section II, show all relevant working in questions involving calculations.
- Write your name and class at the top of this page and at the top of pages 10

Total marks: 65

Section I — 15 marks (pages 2-9)

- Attempt Questions 1–15
- Allow about 25 minutes for this part

Section II — 50 marks (pages 11-20)

- Attempt Questions 16 – 23
- Allow about 1 hour and 35 minutes for this part

Section I

15 marks
Attempt Questions 1–15
Allow about 25 minutes for this section.

Use the multiple-choice answer sheet for Questions 1–15.

---

1 A ball is dropped off a balcony and is allowed to hit the floor.

Which statement most correctly describes the ball's motion?

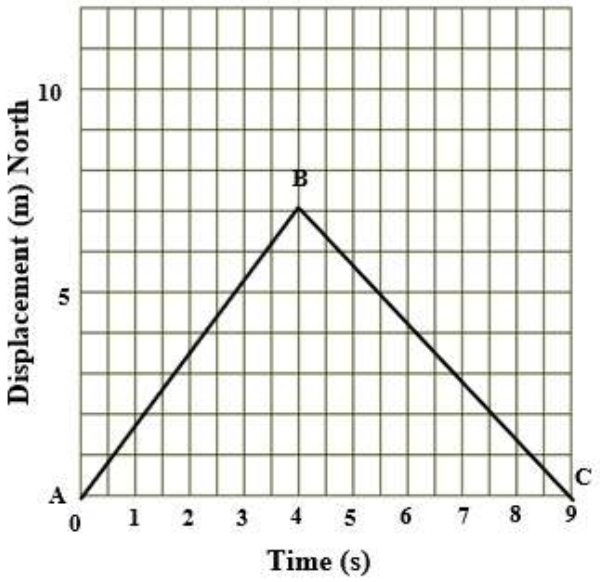
A. The ball has travelled with a constant speed

B. The ball travels with uniformly accelerated motion

C. The ball has travelled with non-uniformly accelerated motion

D. Just before the ball reaches the floor, it reached slowest speed.

2 The motion of a car was graphed as it travelled through checkpoints A, B and C.



Which description best describes the car's motion as it travels through these checkpoints?

A. The average velocity between checkpoints B to C is 1.4 ms^{-1} South.

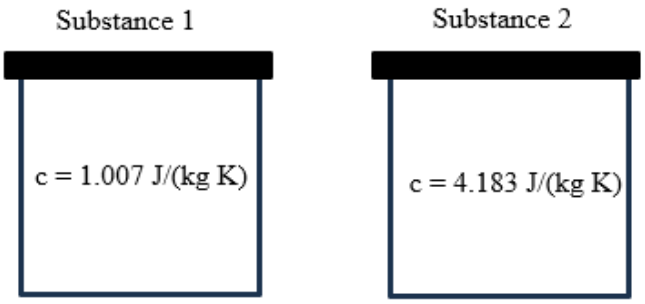
B. The average acceleration between checkpoint A to B is 14 ms^{-2} South.

C. The average velocity between checkpoints A to B and B to C are identical.

D. The displacement across the entire journey is equal to the area under the curve.

3 Substance 1 and Substance 2 were heated in two pots on a cooktop to determine their specific heat.

This was calculated for each substance as shown below.



Which statement most correctly describes the specific heat of these substances?

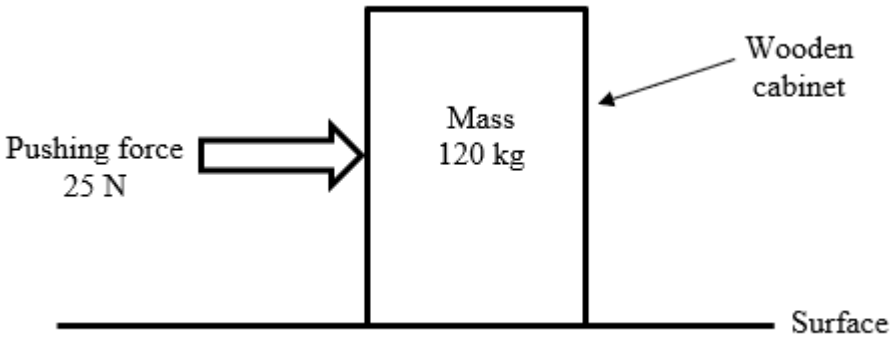
A. Substance 1 and Substance 2 took the same amount of time to heat up.

B. Substance 1 took far more time to heat up in comparison to Substance 2.

C. Substance 2 took far more time to heat up in comparison to Substance 1.

D. Substance 1 and Substance 2's specific heat was independent of heating time.

4. A large 120 kg wooden cabinet is pushed across a floor. The floor is made of three different surfaces that apply different amounts of friction as shown below.



Wood (Friction force - 25N) Concrete (Friction force - 30N) Carpet (Friction force - 50N)

Which statement best describes the pushing force required to push the cabinet across the carpet?

A. Twice the pushing force shown in the diagram would be needed.

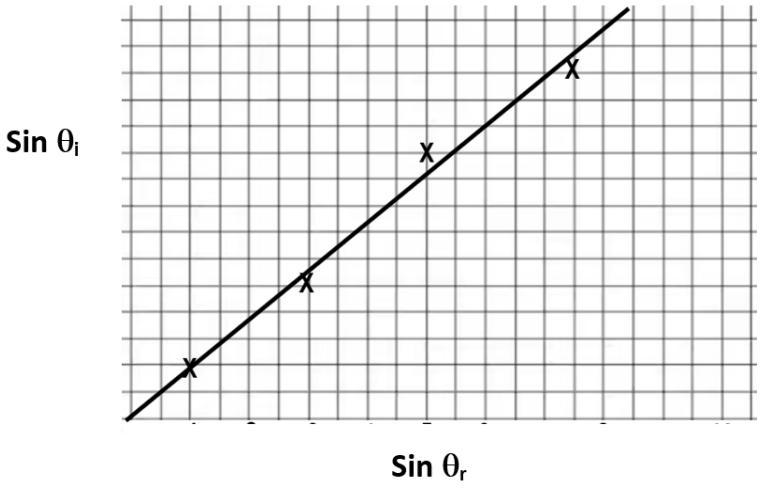
B. The cabinet would be too difficult to move with any surface combination.

C. More than twice the pushing force shown in the diagram would be needed.

D. The same pushing force will work as surface type does not affect movement.

5 A student observed data and recorded their findings in a graph.

A line of best fit was drawn to show the relationship between Sin θ_i and Sin θ_r.



Which quantity can be determined by calculating the gradient from this graph?

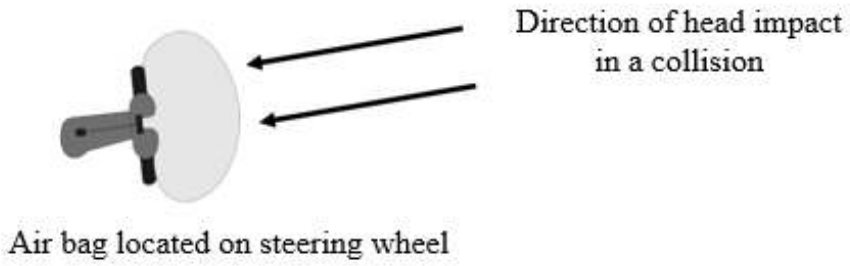
A. Power

B. Resistance

C. Ampere's Law

D. Refractive Index

6 Airbags deploy from steering wheels to save lives in car accidents as shown in the diagram.



Which principle of physics best explains the reason why airbags save lives in collisions?

A. Shortening the collision time will decrease the forces on an occupant in a car

B. Air cushions when deployed allows the head to bounce away avoiding injury

C. The airbag extends the time of the collision which decreases the impact force

D. The force of the air counteracts the force of the head reaching the steering wheel

7 Bats use the Doppler effect to catch moths as modelled in the diagram.

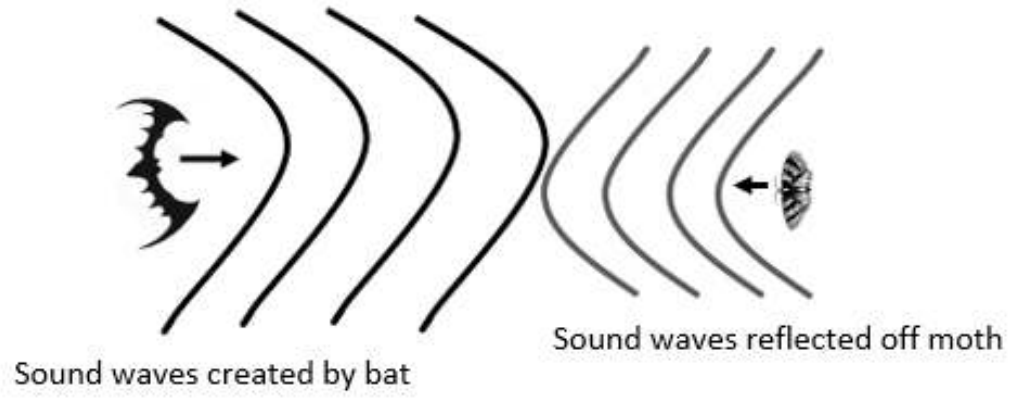


Diagram not drawn to scale

Researchers record a flying bat travelling at 30 ms^{-1} towards a stationary moth. They also record the frequency of the bats' call to be at 150 KHz.

What is the value of the frequency received by the moth?

A. 80 kHz

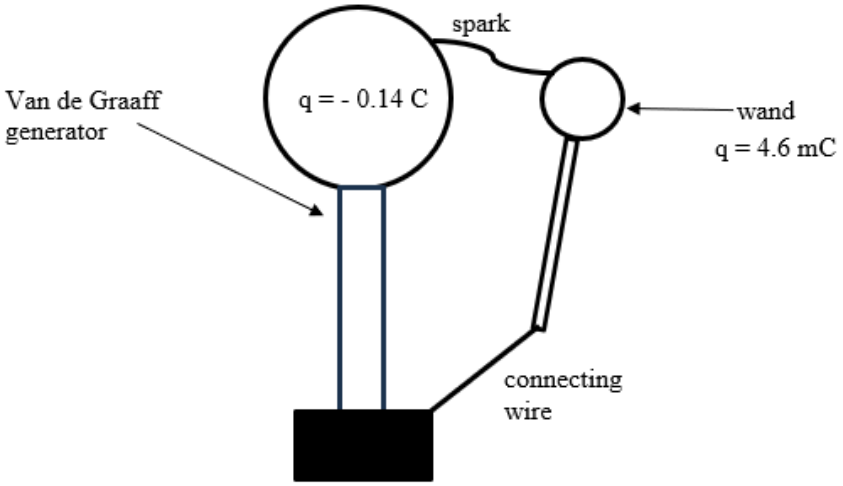
B. 138 kHz

C. 163 kHz

D. 220 kHz

8 A spark was induced between a Van de Graaff Generator and the wand after the generator was switched on and it was allowed to charge up.

When the spark occurred, the distance between the Van de Graaff generator and the wand was 4.5 cm, the charge on the generator was –0.14 C and the charge on the wand was 4.6 mC.



Question 8 (continued)

Which formula is required to measure the electrostatic force which created the spark?

A. $F = \frac{1}{4\pi\epsilon_0} \times \frac{(-0.14)(4.5 \times 10^{-3})}{(4.6 \times 10^{-2})^2}$

B. $F = \frac{1}{4\pi\epsilon_0} \times \frac{(-0.14)(4.6 \times 10^{-3})}{(4.5 \times 10^{-2})^2}$

C. $F = \frac{1}{4\pi\epsilon_0} \times \frac{(-0.14)(4.6 \times 10^{-6})}{(4.5 \times 10^{-3})^2}$

D. $F = \frac{1}{4\pi\epsilon_0} \times \frac{(0.14 \times 10^{-3})(4.6 \times 10^{-6})}{(4.5 \times 10^{-2})^2}$

9 The length of a string and the wavelength created as a wave passes through it have a specific relationship when standing waves are created.

Which relationship best describes the wave created on a string shown above?

A. $\lambda = \frac{1}{4}L$

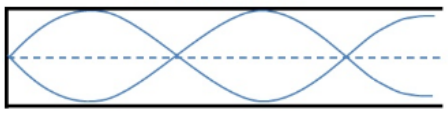
B. $\lambda = \frac{2}{3}$ L

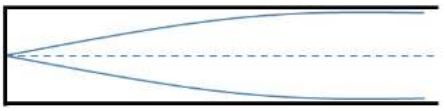
C. λ = L

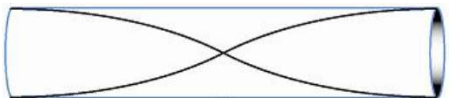
D. λ = 2L

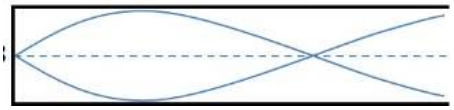
10 Standing waves were created in some closed and open pipes and their patterns are represented below. These standing waves were identified as harmonics.

Which pipe best displays a 3rd harmonic wave pattern created in a closed pipe?

A 

B 

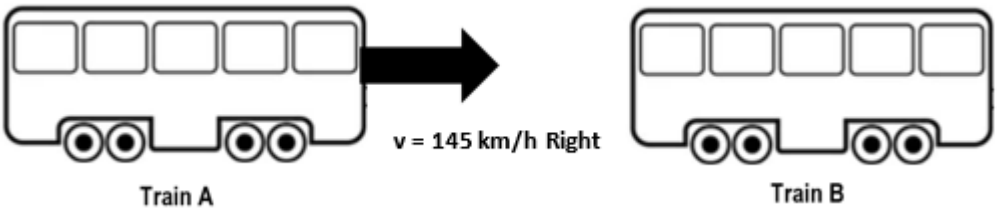
C 

D 

The information below relates to Questions 11 and 12.

A diagram is created to show two trains just before they collided.

Train A was moving with a velocity of 145 km/h to the right, towards Train B as shown. Both trains are identical, having a mass of 15 020 kg each.



11 Which conclusion best describes the motion of these trains before and after the collision?

A. The momentum of Train A before the collision equals 2177900 Ns.

B. Only the momentum of both trains will be conserved in this collision.

C. Momentum and kinetic energy of both trains will be conserved in this collision.

D. The collision will be an elastic collision as both trains will collide and rebound with identical motions.

12 If Train A rebounds after the collision with a velocity of 100 k/hr^{-1} Left, what is the velocity of Train B after the collision?

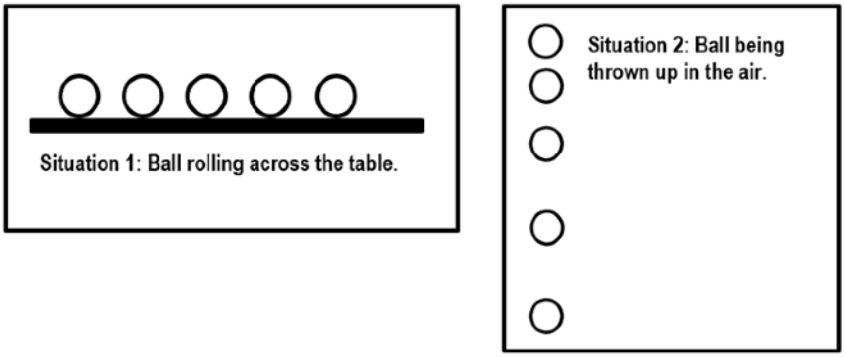
A. 45 km/h Right

B. 142 km/ Right

C. 245 km/h Right

D. 322 km/h Right

13 The diagrams represent stroboscopic photos taken of a ball moving in two different situations as described.



Which hypothesis can be written about the acceleration of the ball in both situations?

A. Both situations show the ball undergoing zero acceleration

B. Both situations show the ball undergoing the same acceleration.

C. Both situations show the ball undergoing an acceleration of 9.8 ms^{-2}.

D. Both situations show the ball undergoing a constant acceleration value.

14 Diagram A is a circuit which a student constructs to investigate Ohm's Law. Diagram B is a graph which displays Line X and Y which are two possible relationships for Ohm's Law in this circuit.

Diagram A

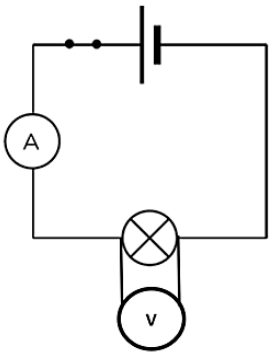
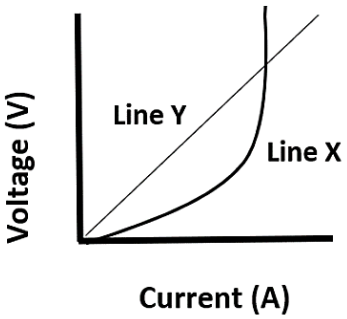


Diagram B



Which statement below best explains Ohm's Law in this circuit?

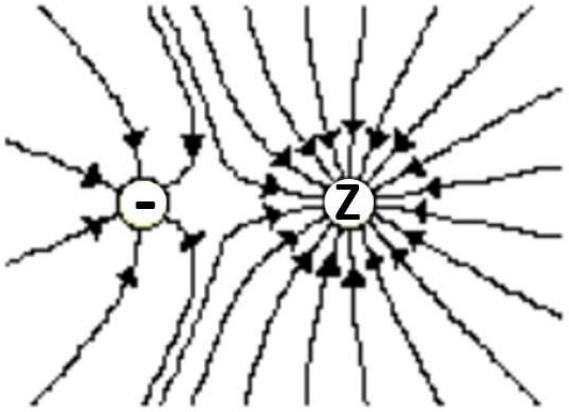
A. Line X shows an ohmic relationship for the light globe.

B. Incandescent globes typically create the data plots shown in Line Y.

C. Line X and Y are both displaying data gained from the same light globe.

D. The gradient of line Y can be used to determine the resistance of the light globe.

15 This diagram was drawn to model a charge, Z, and how it interacts with negative charge.
42



This model of electric fields clearly shows that Charge Z is

A. a weaker negative charge as shown by the number of field lines repelling the negative charge.

B. a stronger positive charge as it has more field lines around it, attracting the weaker negative charge.

C. a positive charge as shown by the field lines pointing towards it, attracting the negative charge.

D. a stronger negative charge as it has more field lines around it, repelling the other weaker negative charge.

Name:.....
Class:.....

2023 Preliminary Physics
Section II

Answer Booklet

50 marks
Attempt Questions 16 – 23
Allow about 1 hour 35 minutes for this part

Instructions

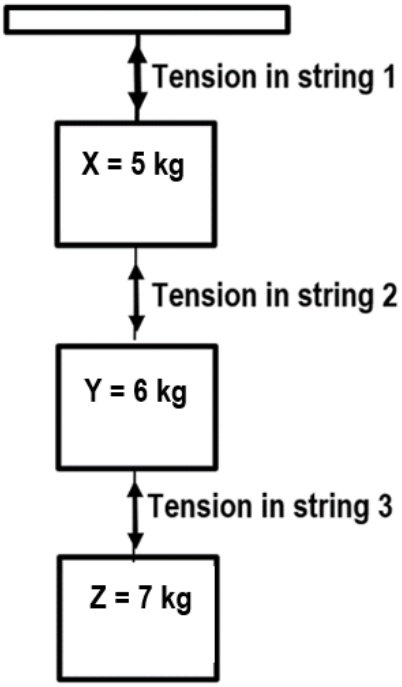
- Write your name and class at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Show all relevant working in question involving calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (6 marks)

Three masses, X, Y and Z, were connected vertically from a roof.

The masses were stationary when they were analysed. The mass values and the location of the tension forces on the strings 1, 2 and 3 are indicated on the free body diagram.

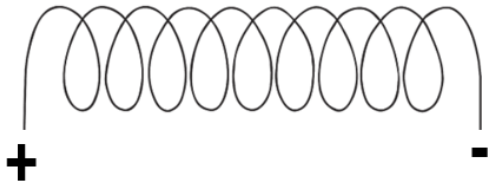


(a) Calculate the difference in weight force between mass X and Z. **2**

(b) Identify which string, 1, 2 or 3, has the greatest tension and calculate its value. **4**

Question 17 (6 marks)

A solenoid represented in the diagram was investigated to determine aspects of its magnetic field and magnetic field strength as a current is passed through it.



(a) In the space below, redraw a model of this solenoid, then add the appropriate magnetic field created when the current is passing through it. **2**

(b) Describe how this solenoid can be re-designed with TWO modifications to create a strong electromagnet. **2**

.....

.....

.....

.....

.....

.....

2

(c) The solenoid has a cross sectional diameter of 5 cm and a length of 20 cm, with 3 25 turns. Calculate the strength of the magnetic field in the middle of the solenoid if the current is 3 A.

……

……

……

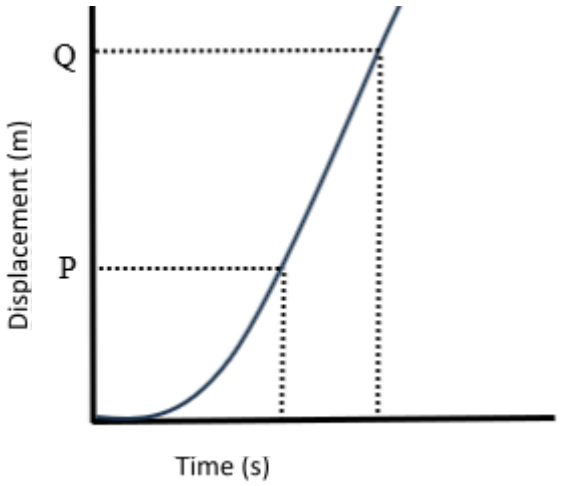
……

……

……

Question 18 (4 marks)

An object's motion is recorded on a graph and the points P and Q are identified.



(a) Describe the type of motion being displayed in the graph. **1**

.....

.....

.....

(b) Which aspect of the object's motion could be calculated if a tangent was drawn at point P? **1**

.....

.....

(c) With reference to this graph, describe how the acceleration of an object could be determined using a displacement time graph. **2**

.....

.....

.....

.....

.....

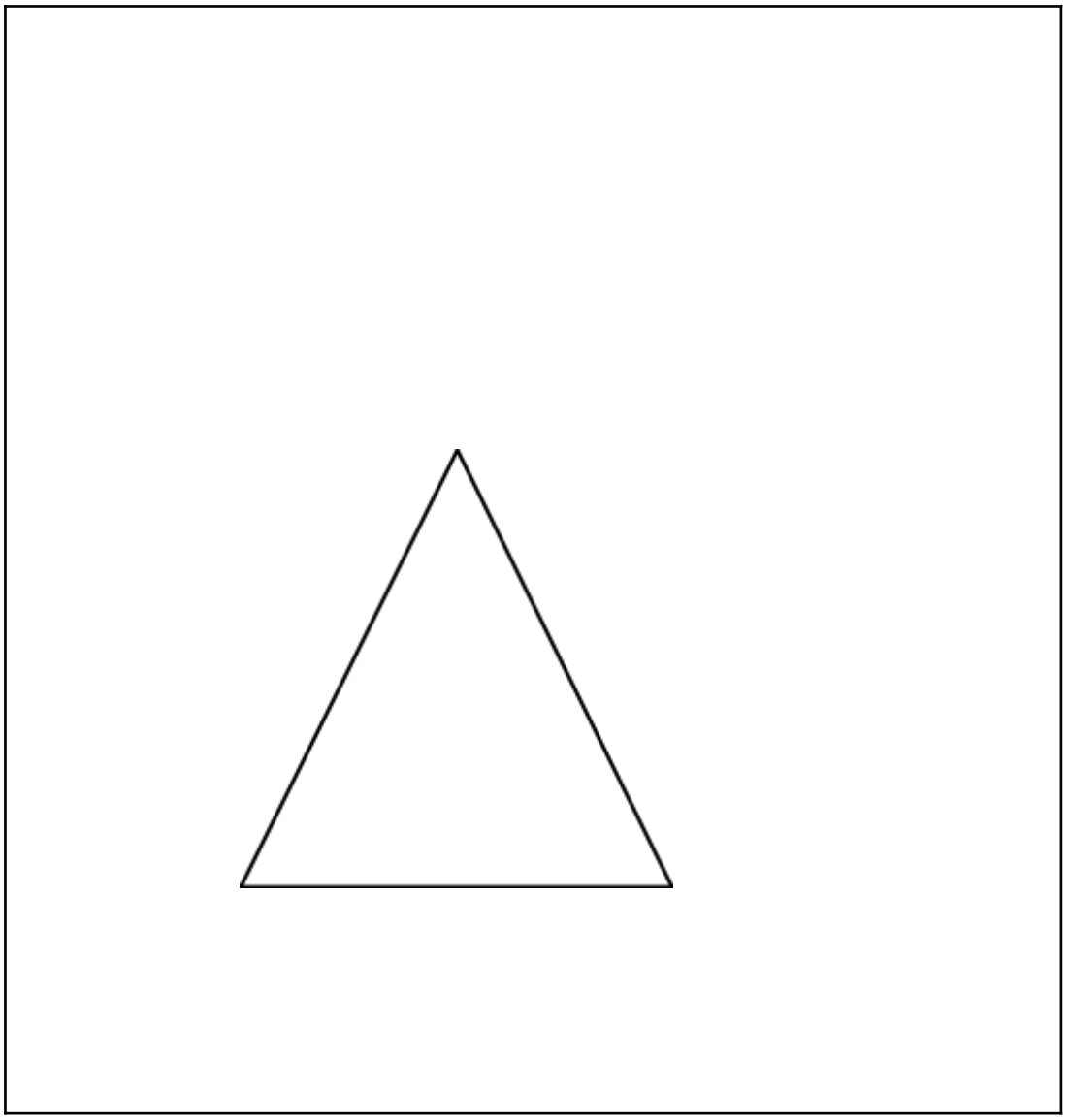
.....

Question 19 (7 marks)

A student wants to investigate how light behaves as it enters, travels through, and leaves a Perspex triangular prism.

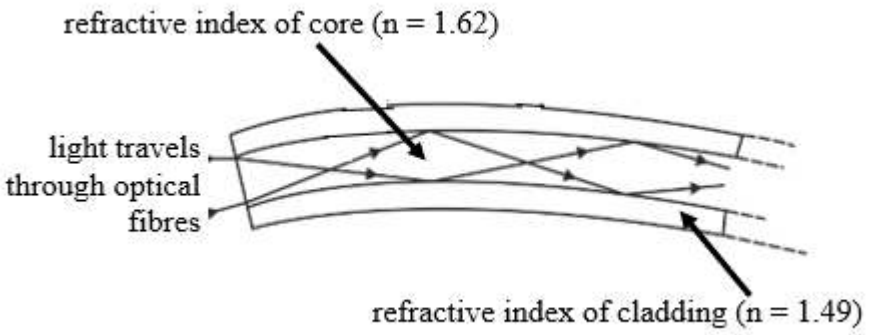
The student sets up a light ray box using the Perspex prism.

(a) Complete the diagram to show how dispersion can be demonstrated using a ray box and a prism. **3**



(b) Optical fibres are designed to keep the pulses of light inside cables so they can code information across the internet and cable TV services. **4**

To achieve this, the cladding must be lower in its refractive index in comparison to the core of the optical fibre.



Justify the need to have the greatest refractive index in the core of optical fibres and then determine the critical angle required to maintain total internal reflection in this cable.

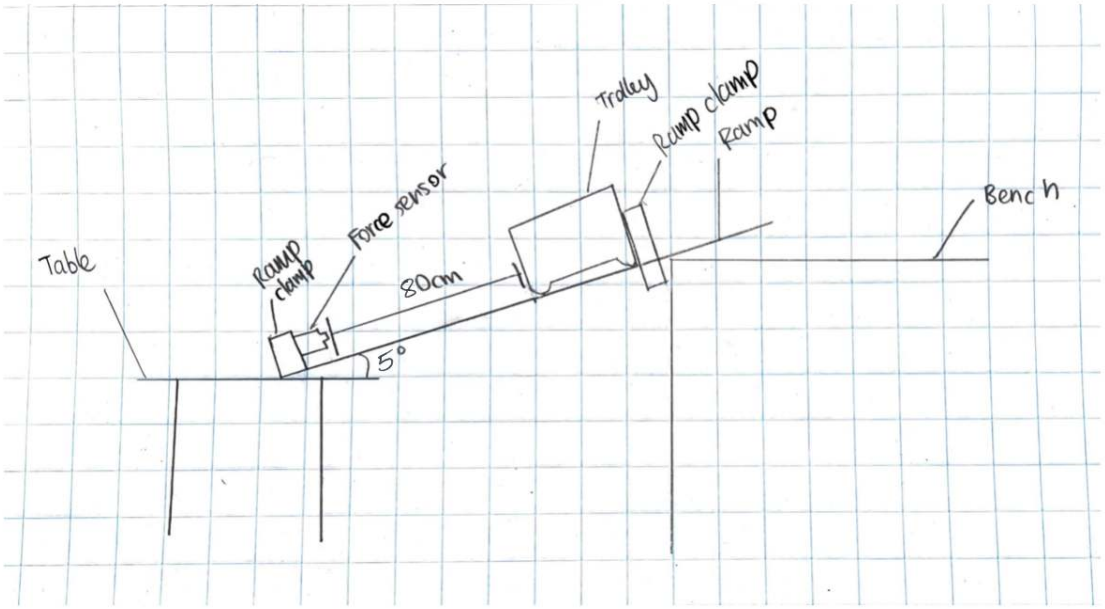
End of Question 19

Question 20 (10 marks)

A student undertook a depth study to analyse the effectiveness of a crumple zone design at absorbing kinetic energy.

The student fixed the 10 g crumple zone to the front of a 500 g dynamics trolley, as shown below.

The frictionless track was set to 5.0˚ and the distance between the front of the trolley/crumple zone and the force meter was 80 cm, as shown in the student's diagram below.



The force meter at the bottom of the track measures the force applied to the trolley as a function of time during the collision.

(a) Determine the velocity at which the trolley hits the force meter.

……

……

……

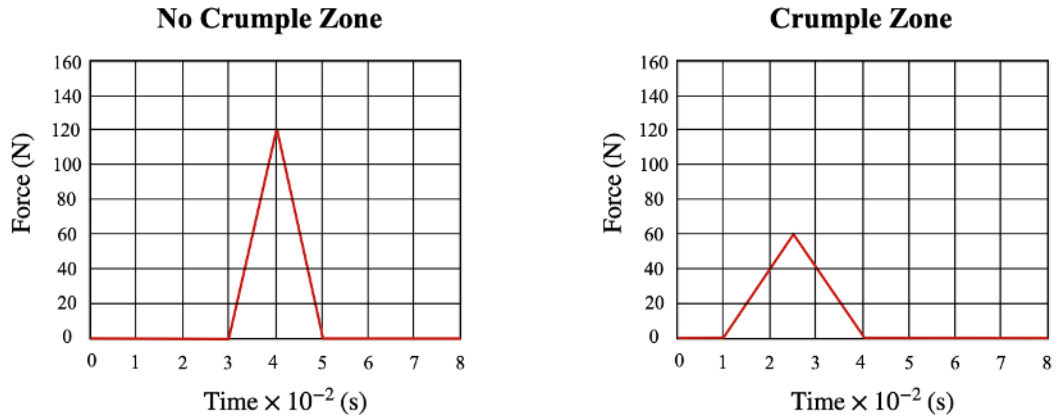
……

……

3

(b) The student's partner repeated the experiment but made one change to the method. They altered the angle of the ramp to 7.0°. After doing so, the second student determined that the trolley hit the force meter at a velocity of 1.4 m s^{-1}. **3**

After numerous trials, the average results as shown by the force meter, are shown below.



The student ensured that the mass of the trolley with and without the crumple zone remained the same.

Calculate the amount of kinetic energy the crumple zone absorbs.

.....

.....

.....

.....

.....

.....

(c) Explain why the impulse was not the same between the control and the crumple zone runs. **4**

.....

.....

.....

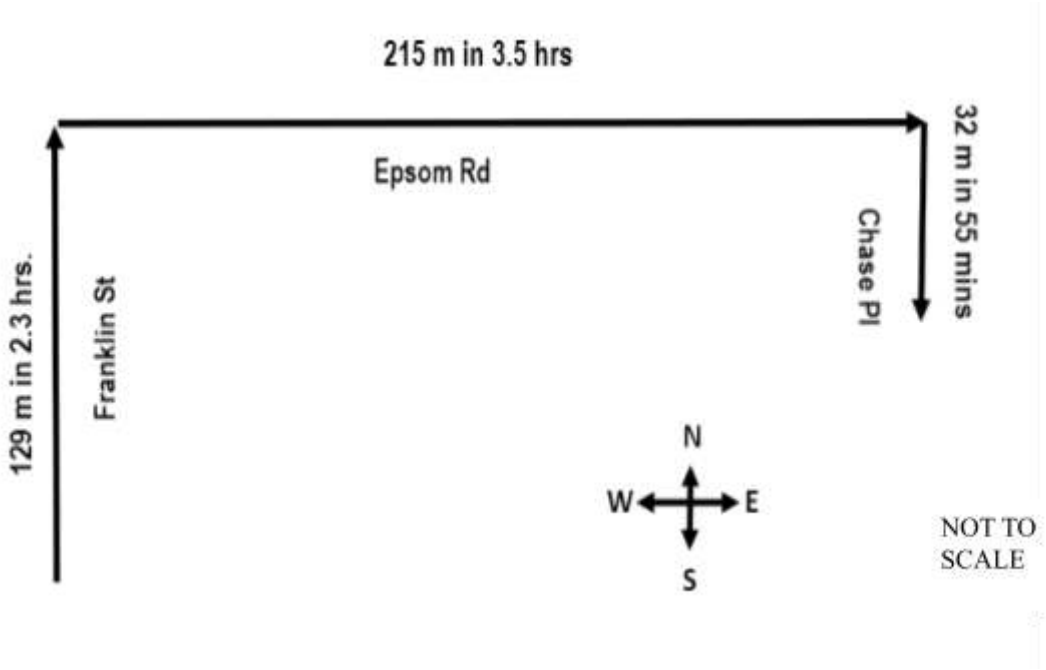
.....

.....

.....

Question 21 (4 marks)

The map shows the journey of a person walking in their neighbourhood.

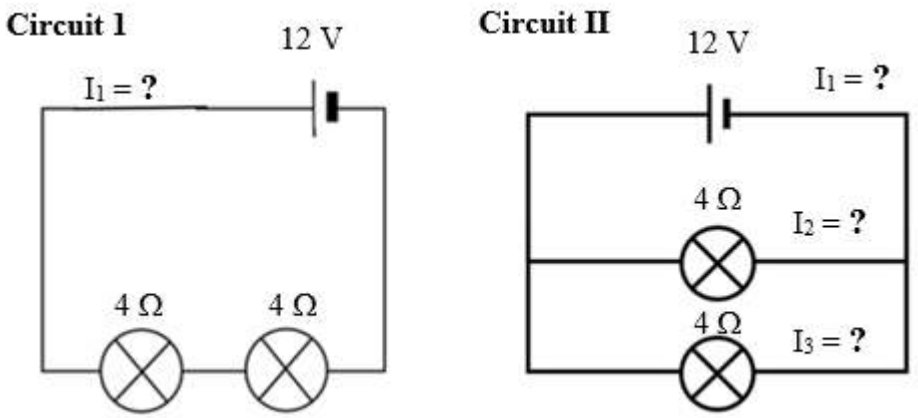


(a) Calculate the net displacement of the person when they reached the end of Epsom Rd. **2**

(b) Explain how the net displacement of the person could be calculated once they finished their walk on Chase Pl. **2**

Question 22 (7 marks)

The diagrams of two electrical circuits, Circuit I and Circuit II are shown.



(a) Compare the total resistance of Circuit I with Circuit II. **2**

.....

.....

.....

.....

.....

(b) Use calculations to help explain why the current differs in the THREE locations marked I_1, I_2 and I_3 in Circuit II. **3**

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) Explain why a voltmeter must be used in parallel. **2**

……

……

……

……

Question 23 (6 marks)

Five different balls were dropped off a 4-metre-high balcony and their fall times were recorded with a stopwatch.

This experiment was repeated four times and recorded as T_1, T_2, T_3 and T_4 in the given table. The average times and acceleration values are not included in the data table.

Ball Types	T_1 (s)	T_2 (s)	T_3 (s)	T_4 (s)	Average time (s)	Acceleration (ms^{-2})
Tennis ball	0.94	1.25	0.88	0.85		
Baseball	1.06	1.43	0.87	0.90		
Soft ball	1.56	0.89	0.79	0.88		
Squash ball	0.92	0.65	0.76	0.98		
Golf ball	0.88	0.93	0.91	0.89		

(a) Which type of ball achieved the most accurate value for acceleration? Justify your answer. **2**

.....

.....

.....

.....

(b) Which type of ball had the most reliable set of results? Justify your answer. **2**

.....

.....

.....

.....

.....

(c) Outline TWO reasons why there is so much variation in these results. **2**

.....

.....

.....

.....

.....

End of paper

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

DATA SHEET

Charge on electron, *qe*	-1.602×10^{-19} C
Mass of electron, *me*	9.109×10^{-31} kg
Mass of neutron, *mn*	1.675×10^{-27} kg
Mass of proton, *mp*	1.673×10^{-27} kg
Speed of sound in air	340 ms^{-1}
Earth's gravitational acceleration, *g*	9.8 m s^{-2}
Speed of light, *c*	3.00×10^{8} m s^{-1}
Electric permittivity constant, ε_0	8.854×10^{-12} A^2 s^4 kg^{-1} m^{-3}
Magnetic permeability constant, μ_0	$4\pi \times 10^{-7}$ N A^{-2}
Universal gravitational constant, *G*	6.67×10^{-11} N m^2 kg^{-2}
Mass of Earth , M_E	6.0×10^{24} kg
Radius of Earth, r_E	6.371×10^{6} m
Planck constant, *h*	6.626×10^{-34} J s
Rydberg constant, *R* (hydrogen)	1.097×10^{7} m^{-1}
Atomic mass unit, *u*	1.661×10^{-27} kg
	931.5 MeV/c^2
1 eV	1.602×10^{-19} J
Density of water, ρ	1.00×10^{3} kg m^{-3}
Specific heat capacity of water	4.18×10^{3} J kg^{-1} K^{-1}
Wien's displacement constant, *b*	2.898×10^{-3} m K

FORMULAE SHEET

Motion, forces and gravity

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$\Delta U = mg\Delta h$$

$$P = \frac{\Delta E}{\Delta t}$$

$$\sum \frac{1}{2}mv_{\text{before}}^2 = \sum \frac{1}{2}mv_{\text{after}}^2$$

$$\Delta \vec{p} = \vec{F}_{\text{net}}\Delta t$$

$$\omega = \frac{\Delta \theta}{t}$$

$$\tau = r_{\perp}F = rF\sin\theta$$

$$v = \frac{2\pi r}{T}$$

$$U = -\frac{GMm}{r}$$

$$v = u + at$$

$$\vec{F}_{\text{net}} = m\vec{a}$$

$$W = F_{\parallel}s = Fs\cos\theta$$

$$K = \frac{1}{2}mv^2$$

$$P = F_{\parallel}v = Fv\cos\theta$$

$$\sum m\vec{v}_{\text{before}} = \sum m\vec{v}_{\text{after}}$$

$$a_c = \frac{v^2}{r}$$

$$F_c = \frac{mv^2}{r}$$

$$F = \frac{GMm}{r^2}$$

$$\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$$

Waves and thermodynamics

$$v = f\lambda$$

$$f = \frac{1}{T}$$

$$d\sin\theta = m\lambda$$

$$n_x = \frac{c}{v_x}$$

$$I = I_{\max}\cos^2\theta$$

$$Q = mc\Delta T$$

$$f_{\text{beat}} = \left| f_2 - f_1 \right|$$

$$f' = f\frac{\left(v_{\text{wave}} + v_{\text{observer}}\right)}{\left(v_{\text{wave}} - v_{\text{source}}\right)}$$

$$n_1\sin\theta_1 = n_2\sin\theta_2$$

$$\sin\theta_c = \frac{n_2}{n_1}$$

$$I_1r_1^2 = I_2r_2^2$$

$$\frac{Q}{t} = \frac{kA\Delta T}{d}$$

Electricity and magnetism

$$E = \frac{V}{d}$$

$$V = \frac{\Delta U}{q}$$

$$W = qV$$

$$W = qEd$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \frac{\mu_0 NI}{L}$$

$$\Phi = B_{||}A = BA\cos\theta$$

$$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\vec{F} = q\vec{E}$$

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

$$I = \frac{q}{t}$$

$$V = IR$$

$$P = VI$$

$$F = qv_{\perp}B = qvB\sin\theta$$

$$F = lI_{\perp}B = lIB\sin\theta$$

$$\frac{F}{l} = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{r}$$

$$\tau = nIA_{\perp}B = nIAB\sin\theta$$

$$V_p I_p = V_s I_s$$

Quantum, special relativity and nuclear

$$\lambda = \frac{h}{mv}$$

$$K_{max} = hf - \phi$$

$$\lambda_{max} = \frac{b}{T}$$

$$E = mc^2$$

$$E = hf$$

$$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

$$t = \frac{t_0}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$l = l_0\sqrt{\left(1 - \frac{v^2}{c^2}\right)}$$

$$p_v = \frac{m_0 v}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$N_t = N_0 e^{-\lambda t}$$

$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$$

PERIODIC TABLE OF THE ELEMENTS

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.38 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.61 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.96 Molybdenum	43 Tc Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanoids	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.9 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89–103 Actinoids	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

KEY

Atomic Number	79
Symbol	Au
Standard Atomic Weight	197.0
Name	Gold

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.1 Ytterbium	71 Lu 175.0 Lutetium

Actinoids

89 Ac Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

Standard atomic weights are abridged to four significant figures.

Elements with no reported values in the table have no stable nuclides.

Information on elements with atomic numbers 113 and above is sourced from the International Union of Pure and Applied Chemistry Periodic Table of the Elements (November 2016 version).

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (February 2010 version) is the principal source of all other data. Some data may have been modified.

Physics

Name:.....
Class:.....

2023

YEAR 11
YEARLY EXAMINATION

Physics Year 11 Examination

Section I – Multiple Choice Answer Sheet

15 marks
Attempt Questions 1–15
Allow about 25 minutes for this section

Select the alternative A, B, C or D that best answers the question. Fill in the response circle completely.

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
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D

2023 Year 11 Yearly
Physics
Marking Guidelines

Section I

Multiple-choice Answer-key (Explanations over page)

Question	Answer
1	B
2	A
3	C
4	C
5	D
6	C
7	C
8	B
9	B
10	D
11	B
12	C
13	D
14	D
15	D

Multiple-choice Explanations

Question	Answer	Explanation
1	B	The dropped ball can only travel with uniform acceleration due to gravitational field.
2	A	Average velocity is the slope of the graph calculated from B and C.
3	C	A large specific heat value indicates that it will take a lot longer for this substance to heat up when compared to the smaller specific heat value.
4	C	More than twice the pushing force is required to move the cabinet against the carpet.
5	D	Refractive Index is calculated when the gradient of this graph is determined.
6	C	To decrease the impact force, the collision time must be increased, and this is what the airbag does.
7	C	The Doppler effect formula calculated this frequency $f' = f\frac{(v_{\text{wave}}+v_{\text{observer}})}{(v_{\text{wave}}-v_{\text{source}})}$
8	B	Ampere's Law is best substituted using this data and this formula to calculate the magnitude and direction of the force between the charges.
9	B	The wavelength which is displayed in the tube is 2/3 L.
10	D	The diagram correctly displays a standing wave for the third harmonic in a closed tube.
11	B	In this type of a collision only momentum is conserved.
12	C	Using the correct substitution of this formula the velocity is calculated. $\sum m\,\vec{v}_{\text{before}} = \sum m\,\vec{v}_{\text{after}}$
13	D	Both situations have motion which is undergoing constant acceleration.
14	D	The slope of line Y determines the resistance of the light globe in Diagram B.
15	D	Charge Z is clearly a stronger negative charge repelling the other negative as displayed by the large amount of field lines and the non-alignment of the electric field.

Section II

Question 16 (6 marks)

(a) 2 marks

Criteria	Marks
● Calculates the weight difference between the masses X and Y	2
● Provides some relevant information	1

Sample answer:

The weight force of mass X = mg = 5 x 9.8 = 49 N
The weight force of mass Y = mg = 6 x 9.8 = 58.8 N

The weight force difference between the two masses is 58.8 - 49 = 9.8 N

(b) 4 marks

Criteria	Marks
● Correctly identifies that string 1 has the largest tension force in this set up by correctly calculating the three tension forces	4
● Correctly calculates tensions 1, 2 and 3	3
● Correctly calculates some tensions	2
● Provides correct relevant information	1

Sample answer:

Net force for mass X = ma = 0 = T_1 - T_2 - (5 x 9.8)
Net force for mass Y = ma = 0 = T_2 - T_3 - (6 x 9.8)
Net force for mass Z = ma = 0 = T_3 - (7 x 9.8)

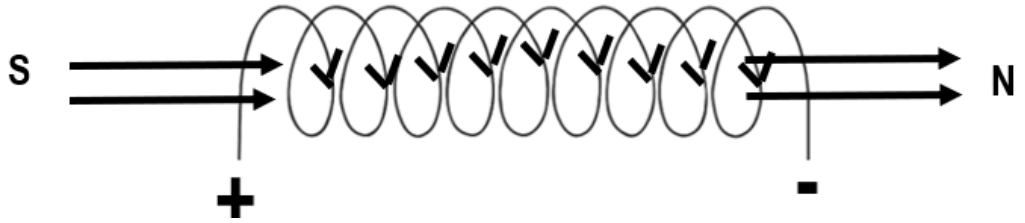
T_3 = 7 x 9.8 = 68.6N
T_2 = T_3 + 6 x 9.8 = 68.6 + 58.8 = 127.4 N
T_1 = T_2 + 5 x 9.8 = 127.4 + 49 = 176.4 N
String 1 or Tension 1 has the largest tension force in this set up.

Question 17 (6 marks)

(a) 2 marks

Criteria	Marks
● Correctly draws the north and south pole orientation following the RHR for solenoids ● Displays the correct direction for current flow	2
● Provides some relevant information	1

Sample answer:



(b) 2 marks

Criteria	Marks
● Explains TWO correct modifications which would enable this coil to be a stronger electromagnet	2
● Correctly describes ONE modification which would enable this set up to be a stronger electromagnet	1

Sample answer:

Firstly, an iron core or nail can be placed inside the solenoid will increase the strength of the magnetic field so that the coil solenoid can easily pick up iron objects like pins and become a stronger electromagnet. Another modification that can increase the size of the magnetic field is increasing the number of loops in the solenoid.

May also include:

- increasing the amount of current flowing through the solenoid

(c)

Criteria	Marks
Correctly calculates the magnetic field	2
Uses correct formula with incorrect substitution or Uses correct formula	1

Sample answer:

$B = \frac{\mu_0 NI}{L}$

$B = \frac{1.257\times10^{-6}\times25\times3}{0.2}$

$B = 4.7\times10^{-4}\ \text{T}$

Question 18(4 marks)

(a) 1 mark

Criteria	Marks
● Correctly identifies the type of motion displayed in the graph	1

Sample answer:

The graph clearly shows uniformly accelerated motion as the displacement in the graph is not just increasing, it is increasing exponentially.

(b) 1 mark

Criteria	Marks
● Correctly identifies what is determined if a tangent was drawn at P	1

Sample answer:

If a tangent was drawn at point P we can determine the object's instantaneous velocity by calculating gradient of this tangent.

(c) 2 marks

Criteria	Marks
● Correctly explains that the object's acceleration can be calculated by comparing the value of the gradient/instantaneous velocity using the tangent at two points such as P and Q	2
● Provides some relevant information	1

Sample answer:

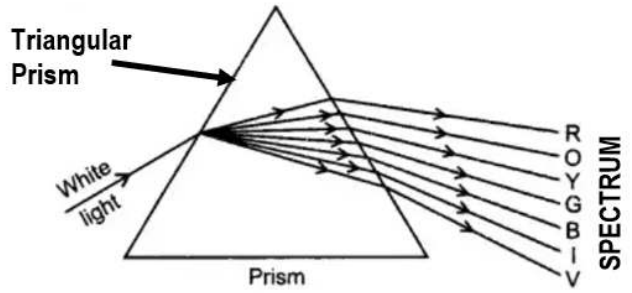
This can be determined by calculating a value for the gradient of the tangent at two points such as P and Q giving us the instantaneous velocity for each. The difference can then be used in the formula: a = $\frac{v-u}{t}$ to calculate the acceleration between these two points.

Question 19 (7 marks)

(a) 3 marks

Criteria	Marks
● Draws an accurate diagram which shows light entering a triangular prism and refracting to create a spectrum of light which is ordered ROYGBIV ● Indicates that red light has the least deviation and violet light with the most deviation	3
● Draws a diagram which shows light refracting in a prism creating a spectrum only	2
● Provides some relevant information	1

Sample answer:



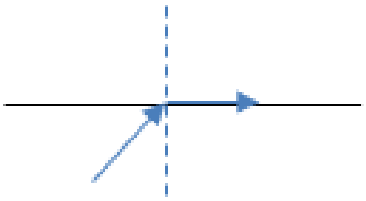
(b) 4 marks

Criteria	Marks
● Correctly identifies that the critical angle is created when $\theta_r = 90^0$ ● Relates total internal reflection to achieving a critical angle $\theta_r = 90^0$ and shows that $\theta_r = 90^0$ only occurs as light is going from higher RI to lower RI ● Correctly calculates the critical angle required to maintain total internal reflection	4
● Correctly identifies that the critical angle is created when $\theta_r = 90^0$ ● Relates total internal reflection/critical angle in some way to light going from higher RI to lower RI ● Correctly calculates the critical angle required to maintain total internal reflection	3
● Correctly calculates the critical angle ● Correctly identifies that the critical angle is created when $\theta_r = 90^0$	2
● Provides some relevant information	1

See over page for sample answer:

Sample answer:

The critical angle occurs when the light has been refracted (or bent) 90^0 from the normal.



This can only be achieved as light passes from a higher RI to a lower one where the beam is being refracted away from the normal. Therefore, the core must have a higher RI than the cladding. This enables the optical fibre to work correctly as total internal reflection is required to transmit light pulses from the sender to the receiver.

Critical angle calculation

n_1 (Sin θ_c) = n_2 (Sin θ_r)

1.62 (Sin θ_c) = 1.49 (Sin 90^0)

Sin $\theta_c = \frac{1.49}{1.62}$

Sin θ_c = 0.92

θ_c = 66.9

The light must achieve a critical angle (θ_c) of 66.9^0 in this cable so that total internal reflection can be achieved, and the optical fibre will work correctly as designed.

Question 20 (10 marks)

Question 20 (a)

Criteria	Marks
Calculates the correct velocity	3
Uses correct formula with incorrect substitution	2
Shows some relevant working	1

Sample answer:

$v^2 = u^2 + 2as$

$v = \sqrt{2asin\,\theta\, s}$

$v = \sqrt{2 \times 9.8 sin\ 5 \times 0.8}$

$v = 1.2$ m s^{-1}

Question 20 (b)

Criteria	Marks
Correctly calculates absorbed kinetic energy	3
Calculates the final velocity	2
Correctly finds the impulse or Shows some relevant working	1

Sample answer:

$Ft = mv - mu$

$v = \frac{Ft}{m} + u$

$v = \frac{-60 \times 3 \times 10^{-2}}{2 \times 0.51} + 1.4$ (NB: Ft/2 is the area under the curve)

$v = -0.36$ m s^{-1}

$\Delta K = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$

$\Delta K = \frac{1}{2}m\left(v^2 - u^2\right)$

$\Delta K = \frac{1}{2}0.51\left(-0.36^2 - 1.4^2\right)$

$\Delta K = -0.47$ J

The crumple zone absorbs 0.47 J of kinetic energy.

Question 20 (c)

Criteria	Marks
Relates impulse to change in momentum and identifies the constant and changing variables that lead to different impulses	4
Identifies the constant and changing variables that lead to different impulses	3
Relates impulse to change in momentum	2
Provides some relevant information	1

Sample answer:

The impulse is equal to the change in momentum. Although the mass and initial velocity was kept the same throughout the experiment the final velocity changed when the crumple zone was attached. Because the crumple zone run had a smaller final velocity in the opposite direction the change in velocity was smaller and therefore the impulse was smaller.

Question 21 (4 marks)

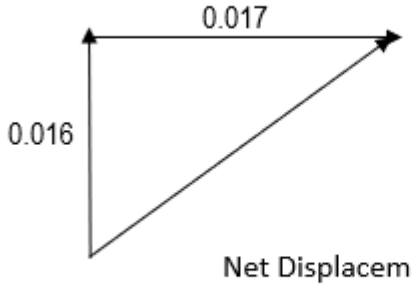
(a) 2 marks

Criteria	Marks
● Correctly calculates the average velocity on Franklin St and Epsom Rd ● Calculates the net displacement from the start of Franklin Road to Epsom Rd	2
● Provides some relevant information	1

Sample answer:

Motion on Franklin St
129 m N in 2.3 hrs
Average velocity = 129 m N /8280 s
Vav = 0.016 ms^{-1} N

Motion on Epsom Rd
215 m E in 3.5 hrs
Average velocity = 215 m E /12600 s
Vav = 0.017 ms^{-1} E



Tan q = 0.017/0.016
q = 46.7^0

Net Displacement
= $\sqrt{0.016^2 + 0.017^2}$
= 0.02 m N 46.7^0 W

(b) 2 marks

Criteria	Marks
● Correctly explains that a straight line must be drawn to scale and measured to determine the magnitude of the net displacement ● Correctly describes that the direction of the net displacement can be determined by measuring the angle created by line	2
● Provides some relevant information	1

Sample answer:

The net displacement can be calculated by drawing a straight line to scale from the start of Franklin St to the end of Chase Pl. This line can then be measured to scale to determine the magnitude of the net displacement of the journey. A protractor can then be used to determine the direction of the net displacement by measuring the angle to determine its direction from North as shown by the magnetic compass in the diagram.

Question 22 (5 marks)

(a) 2 marks

Criteria	Marks
● Correctly calculates the total resistance in Circuit I and Circuit II	2
● Provides some relevant information	1

Sample answer:

Total Resistance in Circuit I

$R_T = 4\ \Omega + 4\ \Omega = 8\ \Omega$

Total Resistance in Circuit II

$\frac{1}{RT} = \frac{1}{4}\ \Omega + \frac{1}{4}\ \Omega$

$= \frac{2}{4}\ \Omega$

$R_T = \frac{4}{2} = 2\ \Omega$

(b) 3 marks

Criteria	Marks
● Correctly calculate the current values in Circuit II (I_1, I_2 and I_3) and relates differences to Kirchhoff's Law	3
● Correctly calculates the total current in Circuit II	2
● Provides some relevant information	1

Sample answer:

Total Current in Circuit II (I_1)

$V = I\ R$

$I = \frac{V}{R}$

$I_1 = \frac{12}{2}$

$= 6\ A$

$I_2 = \frac{12}{4} = 3\ A$ and $I_3 = \frac{12}{4} = 3\ A$

Adding both currents in each parallel component of the circuit I_2 (3A) + I_3 (3A) = the total current in the circuit (I_1) (6A) as per Kirchhoff's Law that states the total current entering a junction should equal the current that leaves it.

Question 22 (C)

Criteria	Marks
Correctly relates how voltage is measured in a circuit to the property of voltage	2
Describes how voltage is measured	1

Sample answer:

A voltmeter is used in parallel in a circuit to measure the potential difference (voltage) across two points without altering the circuit's operation. If it were connected in series, it would add its own resistance to the circuit, skewing the measurement and potentially altering the operation of the circuit. In parallel configuration, the voltmeter accurately reads voltage while minimally affecting the current flow.

Question 23 (6 marks)

(a) 2 marks

Criteria	Marks
● Correctly calculates and identifies which type of ball has the most accurate acceleration value using correct working	2
● Provides some relevant information	1

Sample answer:

The golf ball has the most accurate average acceleration value.

$S = ut + ½ at^2$

$4 = ½ 9.8 t^2$

$t^2 = \frac{4}{4.9}$

$t = 0.9$ s

This value is closest to the golf ball

(b) 2 marks

Criteria	Marks
● Correctly calculates and identifies which type of ball has the most reliable acceleration value	2
● Provides some relevant information	1

Sample answer:

Reliable results need to be both accurate and reproducible. The golf ball's drop times of 0.88 s, 0.93 s, 0.91 s and 0.89 s have the least spread of all the balls of only 0.05, being very reproducible, plus having multiple drops which are the closest to the best accepted value of 0.9 s or 9.8 ms^{-2} makes the golf ball results the most reliable.

All the other types of balls have a much greater spread; tennis 0.4, baseball 0.53, soft ball 0.77 and squash ball 0.33 so give average results that are not as accurate.

c) 2 marks

Criteria	Marks
● Correctly Identifies TWO reasons for variations in results	2
● Provides some relevant information	1

Sample answer:

One major cause of variation in the results is the reaction time required to start and stop the stopwatch. This can occur when the ball was released and when the ball hit the floor. This issue would bring some error into the experiment as the drop times would be less precise, especially if the reaction time to start and stop the stopwatch was large.

Another source of variation could be how the ball was dropped off the balcony. If it was dropped exactly at the 4 m mark or straight without deviation. These variations would affect the results as the different drop paths would add variation to the drop times in the results.

2023 Year 11 Yearly
Physics
Mapping Grid

Question	Marks	Content	Syllabus outcomes
Section 1			
1	1	1.1.5	PH11-8
2	1	4.3.5	PH11-11
3	1	1.1.1	PH11-8
4	1	1.1.4	PH11-8
5	1	3.1.4	PH11-10
6	1	3.1.2	PH11-10
7	1	3.5.3	PH11-10
8	1	2.2.3	PH11-9
9	1	2.1.1	PH11-9
10	1	3.4.3	PH11-10
11	1	2.3.4	PH11-9
12	1	3.3.7	PH11-10
13	1	4.1.1	PH11-11
14	1	3.3.5	PH11-10
15	1	3.3.6	PH11-10
16	1	2.3.2	PH11-9
17	1	2.3.5	PH11-9
18	1	1.1.4	PH11-8
19	1	4.2.3	PH11-11
20	1	4.1.2	PH11-11
Section 2			
21(a)	2	2.2.2	PH11-9
21(b)	4	2.2.2	PH11-9
22 (a)	2	4.3.2	PH11-11
22 (b)	2	4.3.4	PH11-11
23 (a)	1	1.1.5	PH11-8
23 (b)	1	1.1.5	PH11-8
23 (c)	2	1.1.5	PH11-8
24 (a)	3	3.4,2	PH11-10
24 (b)	4	3.4.3	PH11-10
25 (a)	3	2.1.2	PH11-9
25 (b)	4	2.1.3	PH11-9

26 (a)	7	3.5.4	PH11-10

27(a)	2	1.2.4	PH11-8
27 (b)	2	1.2.4	PH11-8
28 (a)	2	4.2.4	PH11-11
28 (b)	3	4.2.4	PH11-11
29 (a)	2	1.1.1	PH11-8
29 (b)	2	1.1.4	PH11-8
29 (c)	2	1.1.4	PH11-8
30 (a)	3	4.1.2	PH11-11
30 (b)	2	4.1.4	PH11-11