DULWICH COLLEGE | SINGAPORE |

# Year 10 Examination

## *Physics – Double award – End of year*

Name:……

Time allowed:

Answer **all** questions in the spaces provided/on lined paper.
(Any other subject specific information to go here)

| | | |
|---|---|---|
| Total Marks available | /90 | Teacher comment: |
| | % | |
| Level/Grade | | |

| |
|---|
| Student reflection |

## FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time $\qquad E = I \times V \times t$

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}} \qquad v = \frac{2 \times \pi \times r}{T}$$

(final speed)$^2$ = (initial speed)$^2$ + (2 × acceleration × distance moved)

$$v^2 = u^2 + (2 \times a \times s)$$

Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$.

**Q1.**

This question is about waves.

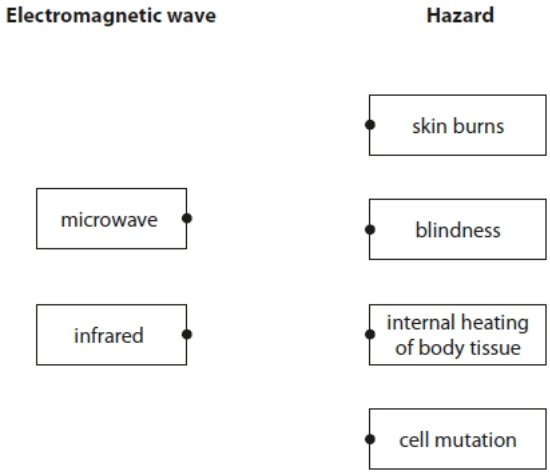
(a) (i) Which of these waves is longitudinal?

**(1)**

- ☒ **A** infrared
- ☒ **B** radio
- ☒ **C** sound
- ☒ **D** ultraviolet

(ii) Draw a straight line linking each electromagnetic wave to its correct hazard.

**(2)**




(b) (i) Which of these is a use for x-rays?

**(1)**

- ☒ **A** checking for broken bones
- ☒ **B** cooking food
- ☒ **C** detecting forged banknotes
- ☒ **D** smoke detectors

(ii) Which of these is a use for infrared waves?

**(1)**

- ☒ **A** checking for broken bones
- ☒ **B** cooking food
- ☒ **C** detecting forged banknotes
- ☒ **D** sterilising medical instruments

**(Total for question = 5 marks)**

**Q2.**

(a) A speed camera is positioned at the side of a road.

© Darryl Sleath/Shutterstock

The camera measures the speed of a vehicle on the road to determine whether the vehicle is travelling too fast.
The camera takes two photographs of the vehicle 0.25 s apart.
The photographs are used to measure the distance travelled by the vehicle during this time.

(i) State the formula linking average speed, distance moved and time taken.

**(1)**

(ii) In the time between the two photographs, the car travels a distance of 6.5 m.
Calculate the average speed of the car.

**(2)**

average speed = ..... m/s

(iii) The speed limit of the road is 80 kilometres per hour.
Determine whether the car is exceeding the speed limit.

**(2)**

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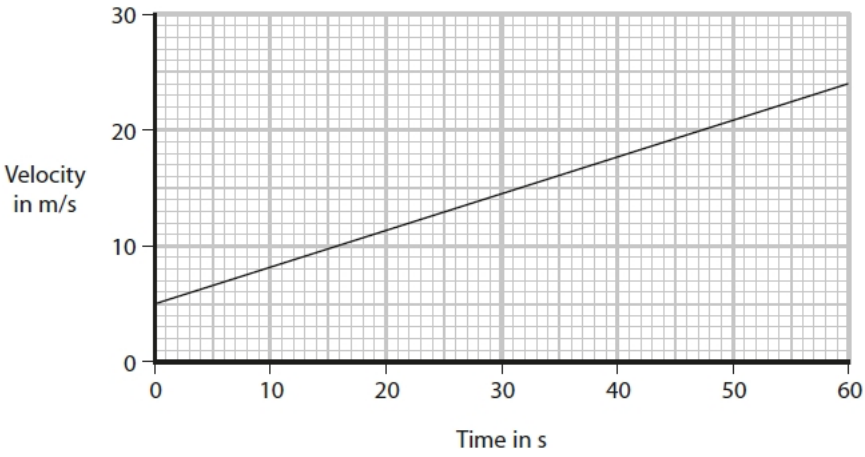
(b) The velocity-time graph shows how the velocity of a lorry changes with time.




(i) Explain how the graph shows that the lorry has a constant acceleration.

**(2)**

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(ii) State the formula linking acceleration, change in velocity and time taken.

**(1)**

(iii) Calculate the acceleration of the lorry.

**(3)**

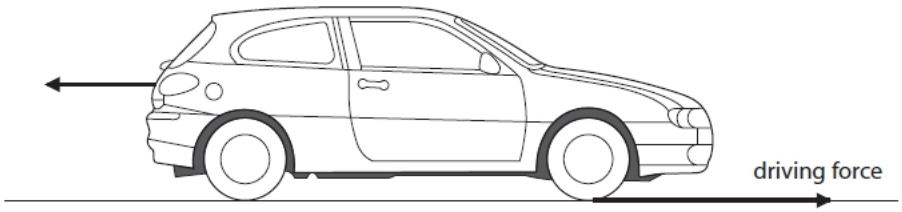
acceleration = ..... $m/s^2$

**(Total for question = 11 marks)**

**Q3.**

(a) A car accelerates along a level road.

The diagram shows some of the horizontal forces acting on the car as it accelerates.




(Source: DEEWI114481 © father/Shutterstock)

(i) A driving force acts on the car, as shown in the diagram.
State the name of the other force shown in the diagram.

**(1)**

.....

(ii) State the formula linking unbalanced force, mass and acceleration.

**(1)**

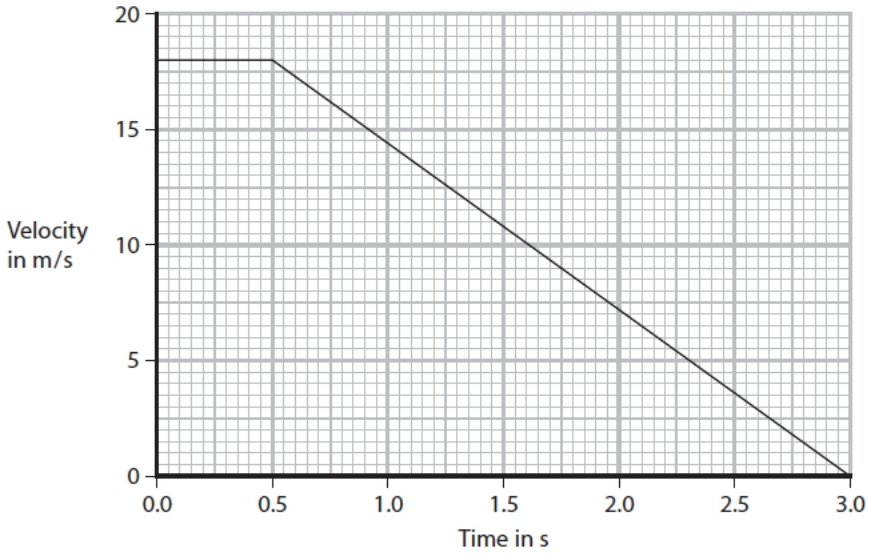
(iii) The unbalanced force acting on the car is 2900 N.
The mass of the car is 1200 kg.
Calculate the acceleration of the car.

**(2)**

acceleration = ..... $m/s^2$

(b) The driver sees an obstacle in the road and applies the brakes.

The driver has a reaction time of 0.5 s. He applies the brakes for 2.5 s.
The graph shows how the velocity of the car changes from when the driver sees the obstacle until the car stops.




(i) Describe how the thinking distance is affected by the condition of the car's brakes and the speed of the car.

**(2)**

condition of brakes .....

.....

speed of car .....

.....

(ii) Use the graph to calculate the braking distance.

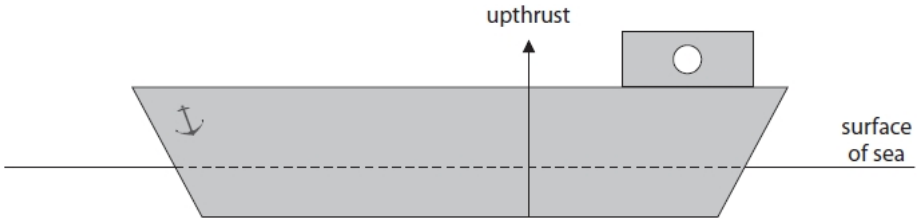
**(3)**

braking distance = ..... m

**(Total for question = 9 marks)**

**Q4.**

A ship floats on the sea.




(a) The ship floats because of the forces acting on it.

(i) The upward force acting on the ship is called upthrust.
This force is shown on the diagram.
Draw another labelled arrow on the diagram to show the other vertical force acting on the ship.

**(2)**

(ii) Forces are vector quantities.
State what is meant by the term **vector quantity**.

**(2)**

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(iii) Give another example of a vector quantity.

**(1)**

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(b) The upthrust force acting on the ship is proportional to the pressure difference between the bottom of the ship and the surface of the sea.

The pressure acting on the ship at the surface of the sea is 100 kPa.
(i) State the formula linking pressure difference, height, density and gravitational field strength (*g*).

**(1)**

(ii) The bottom of the ship is 15.8 m below the surface of the sea.
Show that the pressure acting on the bottom of the ship is approximately 260 kPa.
[density of seawater = 1030 kg/m$^3$]

**(3)**

(iii) The area of the boat is 1,000 $m^2$. What is the force on the bottom of the boat?

**(3)**

(iv) Explain why, when the ship is fully loaded with cargo, the ship sinks slightly with the bottom of the ship deeper below the surface of the sea, comes to rest and continues to float.

**(2)**

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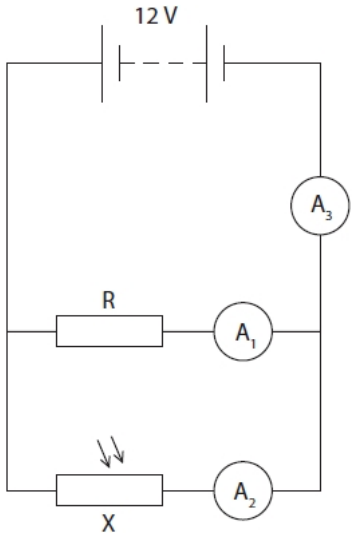
**(Total for question = 14 marks)**

**Q5.**

A 12 V battery is connected to a component, X, and a fixed resistor, R, as shown




(a) (i) State the name of component X.

**(1)**

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(b) The voltage across component X is 12 V.

The resistor R has a value of 840 Ω.
Show that the current in ammeter $A_1$ is approximately 0.01 A.

**(3)**

(c) When the circuit is placed in daylight, the current in $A_2$ is 0.011 A.

(i) Calculate the value of the current through $A_3$.

**(1)**

current = ..... A

(ii) Explain what happens to the current through $A_3$ when the circuit is placed in a darkened room.

**(2)**

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**(Total for question = 7 marks)**

**Q6.**

This question is about electric circuits.

(a) Which quantity is defined as the rate of flow of charge?

**(1)**

☒ **A** current

☒ **B** power

☒ **C** resistance

☒ **D** voltage

(b) Which quantity is defined as the energy transferred per unit charge passed?

**(1)**

- ☒ **A** current
- ☒ **B** power
- ☒ **C** resistance
- ☒ **D** voltage

(c) A student sets up a circuit to investigate how the current in different components varies with voltage.

He investigates these components.

- a short thick copper wire
- a filament lamp
- a long thin copper wire
- a diode

During the investigation, the student keeps the two copper wires at a constant temperature.

(i) Give a reason why he should keep the wires at a constant temperature.

**(1)**

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(ii) Describe how he could keep the wires at a constant temperature.

**(2)**

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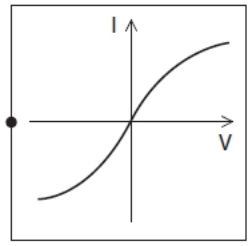
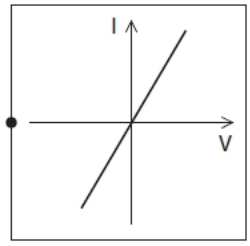
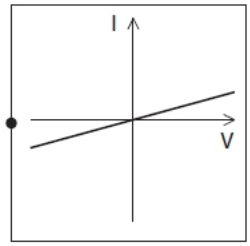
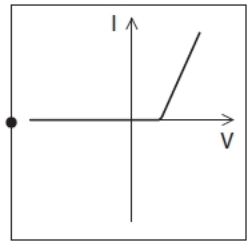
(iii) The student obtains a graph for each component.

Draw a straight line linking each component to its correct graph.

**(3)**

| component | graph |
| --- | --- |
| short thick copper wire |   |
| filament lamp |   |
| long thin copper wire |   |
| diode |   |

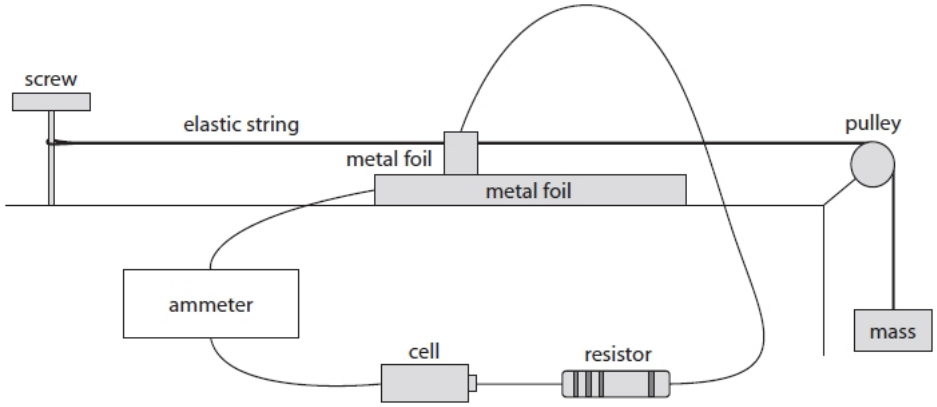
**(Total for question = 8 marks)**

**Q7.**

The diagram shows some apparatus used to find the mass of an object.

The two pieces of metal foil act as a variable resistor.

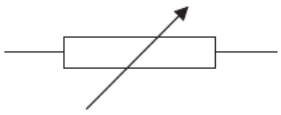
When more mass is added, the elastic string stretches and the small piece of metal foil moves to the right.




(a) (i) Draw the circuit diagram for this electrical circuit.

The variable resistor has been drawn for you.

**(4)**



(ii) Draw a voltmeter on the diagram to measure the voltage of the variable resistor.

**(2)**

(b) Explain how the voltage across the variable resistor changes if more mass is added to the end of the elastic string. **(4)**

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(c) The student extends the investigation by keeping the mass constant and replacing the cell with a variable power supply.

The student measures the current in the circuit for different voltages.
These are the results.

| Voltage in V | Current in mA |
|---|---|
| 0.0 | 0.0 |
| 2.0 | 4.0 |
| 4.0 | 7.0 |
| 6.0 | 11.0 |
| 8.0 | 14.0 |

(i) State the independent variable in the student's investigation.

**(1)**

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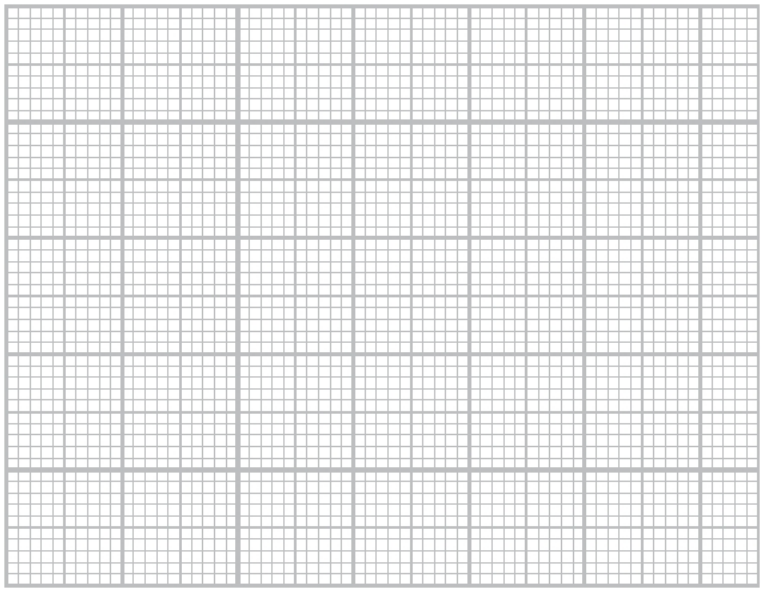
(ii) Plot the student's results on the grid.

**(3)**

(iii) Draw a line of best fit.

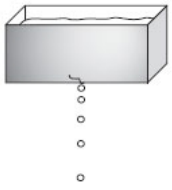
**(1)**



**(Total for question = 15 marks)**

**Q8.**

A water tank drips water.



(a) Scientists could use four quantities to describe the movement of the water drops.

| acceleration | force | mass | velocity |
|---|---|---|---|

Complete the following sentence using one of the quantities from the word box above.

**(1)**

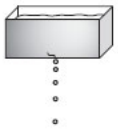
In a vacuum, all bodies falling towards the Earth's surface have the same . . . . . .

(b) The mass of one water drop is 0.000 08 kg.
Calculate its weight.
(gravitational field strength is 10 N/kg)

**(2)**

weight = . . . . . N

(c) The tank is a long way above the ground.
It drips at a steady rate.
The first drawing shows water drops which have just left the tank.
The second drawing shows water drops which are near to the ground.



drops leaving the tank

drops near to the ground

Explain why the drops which are near to the ground are an equal distance apart but the drops which have just started to fall are not.

**(6)**

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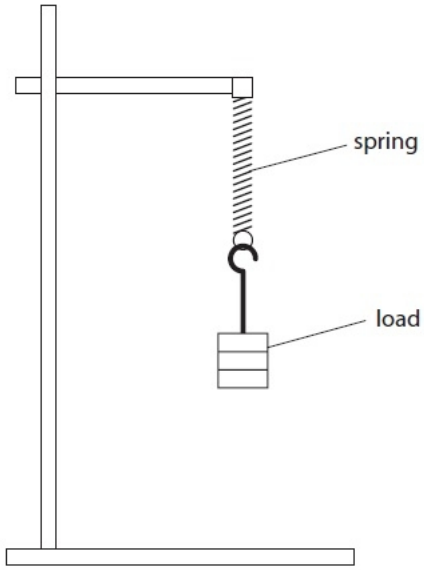
**(Total for Question is 9 marks)**

**Q9.**

A student investigates how the extension of a spring varies when he hangs different loads from it.

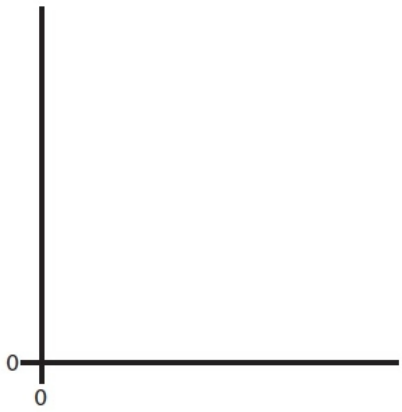


(a) The student finds that the spring obeys Hooke's law.

Draw a graph on the axes to show the Hooke's law relationship.

Label the axes.

**(3)**




(b) The student concludes that the spring shows elastic behaviour.

Explain what is meant by the term **elastic behaviour**.

**(2)**

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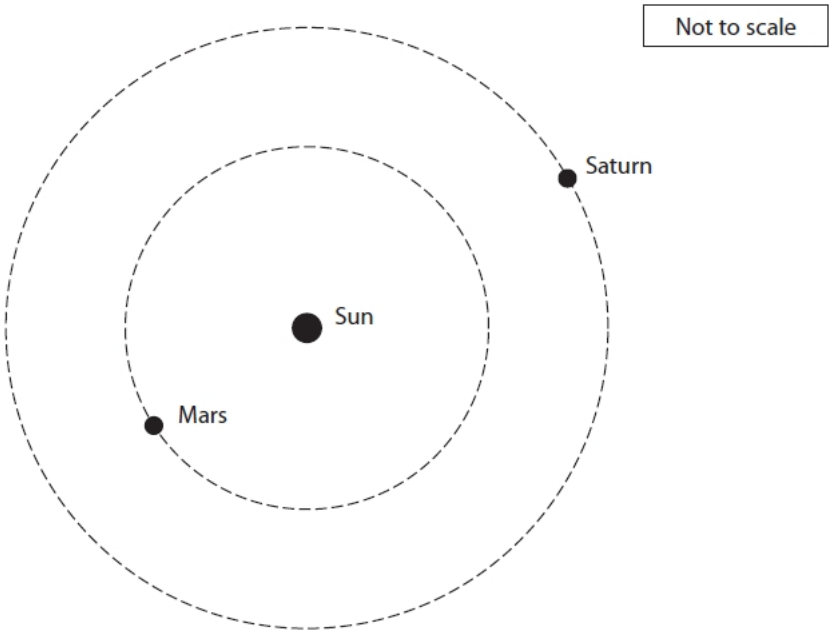
**(Total for Question = 5 marks)**

**Q10.**

The planets Mars and Saturn orbit around the same star, the Sun.

(a) The diagram shows the orbital paths of Mars and Saturn.




Draw an orbital path of a comet on the diagram.

**(2)**

(b) The table gives some information about the orbits of Mars and Saturn.

| | Mars | Saturn |
|---|---|---|
| **Orbital radius in km** | $2.28 \times 10^8$ | $1.43 \times 10^9$ |
| **Orbital speed in km/s** | 24.1 | 9.70 |

Mars completes a number of orbits in the time it takes for Saturn to complete one orbit. Calculate the number of orbits that Mars completes in the time it takes for Saturn to complete one orbit.

**(5)**

number of orbits = .....

**(Total for question = 7 marks)**