



## MARK SCHEME for the *challenging* Set 1 question paper

### 5058 PHYSICS

5058/01

Paper 1, maximum raw mark 40

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussion that took place at an Examiners' meeting before marking began.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

- Cosmic will not enter into discussions or correspondence in connection with these mark schemes.

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|          | <b>COSMIC CHALLENGING EXAMINATIONS - Set 1</b> | <b>5058</b> | <b>1</b> |

1. **B** - 0.02 mm and it has to be subtracted from the final reading

Note that the micrometer screw gauge is currently pointing to the 0.02 mm marking after the 0.00 mm marking. Hence, the zero error is -0.02 mm. This zero error has to be subtracted from the final reading since the taken reading would have been inflated. **(ans)**

8

2. **D** 0 N

There is no acceleration given constant velocity.

Since  $F = M \times A$ ,  
and  $A = 0$ ,  
 $F = 0 \text{ N}$  **(ans)**

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3. **C** A trolley being pulled up a straight ramp at a constant 5 km/h.

Work is done as the trolley is being pulled at a constant speed of 5 km/h. Option B is impossible as the satellite is not in a state of motion. **(ans)**

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4. **B** (2) only

Approach 1:  
Try to take moment about each of five points. The point which has zero net moment is the point where another force is acting. Reason: If taking moment on other points, you must have the missing force to balance the moment.

Approach 2:  
Take moment about any of the five points, then calculate the distance from that point.

You will get option (2). **(ans)**

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5. **C** Moving backwards

The liquid which has mass is moving forward due to inertia, forcing the bubble to move backwards. **(ans)**

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6. **D** 15 Nm

Moments about O  
= 5 (OA + AB) – 5 (OA)  
= 5 (AB)  
= 5 (3)  
= 15 Nm **(ans)**

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7. **D** 440 N

As the ball rebounds to the same height, the speed just before the impact = the speed after the impact.

Let the speed just before the impact be V.

By  $v^2 = u^2 + 2as = 0 + 2 (10) (1.25) = 5 \text{ms}^{-1}$

During the impact, the net force acting on the ball produces the momentum change.

Total reaction – weight = rate of change of momentum

Total reaction – 4 (10) =  $\frac{4(5) - 4(-5)}{0.1}$

Total reaction = 440 N **(ans)**

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8. **B** Moving with an acceleration of  $2.5 \text{ms}^{-1}$

Let f be friction.

To prevent the block from sliding down, net upward force = net downward force.

$5 + f = 2 (10) \sin 30^\circ$   
 $f = 5 \text{ N}$

If force increases to 20 N, it overcomes the weight of the block along the plane (ie 10N) and the friction against it (ie 5N)

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By  $F = ma$ ,  
 $(20 - 10 - 5) = 2$  (a)  
 $a = 2.5 \text{ m s}^{-1}$  (ans)

8

$$A \times \frac{L}{4} = B \times \frac{3L}{8}$$

$$\frac{B}{A} = \frac{2}{3} \quad (\text{ans})$$

8

**9. C** The cube experiences the same friction  $f$

Since the two cubes have the same mass, the frictional force they experienced would be the same. (ans)

8

**14. B** ( 3 ) only

$$5 \text{ W for } \frac{2}{3} \text{ minutes} = 5 \times \frac{2}{3} \times 60 = 200 \text{ J}$$

(ans)

8

**10. D** The inertia of an object still exists in outer space

Inertia is the resistance of mass, i.e. any physical object, to a change in its state of motion.

This means that an object will always continue moving at its current speed and in its current direction until some force causes its speed or direction to change.

Inertia occurs even in outer space. (ans)

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**15. B** 47.8 kW

$$\begin{aligned} \text{Power} &= \text{work done} \div \text{time} \\ &= \text{gain in K.E} \div \text{time} \\ &= \frac{1}{2} \times 1500 \times \left( \frac{100 \times 10^3}{3600} \right)^2 \\ &= \frac{12.1}{12.1} \\ &= 47.8 \text{ kW} \quad (\text{ans}) \end{aligned}$$

8

**11. B** Point Q

The acceleration-time graph is obtained from the velocity-time graph. Point Q is the turning point of the velocity-time graph and so is the maximum value. (ans)

8

**16. C**  $50 \text{ ms}^{-1}$

Total energy at top = Total energy at 5 m from sea

$$\begin{aligned} & \left( \frac{1}{2} \times m \times 40^2 \right) + ( m \times 10 \times 50 ) \\ &= \left( \frac{1}{2} \times m v^2 \right) + ( m \times 10 \times 50 ) \end{aligned}$$

Hence,  $v = 50 \text{ ms}^{-1}$  (ans)

8

**12. D** Greater than  $mg$

By Newton's second law of motion,

$$\begin{aligned} T - mg &= ma \\ T &= ma + mg \end{aligned}$$

Hence,  $T > mg$ . (ans)

8

**17. B** ( 1 ) and ( 2 ) only

When the piston is pulled to the right, the pressure on the trapped air decreases and the trapped air pushes the piston out of the cylinder (volume increases).

As the volume increases, air particles of the trapped air make lesser bombardment with the inner walls of the cylinder and the piston and therefore the pressure of the trapped air decreases. When there are lesser bombardments within the enclosure, less heat is produced and therefore the temperature decreases. (ans)

**13. B** 2 : 3

Taking moments about the centre of gravity of the plank, the clockwise moment must be equal to the anti-clockwise moment.

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**18. C** ( 2 ) and ( 3 ) only

Option ( 1 ) is incorrect as there is no change in temperature during change in states.

Option ( 2 ) is correct.  
When heat is entering an object, there is either an increase in the object's temperature or a change in the object's state.

There is either an increase in the kinetic energy or potential energy. Internal energy is the sum of the kinetic and potential energy.

Option ( 3 ) is correct.  
When heat is entering an object, there is either an increase in the object's temperature or a change in the object's state.

There is either a change in the kinetic energy or potential energy, but not both at the same time.  
**(ans)**

**19. A** ( 1 ) and ( 2 ) only

A substance will only burn when 3 conditions are fulfilled: the presence of a fuel (thing to be burnt), oxygen and a high enough temperature (ignition temperature) for the fuel.

The paper cannot burn because the thermal energy that goes to the paper is quickly taken away by the water and therefore the paper cannot reach its ignition temperature.

The temperature of the paper cannot go higher than 100°C because the thin paper allows heat flow quickly from the flame to the water by conduction and the water's boiling point is 100°C. All water must vaporise before the temperature can increase. The ignition temperature of paper is about 233°C.  
**(ans)**

**20. C** Camel has big humps to store water so that it can dissipate thermal energy by convection.

The big humps do not store water but fats and flesh of the camel. It is a food reserve to be absorbed by the camel as nutrition when food is scarce.  
**(ans)**

**21. C** 150°C

Based on the fact that the relationship between the increase in temperature and the increase in electrical resistance is linear,

$$\frac{250 - 500}{200 - (-50)} = \frac{300 - 500}{T - (-50)}$$

$$\frac{-250}{250} = \frac{-200}{T + 50}$$

T = 150°C **(ans)**

**22. C** ( 1 ) and ( 2 ) only

Option ( 1 ) is correct.  
The specific heat capacity can be compared by the steepness of the gradient of the temperature - time graph. The steeper it is, the easier it is to increase temperature and therefore the lower the specific heat capacity it will have.

Option ( 2 ) is correct.  
The heat capacity can be compared by the steepness of the gradient of the temperature - time graph. The mass is the same for both cases and therefore, we are basically still comparing their specific heat capacities.

Option ( 3 ) is incorrect.  
Portion QR is in a solid-liquid state. **(ans)**

**23. B** The waves travel slower

Approaching the shore, the sea becomes shallower. As a result, the waves travel slower and the wavelength becomes shorter. **(ans)**

**24. A** 5 cm wavelength, 0.5 ms<sup>-1</sup> speed

Wavelength = 15 cm ÷ 3

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$$= 5 \text{ cm}$$

Frequency of dipper = frequency of wave  
= 10 Hz

$$\begin{aligned} \text{Speed of wave} &= f\lambda \\ &= 10 (0.05) \\ &= 0.5 \text{ ms}^{-1} \quad \text{(ans)} \end{aligned}$$

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**25. A**

The maximum velocity of the particle is at the equilibrium position. By drawing the wave profile for the next instant, it can be seen that point A is moving upwards with the maximum velocity. **(ans)**

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**26. C** 50°

Angle of reflection is the angle between the normal and the reflected ray.

$$\begin{aligned} \text{Angle of incidence} &= \text{angle of reflection} \\ &= 50^\circ \quad \text{(ans)} \end{aligned}$$

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**27. C** (2) and (3) only

$$\begin{aligned} \sin c &= 1 \div n \\ \sin c &= 1 \div 1.2 \\ c &= 56.4^\circ \end{aligned}$$

$$\begin{aligned} \sin c &= 1 \div n \\ \sin c &= 1 \div 1.5 \\ c &= 41.8^\circ \end{aligned}$$

$$\begin{aligned} \sin c &= 1 \div n \\ \sin c &= 1 \div 2.2 \\ c &= 27.0^\circ \end{aligned}$$

The medium that can cause a total internal reflection of an angle of incidence of 45° is the medium that is suitable to be used as the prism. The only medium that cannot achieve total internal reflection at  $i = 45^\circ$  is the one with refractive index of 1.2. **(ans)**

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**28. C** A glass block

Converging lens and diverging lens will converge and diverge the rays respectively.

A mirror will only reflect the light. Only a rectangular glass block is able to produce such effects when the light rays strike the glass block at 90°. **(ans)**

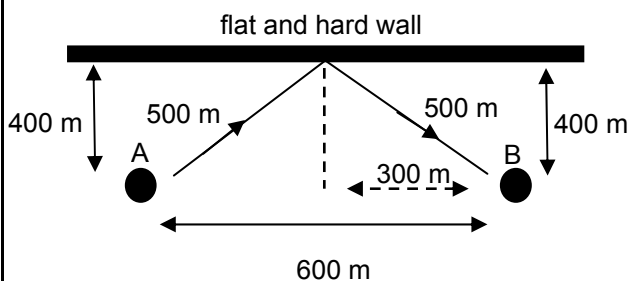
8

**29. A** (1) and (2) only

Option (3) is incorrect. A stronger light ray can only make the emergent ray stronger. It cannot change the speed or direction. **(ans)**

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**30. C** 1.25 s



Distance travelled by sound directly from A to B = 600 m

The distance travelled by the reflected sound  
=  $2 \times \sqrt{300^2 + 400^2} = 1000 \text{ m}$

Difference in the distance travelled  
=  $1000 - 600$   
= 400 m

Duration of interval between claps  
= distance  $\div$  speed  
=  $400 \div 320$   
= 1.25 s **(ans)**

8

**31. D** All of the above

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The soft tissue in your body is composed of smaller atoms, which does not absorb X-rays particularly well.

The calcium atoms that make up your bones are much larger, so they are better at absorbing X-rays.

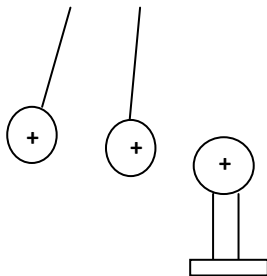
X-ray scanners are often used to detect minute flaws in heavy metal equipment due to the penetrating capability of X-rays.

X-ray scanners are also used in airport security due to their penetrating capabilities. **(ans)**

**32. C** ( 1 ) and ( 3 ) only

In ascending order of wavelength, the sequence of colour spectrum is: violet, indigo, blue, green, yellow, orange, red. Yellow and red comes after green. **(ans)**

**33. D**



Electrons from both light neutral conducting spheres will be attracted into the heavy conducting sphere, causing the heavy conducting sphere to be less positively-charged.

The two light conducting spheres lose electrons and become positively-charged. Since all three conducting spheres are now positively-charged, they repel and the two light spheres swing away from the heavy sphere. **(ans)**

**34. B**

When the X-plates (time-base) are switched off, the signal will only display along a vertical axis and does not sweep across the screen.

The alternating voltage connected to the Y-plates will move the signal up and down. **(ans)**

**35. A** The current drawn from the mains gets higher and overheating may occur

Option B is incorrect. The voltage does not increase with additional plug on the multi-plug adaptor.

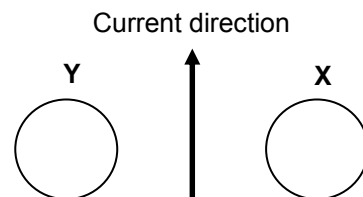
Option C is incorrect. The flow of current into each appliance will not be affected by the use of multi-plug adaptor as the appliances are connected in parallel.

Option D is incorrect. The flow of current into each appliance will not be affected by the use of multi-plug adaptor as the appliances are connected in parallel. **(ans)**

**36. C** The casing of the hair-dryer is made of plastic material

The plastic casing is an insulator. As such, the earth wire is redundant in such appliances. **(ans)**

**37. C**



According to the right-hand grip rule, the magnetic field caused by the current-carrying wire will only make the needles move out or into the plane of the paper and not be able to rotate the needles clockwise or anti-clockwise.

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The compasses therefore should be pointing to the north-south direction. They should be pointing in the same direction and not in different directions. **(ans)**



### 38. A

Current flows from B to C ( from + to - ) and magnetic field flow direction is from top to bottom ( from N-pole to S-pole).

Using Fleming's left hand rule, the U-shape wire will swing away from the magnet. **(ans)**



### 39. B III only

Lenz's law states that the induced current flows in a direction to oppose the motion or change producing it.

When the S-pole of the magnet is moving away, there is a change. The solenoid would induce a N-pole at Y to oppose the change.

When the S-pole of the magnet is moving towards the solenoid, there is a change. The solenoid would induce a S-pole at Y to oppose the change.

Faraday's law of electromagnetic induction states that the induced e.m.f. in a circuit is directly proportionate to the rate of change of the magnetic flux linking the circuit.

When there is no movement of both the magnet and the solenoid, there is no rate of change of magnetic flux (although there is a magnetic field).

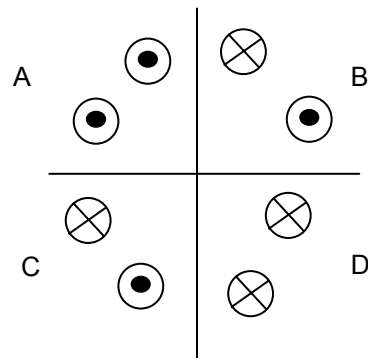
Therefore, there is no induced e.m.f. in the circuit. **(ans)**



### 40. A

Based on the right-hand grip rule, the strength of magnetic field going in and coming out of the paper based on the contribution of the two current carrying wires are shown below.

From the diagram, segment A has more magnetic field flux or magnetic field lines coming out of paper.



**(ans)**



|                 |  |                 |              |
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**Notes:**