DULWICH COLLEGE | SINGAPORE |

Year 10 Examination

Physics – End of year exam - Separate

Name:……

Time allowed: 90

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 $E = I \times V \times t$

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

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

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

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

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

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

pressure × volume = constant $p_1 \times V_1 = p_2 \times V_2$

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant} \qquad \frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken}} \qquad F = \frac{(mv - mu)}{t}$$

$$\frac{\text{change of wavelength}}{\text{wavelength}} = \frac{\text{velocity of a galaxy}}{\text{speed of light}} \qquad \frac{\lambda - \lambda_0}{\lambda_0} = \frac{\Delta\lambda}{\lambda_0} = \frac{v}{c}$$

change in thermal energy = mass × specific heat capacity × change in temperature

$$\Delta Q = m \times c \times \Delta T$$

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

Q1.

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

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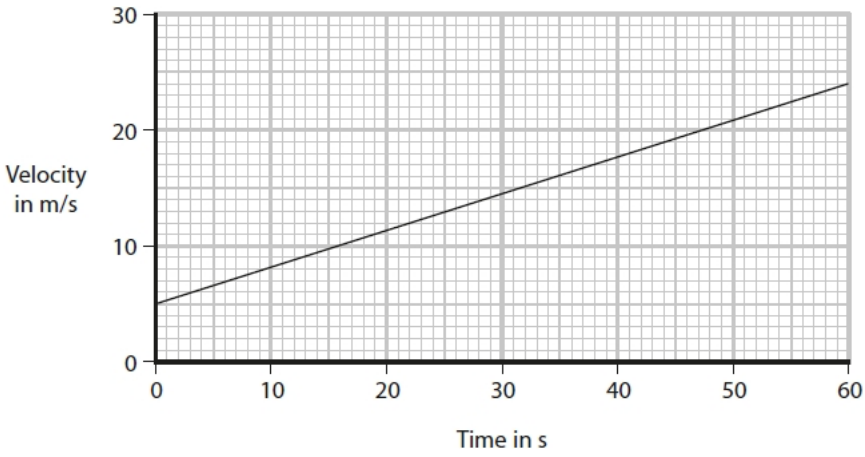
(b) The velocity-time graph shows how the velocity of a lorry changes with time.



(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

(iv) Calculate the distance travelled by the lorry.

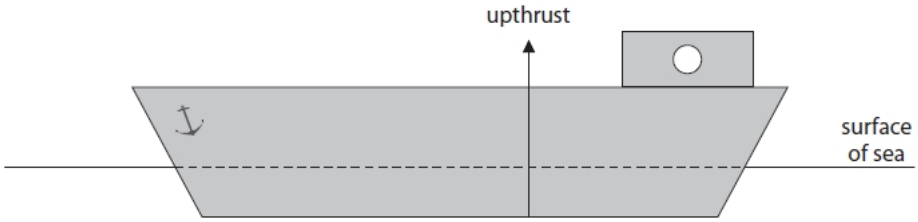
(3)

distance = ... m

(Total for question = 14 marks)

Q2.

A ship floats on the sea.



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

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

(2)

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(ii) 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)

(Total for question = 7 marks)

Q3.

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) Diagram 1 shows an electric circuit with two resistors, R and S.
Some of the values of the current are also shown.

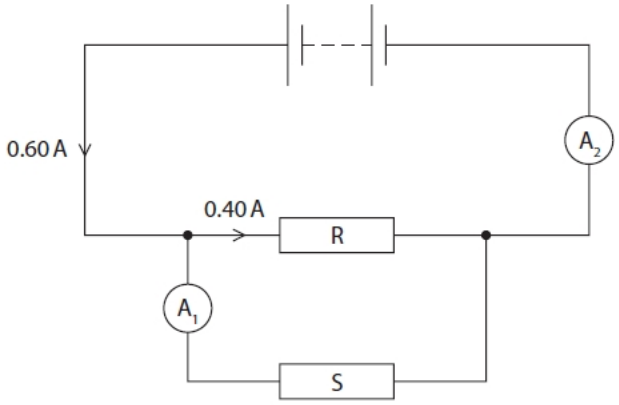

Diagram 1

(i) Deduce the readings on the ammeters.

(2)

current measured by A_1 = ... A

current measured by A_2 = ... A

(ii) Resistor R has a resistance of 11 Ω.
Calculate the voltage across resistor R.

(3)

voltage = ... V

(iii) Explain how the voltage across resistor R compares with the voltage across the battery.

(2)

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(c) Diagram 2 shows a different circuit containing a battery, an ammeter and a thermistor.

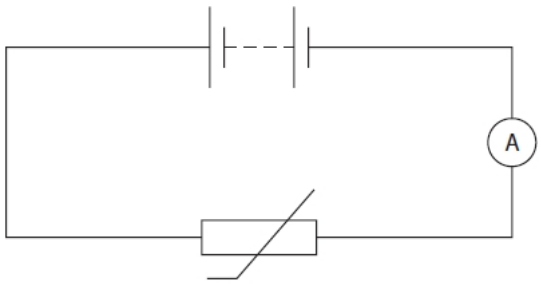

Diagram 2

Explain how the thermistor can be used to vary the current in this circuit.

(3)

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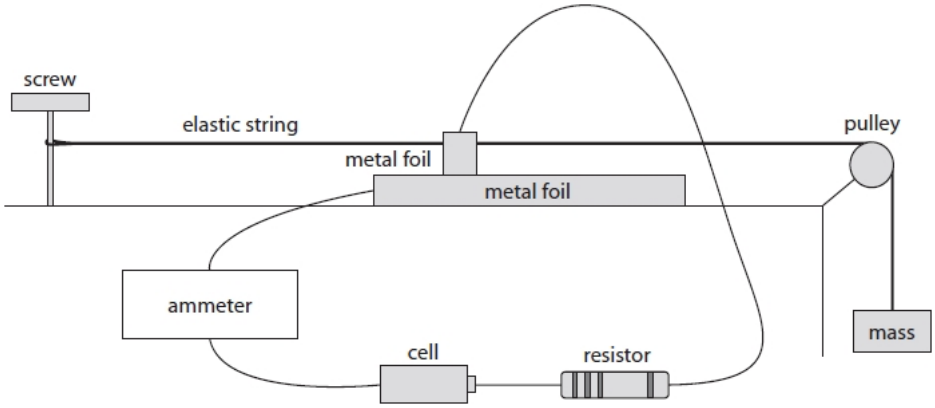
(Total for question = 11 marks)

Q4.

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

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

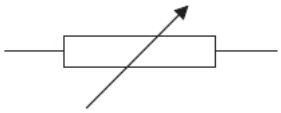
When more mass is added, the elastic string stretches and the small piece of metal foil moves to the right.



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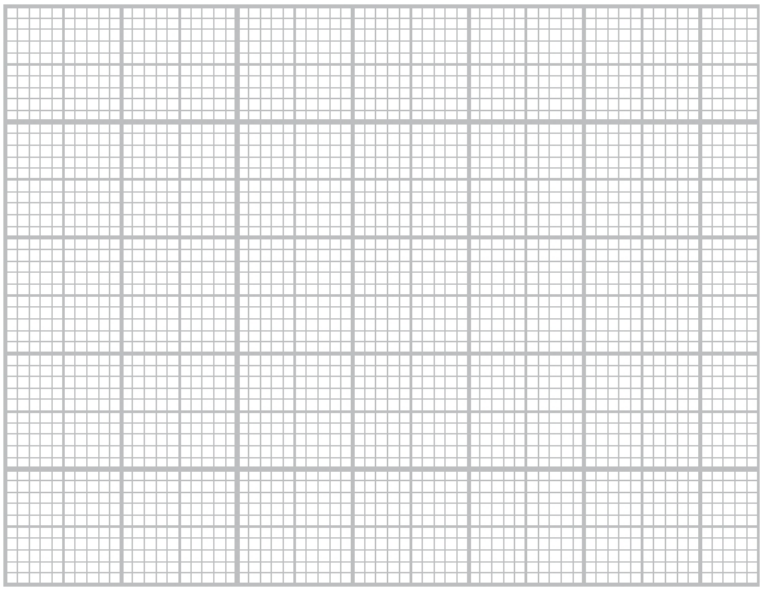
(ii) Plot the student's results on the grid.

(3)

(iii) Draw a line of best fit.

(1)

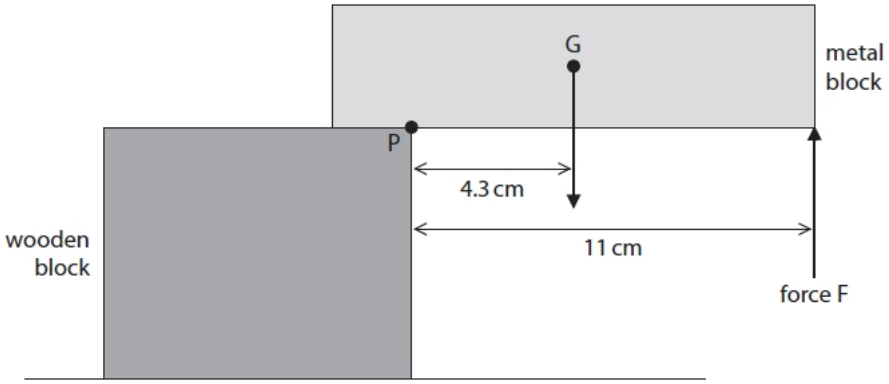


(Total for question = 15 marks)

Q5.

The diagram shows a metal block on top of a wooden block.

The metal block is held stationary by force F.



(a) (i) The weight of the metal block acts through point G.
Give the name of point G.

(1)

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(ii) Name a piece of apparatus that could be used to measure the weight of the metal block.

(1)

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(b) (i) State the formula linking moment, force and perpendicular distance from the pivot.

(1)

(ii) The weight of the metal block is 0.68 N.
Show that the moment of the weight of the metal block about point P is approximately 2.9 N cm.

(1)

(iii) Force F is applied to the metal block to stop it from moving.
Calculate the magnitude of force F.

(3)

force F = ... N

(Total for question = 7 marks)

Q6.

(a) (i) State Hooke's Law.

(2)

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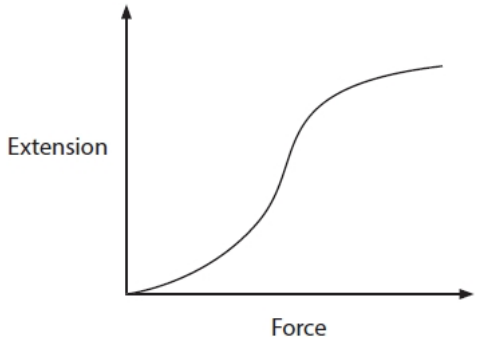
(ii) The graph shows how the extension of a rubber band varies with the force applied.



Explain how the graph shows that the rubber band does not obey Hooke's Law.

(2)

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(b) Diagram 1 shows a model aeroplane powered by a rubber band.

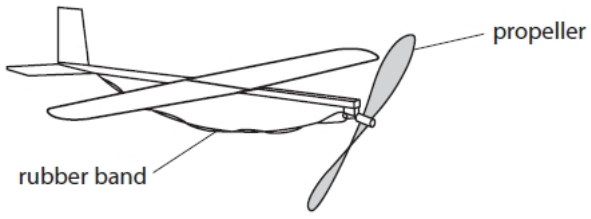


Diagram 1

A person rotates the propeller of the model aeroplane, which twists the rubber band.
He then releases the propeller and it spins.
Energy transfer occurs during this process.
The box lists words associated with energy.

kinetic	gravitational	electrostatic
mechanical	elastic	magnetic
heating	chemical	radiation

Use words from the box to complete the passage.

(3)

The person does ..... work to twist the rubber band.
As the person twists the rubber band it extends, increasing the .....
energy store of the rubber band. When the rubber band is released it does mechanical work, increasing the ..... energy store of the propeller.

(c) Diagram 2 shows the aeroplane flying horizontally to the right.

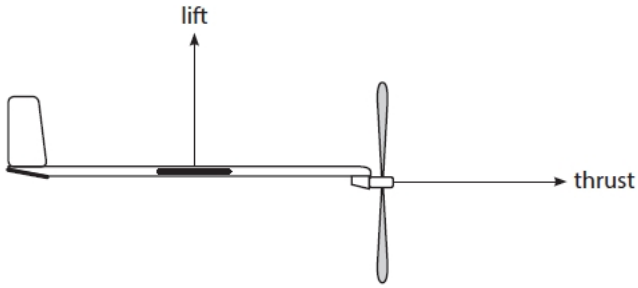


Diagram 2

The aeroplane flies at a constant speed.
Diagram 2 shows two forces acting on the aeroplane.
Draw labelled arrows on diagram 2 to show two more forces acting on the aeroplane.

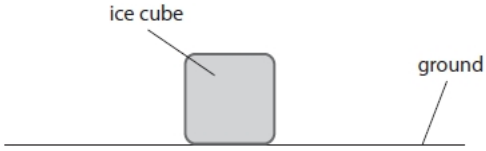
(4)

(Total for question = 11 marks)

Q7.

This is a question about a melting ice cube.

(a) The diagram shows an ice cube placed on the ground.



(i) The mass of the ice cube is 3.7 g and its area of contact with the ground is 2.6×10^{-4} m^2.
Calculate the pressure the ice cube exerts on the ground.

(4)

pressure = ... Pa

(ii) The ice cube melts and becomes a puddle with a larger cross-sectional area.
Explain how the pressure of the ice cube on the ground changes when it melts.

(2)

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(b) Ice melts at a temperature of 0 °C.

On the axes, sketch how the temperature of the ice cube changes as it rises from a temperature of –10 °C to a temperature of 20 °C.

(3)

(c) Explain the changes that occur when a solid melts.

Refer to particles in your answer.

(2)

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(Total for question = 11 marks)

Q8.

A machine called the synchrocyclotron (SC) was designed to cause protons to move in a circular path using strong magnetic fields.

(a) The SC used electromagnets to produce the strong magnetic fields.

Describe the construction of a simple electromagnet.
You may draw a diagram to support your answer.

(3)

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(b) The SC is surrounded by very thick concrete walls.

The radiation produced by the SC created atoms of radioactive barium-133 in the concrete walls. Barium-133 has a half-life of 10.5 years.

(i) State what is meant by the term **half-life**.

(2)

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(ii) In 1990, the SC stopped being used at CERN, a research centre.
In 1990, the largest number of barium-133 atoms were found 40 cm deep in the concrete walls.
Since 2014, members of the public have been allowed to visit the SC at CERN.
Explain why the radioactive barium-133 in the concrete walls is not a risk to people visiting the SC.

(2)

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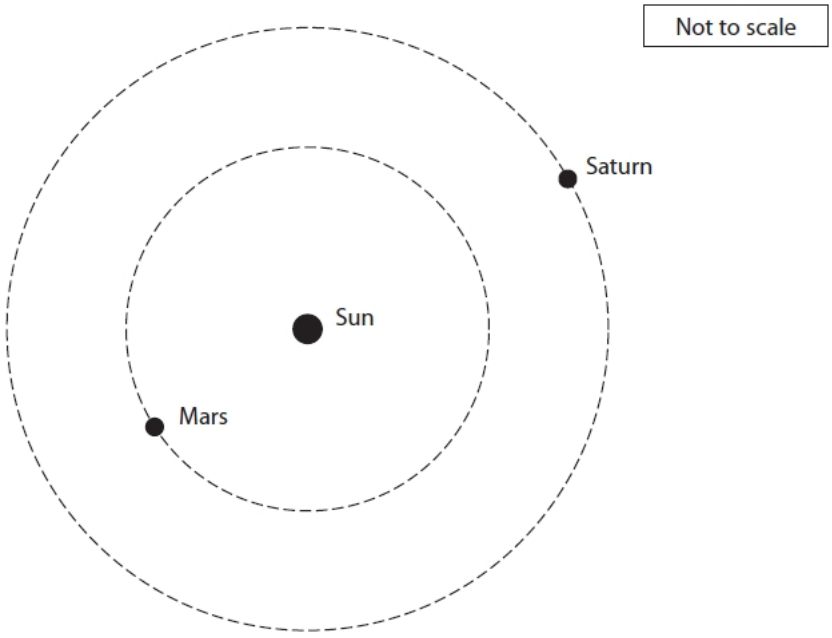
(Total for question = 7 marks)

Q9.

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	2.28×10^8	1.43×10^9
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)